SCHEME OF EXAMINATION

&

SYLLABI

for

Bachelor of Technology Programmes of Studies under the aegis of University School of Information, Communication & Technology offered at Affiliated Institutions of the University

(1st Year Common Scheme and Syllabus and 2nd Year onwards Scheme and Syllabus)

GURU GOBIND SINGH
INDRAPRASTHA
UNIVERSITY
University School of Information, Communication &Technology
Sector 16C, Dwarka, Delhi – 110 078 [INDIA]
www.ipu.ac.in

CONTENTS

Approval History:

1. 1st year scheme and syllabus (1st and 2nd semester) and Framework for higher semesters (3rd to 8th) implemented from 2021-22 batch approved by 55thBoard of Studies of USICT held on dated 31.10.2021 .
2. 1st year scheme and syllabus (1st and 2nd semester) and Framework for higher semesters (3rd to 8th) implemented from 2021-22 batch approved by Academic Council Sub-committee on dated 22.11.2021.
3. Modification to BS-103 / BS-104 syllabus implemented from 2021-22 batch approved by 56thBoard of Studies of USICT held on 24.01.2022.
4. 1st year scheme and syllabus (1st and 2nd semester) and Framework for higher semesters (3rd to 8th) implemented from 2021-22 batch approved by 52ndAcademic Council vide agenda item 52.14 on dated 22.02.2022.
5. Modification to BS-103 / BS-104 syllabus implemented from 2021-22 batch approved by 52ndAcademic Council held on dated 22.02.2022 vide agenda item no. AC 52.33.
6. Scheme of study of 2nd and higher years approved by the 58thBoS of USICT held on dated 10.09.2022.
7. Scheme and Syllabus of 2nd year approved by the 58thBoS of USICT held on dated 10.09.2022.
8. Inclusion of lateral entry guidelines and bridge course with effect from lateral entry admissions in the year 2022-23 (regular batch 2021-22) approved by BoS on 10/09/2022. And, the same approved in AC subcommittee on dt. 14.09.2022.
9. Inclusion of Basic Chemistry in lieu of Applied Chemistry for admitted students in the 1st year, for students who did not study chemistry at 10+2 level, approved by BoS on 10 /09/2022 w.e.f academic session 2022-23. And, the same approved in AC subcommittee on dt. 14.09.2022.
10. Scheme of study of 2nd and higher years approved by Academic Council Sub-committee on dated 14.09.2022
11. Scheme and Syllabus of 2nd year approved by Academic Council Sub-committee on dated 14.09.2022.
12. Modification to the some paper codes and name & syllabus of ECC-210/ECC-313, ECC-212, ECC-258, EEC-206, CEC-206, CEC-208, CEC-210, CEC-212 and CEC-254 implemented from 2021-22 batch approved by 60thBoard of Studies of USICT held on 17.03.2023 and approved by Academic Council Sub-committee on dated 20.03.2023.

Provision for Smooth Implementation

This document describes the curriculum of the Bachelor of Technology Programmes that are (or allowed to be) offered at the affiliated institutions of Guru Gobind Indraprastha University, Delhi, under the aegis of the University School of Information, Communication and Technology. In the event of any difficulty of implementation, and / or interpretation of any clause of the document, the same may be brought to the notice of Dean of the University School of Information Communication and Technology. The decision of the Dean, University School of Information Communication and Technology shall be final and implemented to resolve the issue. The same shall be put up in the subsequent meeting of the Board of Studies of the University School of Information Communication and Technology for its approval. If the decision of the Board of Studies of the University School of Information Communication and Technology is at variance with the decision taken earlier by the Dean of the School, the decision of the Board shall be effective from the date of the approval by the Board of Studies. In the interim period (between the approval of the Dean, of the School and the Board of Studies approval), the decision already taken by the Dean of the school shall stand.

Programme Outcomes

1. **Engineering Knowledge** (**PO01**): Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis** (**PO02**): Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/Development of Solutions** (**PO03**): Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems** (**PO04**): Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems:
    a. that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline as against problems given at the end of chapters in a typical text book that can be solved using simple engineering theories and techniques;
    b. that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions;
    c. that require consideration of appropriate constraints / requirements not explicitly given in the problem statement such as cost, power requirement, durability, product life, etc.;
    d. which need to be defined (modelled) within appropriate mathematical framework; and
    e. that often require use of modern computational concepts and tools, for example, in the design of an antenna or a DSP filter.
5. **Modern Tool Usage** (**PO05**): Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society** (**PO06**): Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability** (**PO07**): Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics** (**PO08**): Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work** (**PO09**): Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication** (**PO10**): Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance** (**PO11**): Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning** (**PO12**): Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Acronyms for Core Disciplines:

CSE : Computer Science and Engineering
IT : Information Technology
CST : Computer Science and Technology
ITE : Information Technology and Engineering
ECE : Electronics and Communications Engineering
EE : Electrical Engineering
EEE : Electrical and Electronics Engineering
ICE : Instrumentation and Control Engineering
ME : Mechanical Engineering
CE : Civil Engineering

Acronyms for Emerging Area Disciplines:

MAE : Mechanical and Automation Engineering
CSE-AI : Computer Science and Engineering (Artificial Intelligence)
CSE-AIML : Computer Science and Engineering (Artificial Intelligence and Machine Learning)
CSE-DS : Computer Science and Engineering (Data Science)
CSE-IoT : Computer Science and Engineering (Internet of Things)
CSE-ICB : Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology)
CSE-Net : Computer Science and Engineering (Networks)
CSE-CS : Computer Science and Engineering (Cyber Security)

Acronyms for Minor Specializations*(Applicable only for Core Disciplines)*:

AI : Artificial Intelligence
AIML : Artificial Intelligence and Machine Learning
DS : Data Science
BT : Block Chain Technology
IoT : Internet of Things
ICB : Internet of Things and Cyber Security including Block Chain Technology
Net : Networks
CS : Cyber Security
MLDA : Machine Learning and Data Analytics
SC : Soft Computing
SE : Software Engineering
FSD : Full Stack Development
IPCV : Image Processing and Computer Vision
RA : Robotics and Automation
ES : Embedded Systems
VLSI : VLSI Design
WMC : Wireless and Mobile Communications
EV : Electrical Vehicles
MT : Microgrid Technologies
PS : Power Systems
PED : Power Electronics and Drives
CI : Control and Instrumentation
CADM : Computer Aided Design and Manufacturing
DMS : Design and Measurement Systems
DT : Design Trends
TES : Thermal Energy Sources
QM : Quality Management
CTM : Construction Technology and Management
IE : Infrastructure Engineering
GTSE : Green Technology and Sustainability Engineering
CSE : Computer Science and Engineering
ECE : Electronics and Communications Engineering

EE : Electrical Engineering
SD : Software Development
ME : Mechanical Engineering
ICE : Instrumentation and Control Engineering
CE : Civil Engineering
UHV : Universal Human Values

Acronyms for Course / Paper Groups and Codes:

BS : Basic Science
HS : Humanities, Social Science
MS : Management Studies
ES : Engineering Science
MC : Mandatory Courses
PC : Programme Core, that is course/paper offered in the discipline of the programme as a compulsory paper.
PCE : Programme Core Elective, that is elective course/paper offered in the discipline of the programme.
EAE/OAE : Emerging Area Elective / Open Area Elective offered in the institution
CIC : Computer Science / IT Core
CIE : Computer Science / IT Elective
ECC : Electronics Core
ECE : Electronics Elective
EEC : Electrical Core
EEE : Electrical Elective
ICC : Instrumentation Core
ICE : Instrumentation Elective
MEC : Mechanical Core
MEE : Mechanical Elective
CEC : Civil Core
CEE : Civil Elective
MAC : Automation Core
MAO : Automation Open Elective

Definitions:

Batch: The batch of the student shall mean the year of the first time enrolment of the students in the programme of study in the first semester. Lateral entry students admitted in the 3rd semester / 2nd year shall be designated as students admitted in the previous batch as they are admitted one year later. A student re-admitted in a programme of study in a lower / later batch shall be considered as the student of the original batch for the purpose calculation of duration of study (lateral entry o readmission due to academic break).

Programme of study shall mean Bachelor of Technology.

Major / Primary specialization / discipline shall mean the discipline in which the student is admitted / upgraded or transferred.

Minor specialization shall mean the specializations earned through the EAE or OAE route subject to fulfilment of requirements specified in the scheme of study for the concerned minor specialization.

Other Acronyms:

PCC : Programme Coordination Committee
APC : Academic Programme Committee comprising of all faculty of the department / institutions and as defined in the implementation rules and the Ordinance 11 of the University.
L : Number of Lecture hours per week
T/P : Number of Tutorial / Practical Hours per week
C : Number of credits assigned to a course / paper
COE : Controller of Examinations of the Examinations Division of the University.
SGPA/CGPA : Semester/Cumulative Grade Point Average.
NUES : Non University Examination System - No term end examination shall be held. The evaluation shall be conducted as per the scheme of examinations as described in the scheme of study.

FIRST YEAR

Common Scheme and Syllabus

for

All Bachelor of Technology Programmes of Study under the aegis of University School of Information, Communication & Technology offered at Affiliated Institutions of the University

In light of the eligibility condition specified in the **AICTE Process Handbook 2022-23** (Page Nos 89 and 90), the **Chemistry Papers BS-121 / BS-120 entitled "Basic Chemistry"** shall be offered to students admitted from Academic Session 2022-23 (in the 1st/ 2ndSemester) in lieu of **Chemistry Papers BS-103 / BS-104 entitled "Applied Chemistry".** This shall be offered only to students who have not studied Chemistry at 10+2 Level and are admitted to the following disciplines only:

1) Computer Science and Engineering (CSE)
2) Information Technology (IT)
3) Computer Science and Technology (CST)
4) Information Technology and Engineering (ITE)
5) Electronics and Communications Engineering (ECE)
6) Electrical Engineering (EE)
7) Electrical and Electronics Engineering (EEE)
8) Instrumentation and Control Engineering (ICE)
9) Computer Science and Engineering (Artificial Intelligence) (CSE-AI)
10) Computer Science and Engineering (Artificial Intelligence and Machine Learning) (CSE-AIML)
11) Computer Science and Engineering (Data Science) (CSE-DS)
12) Computer Science and Engineering (Internet of Things) (CSE-IoT)
13) Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology) (CSE-ICB)
14) Computer Science and Engineering (Networks) (CSE-Net)
15) Computer Science and Engineering (Cyber Security) (CSE-CS)

Note: The corresponding practical paper (BS-155 / BS-156) shall be unchanged.
(Addition from Academic Session 2022-23)

First Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
 ES BS	 ES-101 BS-103/BS-121#	*Any one of the following: Programming in 'C' Applied Chemistry / Basic Chemistry#	3	-	3
BS	BS-105	Applied Physics – I	3	-	3
 ES BS	 ES-107 BS-109	*Any one of the following: Electrical Science Environmental Studies	3	-	3
BS	BS-111	Applied Mathematics – I	4	-	4
HS	HS-113	**Group 1 or Group 2 shall be offered: Group 1: Communications Skills OR	3	-	3
 HS HS	 HS-115 HS-117	Group 2: Indian Constitution*** Human Values and Ethics***	 2 1		 2 1
ES	ES-119	Manufacturing Process	4	-	4
Practical/Viva Voce					
BS	BS-151	Physics-I Lab	-	2	1
 ES BS	 ES-153 BS-155	Any of the following corresponding to the theory paper offered: Programming in 'C' Lab Applied Chemistry	-	2	1
ES	ES-157	Engineering Graphics-I	-	4	2
 ES BS	 ES-159 BS-161	Any of the following corresponding to the theory paper offered: Electrical Science Lab Environmental Studies Lab	-	2	1
Total			**20**	**10**	**25**

*For a particular batch of a programme of study one out of these two papers shall be taught in the first semester while the other shall be taught in the 2nd semester. Students who have to re-appear can only reappear in the odd semester if originally offered to the student in the 1st semester and similarly for the students who study the paper in the second semester. The institution shall decide which paper to offer in which semester.

**For a particular batch of a programme of study either the paper on “Communications Skills” (Group 1), or Group 2: papers (“Indian Constitution” and “Human values and ethics”) shall be taught in the first semester while the other group shall be taught in the 2nd semester. Students who have to re-appear can only reappear in the odd semester if originally offered to the student in the 1st semester and similarly for the students who study the paper(s) in the second semester. The institution shall decide which paper group to offer in which semester.

***NUES: All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

#The students who have not studied Chemistry at 10+2 level shall be offered BS-121 in lieu of BS-103, as applicable in applicable disciplines. (Addition from the Academic Session 2022-23)

Group	Code	Paper	L	P	Credits
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2

*NUES: Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall undergo training or participate in the activities for the period of 3rd semester to 6th semester only

Second Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
 ES BS	 ES-102 BS-104/BS-120#	*Any one of the following: Programming in ‘C’ Applied Chemistry / Basic Chemistry#	3	-	3
BS	BS-106	Applied Physics – II	3	-	3
 ES BS	 ES-108 BS-110	*Any one of the following: Electrical Science Environmental Studies	3	-	3
BS	BS-112	Applied Mathematics – II	4	-	4
 HS HS HS	 HS-114 HS-116 HS-118	**Group 1 or Group 2 shall be offered: Group 1: Communications Skills OR Group 2: Indian Constitution*** Human Values and Ethics***	 3 2 1	 -	 3 2 1
ES	ES-114	Engineering Mechanics	3	-	3
Practical/Viva Voce					
BS	BS-152	Physics-II Lab	-	2	1
  ES BS	 ES-154 BS-156	*Any of the following corresponding to the theory paper offered: Programming in ‘C’ Lab Applied Chemistry	-	2	1
ES	ES-158	Engineering Graphics-II	-	2	1
  ES BS	 ES-160 BS-162	*Any of the following corresponding to the theory paper offered: Electrical Science Lab Environmental Studies Lab	-	2	1
ES	ES-164	Workshop Practice		4	2
Total			**19**	**12**	**25**

*For a particular batch of a programme of study one out of these two papers shall be taught in the first semester while the other shall be taught in the 2nd semester. Students who have to re-appear can only reappear in the odd semester if originally offered to the student in the 1st semester and similarly for the students who study the paper in the second semester. The institution shall decide which paper to offer in which semester.

**For a particular batch of a programme of study either the paper on "Communications Skills" (Group 1), or Group 2: papers ("Indian Constitution" and "Human values and ethics") shall be taught in the first semester while the other group shall be taught in the 2nd semester. Students who have to re-appear can only reappear in the odd semester if originally offered to the student in the 1st semester and similarly for the students who study the paper(s) in the second semester. The institution shall decide which paper group to offer in which semester.

*****<u>NUES</u>:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

#The students who have not studied Chemistry at 10+2 level shall be offered BS-120 in lieu of BS-104, as applicable in applicable disciplines. (Addition from the Academic Session 2022-23)

BRIDGE COURSES FOR THE B.TECH LATERAL ENTRY STUDENTS

All the Lateral Entry students of B.Tech., who are directly admitted in the 2nd Year / 3rd Semester of the Progarmme of Study, have to pass the following bridge courses.

Paper Code	Paper Name	L/P
BC-181	Bridge Course in Mathematics	3
BC-183	Bridge Course in Programming in C	3

Implementation Rules for Bridge Courses:

1. The institutions are required to conduct the classes for the above bridge courses in the 3rd Semester along with the classes of the other courses.
2. These papers have to be qualified by the students.
3. For these papers examination shall be conducted by the concerned subject teacher as NUES, the same shall be transferred to Examination Division of the University.
4. The degree to be awarded to the student only subject to the acquiring qualifying grade/marks in the bridge courses and the minimum credits in the regular courses of the scheme of study as prescribed.
5. These Courses shall be qualifying in nature; they shall not be included for calculation of CGPA. The qualifying marks shall be 40 marks in each paper.
6. A separate marksheet will be issued by the Examination Division of the University for the Bridge Course.

PaperCode: ES-101 / ES-102	**Paper: Programming in 'C'**	**L**	**T/P**	**C**
		3	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart basic knowledge about simple algorithms for arithmetic and logical problems so that students can understand how to write a program, syntax and logical errors in 'C'.
2:	To impart knowledge about how to implement conditional branching, iteration and recursion in 'C'.
3:	To impart knowledge about using arrays, pointers, files, union and structures to develop algorithms and programs in 'C'.
4:	To impart knowledge about how to approach for dividing a problem into sub-problems and solve the problem in 'C'.

Course Outcomes (CO):

CO1	Ability to develop simple algorithms for arithmetic and logical problems and implement them in 'C'.
CO2	Ability to implement conditional branching, iteration and recursion and functions in 'C'
CO3	Ability to use arrays, pointers, union and structures to develop algorithms and programs in 'C'.
CO4	Ability to decompose a problem into functions and synthesize a complete program using divide and conquer approach in 'C'.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I

Introduction to Programming: Computer system, components of a computer system, computing environments, computer languages, creating and running programs, Preprocessor, Compilation process, role of linker, idea of invocation and execution of a programme. Algorithms: Representation using flowcharts, pseudocode.
Introduction to C language: History of C, basic structure of C programs, process of compiling and running a C program, C tokens, keywords, identifiers, constants, strings, special symbols, variables, data types, I/O statements. Interconversion of variables.
Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators, bitwise and conditional operators, special operators, operator precedence and associativity, evaluation of expressions, type conversions in expressions.[8Hrs][T2]

Unit II

Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements.
Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi-dimensional arrays.
Functions: User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion.
Strings: Arrays of characters, variable length character strings, inputting character strings, character library functions, string handling functions. [8Hrs] [T2]

Unit III

Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, functions returning pointers, Dynamic memory allocation. Pointers to functions. Pointers and Strings
Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, self-referential structures, unions, typedef, enumerations.
File handling: command line arguments, File modes, basic file operations read, write and append.
Scope and life of variables, multi-file programming. [8Hrs][T2]

Unit IV

C99 extensions. ‘C’ Standard Libraries: stdio.h, stdlib.h, assert.h, math.h, time.h, ctype.h, setjmp.h, string.h, stdarg.h, unistd.h [3Hrs] [T1, R8]
Basic Algorithms: Finding Factorial, Fibonacci series, Linear and Binary Searching, Basic Sorting Algorithms- Bubble sort, Insertion sort and Selection sort. Find the square root of a number, array order reversal, reversal of a string [7Hrs][T1]

Textbooks:

1. *How to solve it by Computer* by R. G. Dromey, Prentice-Hall India EEE Series, 1982.
2. *The C programming language* by B W Kernighan and D M Ritchie, Pearson Education, 1988.

References:

1. *Programming Logic & Design* by Tony Gaddis, Pearson, 2nd Ed. 2016.
2. *Programming Logic and Design* by Joyce Farrell, Cengage Learning, 2015.
3. *Engineering Problem Solving With C* by Delores M. Etter, Pearson, 2013.
4. *Problem Solving and Program Design in C* by Jeri R. Hanly and Elliot B. Koffman, Pearson, 2016.
5. *Structure and Interpretation of Computer Programs* by Harold Abelson and Gerald Sussman with Julie Sussman, MIT Press, 1985.
6. *How to Design Programs* by Matthias Felleisen, Robert Bruce Findler, Matthew Flatt, and Shriram Krishnamurthi, MIT Press, 2018.
7. *ANSI/ISO 9899-1990, American National Standard for Programming Languages ‘C’* by American National Standards Institute, Information Technology Industry Council, 1990 (C89).
8. *ISO/IEC 9899:1999. International Standard for Programming Languages – C (ISO/IEC 9899)* by American National Standards Institute, Information Technology Industry Council, 2000 (C99).
9. *INCITS/ISO/IEC 9899-2011.American National Standard for Programming Languages ‘C’* by American National Standards Institute, Information Technology Industry Council, 2012 (C11).

PaperCode: BS-103 / BS-104	**Paper: Applied Chemistry**	**L**	**T/P**	**C**
		3	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand the fuels and their uses.
2:	To understand phase rule and its applications. Also, to understand the properties and industrial applications of polymers.
3:	To understand the methods used to make pure water.
4:	To understand the chemical aspects of corrosion and gain a basic understanding about the principles of Green Chemistry and Nano-chemistry.

Course Outcomes (CO):

CO1	Ability to use fuels and perform energy conversion calculations.
CO2	Understand the phase rule and its applications. Also, to understand the properties and industrial applications of polymers.
CO3	Ability to analyse water and use technologies to purify it.
CO4	Understand the chemical aspects of corrosion and its prevention. Also, to understand the basics of Green Chemistry and Nano-chemistry.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	1	1	-	1	1	-	1

Unit I

Fuels: Classification and Characteristics of fuels, Calorific values, Comparison between solid, liquid and gaseous fuels, calorific values of fuels, determination of calorific values using Bomb calorimeter, Boy's calorimeter, theoretical calculation of calorific value using Dulong formula and numericals of Calorific values. Types of fuels: - Solid: Coal, proximate and ultimate analysis of coal and numericals, carbonisation of coal in Otto-Hoffman oven with recovery of by-products, metallurgical coke; Liquid: Petroleum products --- refining, cracking-thermal and catalytic, knocking characteristics, Octane and Cetane rating; Gaseous: Natural Gas (NG), CNG, LPG, Coal gas, Oil gas, Producer gas, Water gas; Combustion of fuels numericals. [9Hrs] [T1]

Unit II

Phase rule: Terms used in Gibb's Phase rule, phase diagram and its applications for study of one-component systems: Water and Sulphur and two-component systems: Lead-Silver and Zinc-Magnesium.

Polymers: Classification, functionality and their types; Plastics: Synthesis (reactions) and properties of Polyethylene Plastics (Addition polymers) ---low-density polyethene (LDPE), high-density polyethylene(HDPE), linear low density polyethylene(LLDPE) and ultra-high molecular weight polyethylene (UHMWPE); Vinyl Plastics (Condensation polymers) -Nylons, Phenol-formaldehyde resins(Bakelite) and Glyptal; Speciality Polymers: Engineering thermoplastics, Conducting polymers, Electroluminescent polymers, liquid crystalline polymers and biodegradable polymers. [9Hrs][T1, T2]

Unit III

Water: Introduction, water quality standards, physical, chemical and biological characteristics; hardness of water, disadvantages of hardness, determination of hardness (EDTA method) and related numerical questions. Alkalinity and its determination; Boiler problems with hard water and their prevention: Scale and sludge formation, boiler corrosion, caustic embrittlement, priming and foaming, boiler water treatment –internal or in-situ: carbonate and phosphate conditioning, colloidal and Calgon conditioning; external treatment: (a) Lime soda process and related numericals (b) Zeolite process and numericals, (c) Ion-exchange process. Municipal water supply – its treatment and disinfection using break -point chlorination. Desalination, Reverse Osmosis, Electrodialysis and defluoridation of water. [9Hrs][T1, T2]

Unit IV

Corrosion and its Control: Definition, effects, theory (mechanisms): dry/chemical, wet/electrochemical corrosion, Pilling-Bedworth ratio; Types of corrosion: Galvanic corrosion, Soil corrosion, Pitting corrosion, Concentration cell or Differential Aeration corrosion, Stress corrosion; Mechanism of rusting of iron, Passivity. Factors influencing corrosion; protective measures: galvanization, tinning, cathodic protection, sacrificial anodic protection; electroplating and prevention of corrosion through material selection and design.

Green Technology and Green Chemistry

Twelve Principles of Green Chemistry, Zero Waste Technology, Atom economy, Use of alternative feedstock, innocuous reagents, alternative solvents, designing alternative reaction methodology, minimising energy consumption.

Nano Chemistry: Nanomaterials: Properties, synthesis and surface characterization techniques BET and TEM and applications. [9Hrs][T1, T2]

Textbooks:

1. Applied Chemistry by Achyutananda Acharya and Biswajit Samantray, Pearson, 2017.
2. *Engineering Chemistry: Fundamentals and Applications* by Shikha Agarwal, Cambridge University Press, 2019.

References:

1. *Applied Chemistry: A Textbook of Engineers and Technologists* by O. V. Roussk and H. D. Gesser, Springer, 2013.
2. Engineering Chemistry by Raghupati Mukhopadhyay and Sriparna Datta, New Age Int. (P0 Ltd., 2007.
3. *Engineering Chemistry* by K. Shesha Maheswaramma and Mridula Chugh, Pearson, 2017.
4. *Basic Engineering Chemistry* by S.S. Dara, A. K.Singh, and Abhilasha Asthana, S. Cand and Co., 2012.
5. Engineering Chemistry by K. N. Jayaveera, G.V. Subba Reddy, and C. Ramachandraiah, McGraw Hill, 2016.
6. *Engineering Chemistry* by O. G. Palanna, McGraw-Hill, 2017.
7. *Textbook of Engineering Chemistry* by Jaya Shree Anireddy, Wiley, 2017.
8. *Engineering Chemistry* byE.R. Nagarajan and S. Ramalingam, Wiley, 2017.

PaperCode: BS-121 / BS-120	**Paper: Basic Chemistry**	**L**	**T/P**	**C**
Year of Inclusion: 2022-23		**3**	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand the fuels and their uses.
2:	To lay foundation for the application of engineering materials such as cement and glass Also, to understand the properties and industrial applications of polymers.
3:	To understand the methods used to make pure water.
4:	To understand the chemical aspects of corrosion.

Course Outcomes (CO):

CO1	Ability to use fuels and perform energy conversion calculations.
CO2	Course will impart knowledge about some important engineering materials such as cement and glass. It will also enable the students to understand the properties and industrial applications of polymers.
CO3	Ability to analyse water and use technologies to purify it.
CO4	Students will be able to understand the chemical aspects of corrosion and its prevention.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	1	1	-	1	1	-	1

Unit I

Fuels: Classification and Characteristics of fuels, Calorific values, Comparison between solid, liquid and gaseous fuels, calorific values of fuels, determination of calorific values using Bomb calorimeter, Boy's calorimeter, theoretical calculation of calorific value using Dulong formula and numericals of Calorific values. Types of fuels: - Solid: Coal, proximate and ultimate analysis of coal and numericals, carbonisation of coal in Otto-Hoffman oven with recovery of by-products, metallurgical coke; Liquid: Petroleum products --- mining and refining of petroleum, knocking, numericals based on combustion of fuels (excluding flue gas analysis) . [9Hrs] [T1]

Unit II

Engineering Materials: Portland Cement: manufacturing by Rotary Kiln, role of gypsum, chemistry of setting and hardening of cement. Glass: manufacturing by tank furnace, significance of annealing, types and properties of soft glass, hard glass, borosilicate glass. Polymers: Basic concepts & terminology, classification and functionality of polymers, Properties and applications of (excluding synthesis): polyethylene, polymethacrylate, nylon, bakelite, polycarbonate, conducting polymers, liquid crystalline polymers, biodegradable polymers. [9Hrs][T1, T2]

Unit III

Water: Introduction, water quality standards, physical, chemical and biological characteristics; hardness of water, disadvantages of hardness, determination of hardness (EDTA method) and related numerical questions, Alkalinity of water and related numericals. Boiler problems with hard water and their prevention: Scale and sludge formation, boiler corrosion, caustic embrittlement, priming and foaming, boiler water treatment –internal or in-situ: carbonate and phosphate conditioning, colloidal and Calgon conditioning; external treatment: (a) Lime soda process and related numericals (b) Zeolite process and numericals (c) Ion-exchange process. Desalination, Reverse Osmosis, Electrodialysis. [9Hrs] [T1, T2]

Unit IV

Corrosion and its Control: Definition, effects, theory (mechanisms): dry/chemical, wet/electrochemical corrosion, Pilling-Bedworth ratio; Types of corrosion: Galvanic corrosion, Soil corrosion, Pitting corrosion, Concentration cell or Differential Aeration corrosion, Stress corrosion; Passivity. Factors influencing corrosion; protective measures: galvanization, cathodic protection, sacrificial anodic protection; electroplating. [9Hrs] [T1, T2]

Textbooks:

1. *Engineering Chemistry: Fundamentals and Applications* by Shikha Agarwal, Cambridge University Press, 2019.
2. *Engineering Chemistry by Jain & Jain, Dhanpat Rai Publication Company, 2021 (Seventeenth Edition).*

References:

1. *Applied Chemistry: A Textbook of Engineers and Technologists* by O. V. Roussk and H. D. Gesser, Springer, 2013.
2. Engineering Chemistry by Raghupati Mukhopadhyay and Sriparna Datta, New Age Int. (P0 Ltd., 2007.
3. *Engineering Chemistry* by K. Shesha Maheswaramma and Mridula Chugh, Pearson, 2017.
4. *Basic Engineering Chemistry* by S.S. Dara, A. K.Singh, and Abhilasha Asthana, S. Cand and Co., 2012.
5. Engineering Chemistry by K. N. Jayaveera, G.V. Subba Reddy, and C. Ramachandraiah, McGraw Hill, 2016.
6. *Engineering Chemistry* by O. G. Palanna, McGraw-Hill, 2017.
7. *Textbook of Engineering Chemistry* by Jaya Shree Anireddy, Wiley, 2017.
8. *Engineering Chemistry* byE.R. Nagarajan and S. Ramalingam, Wiley, 2017.

PaperCode: BS-105	**Paper: Applied Physics – I**	**L**	**T/P**	**C**
		3	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand thermodynamic principles.
2:	To understand and model oscillations and waves.
3:	To understand and model interference, diffraction and polarization phenomenon.
4:	To understand and appreciate relativistic systems and Lasers.

Course Outcomes (CO):

CO1	Ability to apply thermodynamic principles to solution of engineering problems.
CO2	Ability to understand and model oscillations and waves.
CO3	Ability to understand and model interference, diffraction and polarization phenomenon.
CO4	Ability to understand and appreciate relativistic systems and Lasers.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	2
CO2	2	2	3	3	2	-	-	-	1	1	-	2
CO3	2	2	3	3	2	-	-	-	1	1	-	2
CO4	2	2	3	3	2	-	-	-	1	1	-	2

Unit I

Introduction to Thermodynamics: Fundamental Ideas of Thermodynamics, The Continuum Model, The Concept of a “System’”, “State”, “Equilibrium”, “Process’”. Equations of state, Heat, Zeroth Law of Thermodynamics, Work, first and second laws of thermodynamics, entropy
[8Hrs]

Unit II

Waves and Oscillations: Wave motion, simple harmonic motion, wave equation, superposition principle. Introduction to Electromagnetic Theory: Maxwell’s equations. work done by the electromagnetic field, Poynting’s theorem, Momentum, Angular momentum in electromagnetic fields, Electromagnetic waves: the wave equation, plane electromagnetic waves, energy carried by electromagnetic waves [8Hrs]

Unit III

Interference: Interference by division of wave front (Young's double slit experiment, Fresnel's biprism), interference by division of amplitude (thin films, Newton's rings, Michelson's interferometer), Coherence and coherent sources

Diffraction: Fraunhofer and Fresnel diffraction; Fraunhofer diffraction for Single slit, double slit, and N-slit (diffraction grating), Fraunhofer diffraction from a circular aperture, resolving power and dispersive power of a grating, Rayleigh criterion, resolving power of optical instruments

Polarization: Introduction to polarization, Brewster's law, Malu's law, Nicol prism, double refraction, quarter-wave and half-wave plates, optical activity, specific rotation, Laurent half shade polarimeter. [12Hrs]

Unit IV

Theory of relativity: The Michelson-Morley Experiment and the speed of light; Absolute and Inertial frames of reference, Galilean transformations, the postulates of the special theory of relativity, Lorentz transformations, time dilation, length contraction, velocity addition, mass energy equivalence. Invariance of Maxwell's equations under Lorentz Transformation.

Introduction to Laser Physics: Introduction, coherence, Einstein A and B coefficients, population inversion, basic principle and operation of a laser, the He-Ne laser and the Ruby laser [12Hrs]

Textbooks:

1. *Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury, McGraw-Hill, 2017.
2. *Physics for Scientists and Engineers* by Raymond A. Serway and John W. Jewett, 9th Edition , Cengage, 2017

References:

1. *Modern Physics* by Kenneth S. Krane, Wiley, 2020.
2. *Principles of Physics* by Robert Resnick, Jearl Walker and David Halliday, Wiley, 2015.
3. *Optics* by Ajoy Ghatak, McGraw Hill, 2020.

PaperCode: ES-107 / ES-108	**Paper: Electrical Science**	**L**	**T/P**	**C**
		3	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart knowledge of the basics electrical engineering.
2:	To impart knowledge of the working of RLC circuits.
3:	To impart basic knowledge about filters and magnetic circuits.
4:	To impart basic knowledge about electrical machines.

Course Outcomes (CO):

CO1	Ability to understand and use Kirchpff's Laws to solve resistive circuit problems.
CO2	Ability to analyse resistive, inductive and capacitive circuits for transient and steady state sinusoidal solutions.
CO3	Understand the first order filters and magnetic circuits.
CO4	Understand the design of electrical machines.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	3	3	3	-	-	-	1	1	1	2
CO2	3	3	3	3	3	-	-	-	1	1	1	2
CO3	3	3	3	3	3	-	-	-	1	1	1	2
CO4	3	3	3	3	3	-	-	-	1	1	1	2

Unit - I

DC Circuits: Passive circuit components, Basic laws of Electrical Engineering, Temperature Resistance Coefficients. voltage and current sources, Series and parallel circuits, power and energy, Kirchhoff's Laws, Nodal & Mesh Analysis, delta-star transformation, superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem. Time domain analysis of first Order RC & LC circuits.

[9Hrs] [T1]

Unit - II

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections. [9Hrs] [T1]

Unit - III

D. C. Generators & Motors: Principle of operation of Generators & Motors, Speed Control of shunt motors, Flux control, Rheostatic control, voltage control, Speed control of series motors.

A. C. Generators & Motors: Principle of operation, Revolving Magnetic field, Squirrel cage and phase wound rotor, Starting of Induction motors, Direct on line and Star Delta starters, Synchronous machines. [9Hrs [T1]]

Unit - IV:

Transformers: Construction and principle of operation, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.
Measuring Instruments: Electromagnetism, Different Torques in Indicating instruments, Moving Iron Instruments: Construction & Principle, Attraction and Repulsion type; Moving Coil instruments: Permanent Magnet type; Dynamometer type Instruments. [9Hrs] [T1]

Textbooks:

1. *Electrical Engineering Fundamentals* by Vincent Del Toro, PHI (India), 1989

References:

1. *An Introduction to Electrical Science* by Adrian Waygood, Routledge, 2nd Ed. 2019.
2. *Electrical Circuit Theory and Technology* by John Bird, Elsevier, 2007.
3. *Principles and Applications of Electrical Engineering* by Giorgio Rizzoni, MacGraw-Hill, 2007.
4. *Electrical Engineering* by Allan R. Hambley, Prentice-Hall, 2011.
5. *Hughes Electical & Electronic Technology* by Edward Hughes revised by Hohn Wiley, Keith Brown and Ian McKenzie Smith, Pearson, 2016.
6. *Electrical and Electronics Technology* by E. Hughes, Pearson, 2010.
7. Basic Electrical Engineering by D.C. Kulshrestha, McGraw-Hill, 2009.
8. Basic Electrical Engineering by D. P. Kothai and I.J. Nagrath, McGraw-Hill, 2010.

PaperCode:BS-109 / BS-110	**Paper: Environmental Studies**	**L**	**P**	**C**
		3	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	The course is designed to impart basic knowledge of the environment and its components.
2:	The course deals in creating awareness about the energy resources and current environmental problems faced by the world.
3:	To understand and learn about environment pollution, related case studies and measures taken for control to pollution.
4:	To understand and explore different approaches of conserving and protecting environment for the benefit of society.

Course Outcomes (CO):

CO1	Environmental Studies course will provide necessary information and knowledge about the various aspects of environment, ecosystems and related biodiversity.
CO2	Students will be able to learn and understand about the availability and sustainable use of resources, environmental problems and their short term and long term impacts to humans.
CO3	Course will help them to learn about environmental policies and protocols, social issues and role of human in conservation and protection of environment.
CO4	Overall, course will help students to develop skills and ability of understanding environment- human relationship.

Course Outcomes (CO to Programme Outcomes (PO)) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	1	1	-	-	3	3	2	1	1	1	1
CO2	-	1	1	-	-	3	3	2	1	1	1	1
CO3	-	1	1	-	-	3	3	2	1	1	1	1
CO4	-	1	1	-	-	3	3	2	1	1	1	1

Unit I

Fundamentals: The Multidisciplinary nature of environmental studies: Definition, components, scope and importance, need for public awareness; Natural Resources.
Ecosystems: Concept, Structure and function of an ecosystem, Types, Functional Components, Different ecosystems, biogeochemical cycles.
Biodiversity: Introduction to biodiversity, biogeographical classification, India as a mega diversity nation, endangered and endemic species of India, threats to biodiversity and conservation of biodiversity. Bioprospecting and Biopiracy. [10Hrs] [T1,T2]

Unit III

Environmental Pollution: (a) Air Pollution: Source, Types, effects on biosphere and Meterology, Air Quality, Control. (b) Water Pollution: Types and Sources. (c) Soil Pollution: Types and Control. (d)

Noise Pollution: Effect, Control (e) Thermal Pollution. (f) Radiation Pollution (g) Solid waste Management, (h) Pollution Prevention, (i) Disaster Management [10Hrs][T1,T2]

Unit III

Social Issues and Environment: Concept of Sustainable Development; Urban problem related to energy; Water Conservation; Wasteland reclamation; Resettlement and Rehabilitation; Climate Change; Nuclear Accidents; Consumerism and Waste Products; Laws related to Environment, Pollution, Forest and Wild life; Environmental Impact Assessment. [8Hrs] [T1,T2]

Unit IV

Human Population and Environment: Population Growth, Human Rights, Family Welfare Programmes, Environment and Human Health, HIV/AIDS, Women and Child Welfare, Role of IT. [8Hrs] [T1,T2]

Textbooks:

1. *Environmental Studies* by AninditaBasak, Pearson, 2009.
2. *Environmental Studies*: Simplified by Benny Joseph, McGraw-Hill, 2017.

References:

1. *Environmental Studies* by D. L. Manjunath, Pearson, 2007.
2. *Environmental Studies* by Anil Kumar De and Arnab Kumar De, New Age Int. (P) Ltd, Publishers, 2005.
3. *Companion to Environmental Studies*edited by Coel Castree, Mike Hulme, and James D. Proctor, Routledge, 2018.
4. *Environmental Studies* by Deepa Sharma and Bhupendra Singh Chabbra, New Age Int. (P) Ltd, Publishers, 2007.
5. *Environmental Studies: Simplified* by Raj Kumar Singh, McGraw-Hill, 2012.
6. *Basics of Environmental Studies* by U. K. Khare, McGraw-Hill, 2014.

PaperCode: BS-111	**Paper: Applied Mathematics – I**	**L**	**T/P**	**C**
		4	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand use series, differential and integral methods to solve formulated engineering problems.
2:	To understand use Ordinary Differential Equations to solve formulated engineering problems.
3:	To understand use linear algebra to solve formulated engineering problems.
4:	To understand use vector calculus to solve formulated engineering problems.

Course Outcomes (CO):

CO1	Ability to use series, differential and integral methods to solve formulated engineering problems.
CO2	Ability to use Ordinary Differential Equations to solve formulated engineering problems.
CO3	Ability to use linear algebra to solve formulated engineering problems.
CO4	Ability to use vector calculus to solve formulated engineering problems.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	3	3	3	1	-	-	-	-	-	1	2
CO2	2	3	3	3	1	-	-	-	-	-	2	2
CO3	2	3	3	3	1	-	-	-	-	-	2	2
CO4	2	3	3	3	1	-	-	-	-	-	2	2

Unit I

Partial derivatives, Chain rule, Differentiation of Implicit functions, Exact differentials. Maxima, Minima and saddle points, Method of Lagrange multipliers. Differentiation under Integral sign, Jacobians and transformations of coordinates. [8Hrs][T2]

Unit II

Ordinary Differential Equations (ODEs): Basic Concepts. Geometric Meaning of $y' = f(x, y)$. Direction Fields, Euler's Method, Separable ODEs. Exact ODEs. Integrating Factors, Linear ODEs. Bernoulli Equation. Population Dynamics, Orthogonal Trajectories. Homogeneous Linear ODEs with Constant Coefficients. Differential Operators. Modeling of Free Oscillations of a Mass-Spring System, Euler-Cauchy Equations. Wronskian, Nonhomogeneous ODEs, Solution by Variation of Parameters.
Power Series Method for solution of ODEs: Legendre's Equation. Legendre Polynomials, Bessel's Equation, Bessels's functions Jn(x) and Yn(x). Gamma Function [12Hrs][T1]

Unit III

Linear Algebra: Matrices and Determinants, Gauss Elimination, Linear Independence. Rank of a Matrix. Vector Space. Solutions of Linear Systems and concept of Existence, Uniqueness, Determinants. Cramer's Rule, Gauss–Jordan Elimination. The Matrix Eigenvalue Problem.
Determining Eigenvalues and Eigenvectors, Symmetric, Skew-Symmetric, and Orthogonal Matrices. Eigenbases. Diagonalization. Quadratic Forms.Cayley – Hamilton Theorem (without proof)[10Hrs][T1]

Unit IV

Vector Calculus: Vector and Scalar Functions and Their Fields. Derivatives, Curves. Arc Length. Curvature. Torsion, Gradient of a Scalar Field. Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field, Line Integrals, Path Independence of Line Integrals, Double Integrals, Green's Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Stokes Theorem. Divergence Theorem of Gauss. [10Hrs][T1]

Textbooks:
1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10th Ed., 2011.
2. *Mathematical Methods for Physics and Engineering*, by K. F. Riley, M. P. Hobson and S. J. Bence, CUP, 2013. (for Unit I)

References:
1. *Engineering Mathematics* by K.A. Stroud withDexter J. Booth, Macmillan, 2020.
2. *Advanced Engineering Mathematics* by Larry Turyn, Taylor and Francis, 2014.
3. *Advanced Engineering Mathematics* by Dennis G. Zill, Jones & Bartlett Learning, 2018.
4. *Advanced Engineering Mathematics with MATLAB* by Dean G. Duffy, Taylor and Francis, 2017.
5. *Advanced Engineering Mathematics* by Merle C. Potter, Jack L. Lessing, and Edward F. Aboufadel, Springer (Switzerland), 2019.

PaperCode:HS-113 / HS-114	**Paper: Communications Skills**	**L**	**T/P**	**C**
		3	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.

Course Objectives:

1:	To understand the communication system paradigm.
2:	To understand how language vocabulary can be increased and difference between Indian, British and American English.
3:	To understand how to write a business letter and make a speech.
4:	To improve grammar and sentence structure.

Course Outcomes (CO):

CO1	Ability to Communicate as an Individual and in a Group.
CO2	Ability to learn new words, differentiate between Indian, British and American English.
CO3	Ability to write business letters and make speeches.
CO4	Improved grammar and sentence structure.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	-	-	-	-	-	-	-	-	3	3	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	3
CO4	-	-	-	-	-	-	-	-	3	3	-	3

Unit I

Role and Importance of Communications, Attributes of Communications, Verbal and Non-Verbal Communications, Verbal Communications Skills, Non-verbal Communication Methods, Body Language, Barriers to Communications, Socio-psychological barriers, Inter-Cultural barriers, Overcoming barriers, Communication Mediums: Characterization and Choice of medium, Effective Communication: Correctness, Clarity, Conciseness, Courtesy, Group Communication: Meetings (types, purpose), Group Discussions, Conduct of Meeting, Participant Role, Making Presentations. [8Hrs][T1]

Unit II

Spoken and Written English: Attributes of spoken and written communication, Formal & Informal Communication, Variation in between Indian, British and American English. Etiquette and Manners: Personal Behaviour, Greetings, Introductions, Telephone Etiquette. Vocabulary Development: Dictionaries and Thesaurus, Words often confused, generally used one word substitutions, Comprehension. [8Hrs][T1]

Unit III

Letter writing: Planning the message, Planning Content, Structure, Language use, Layout, enquires and replies, asking for or giving quotations, Bargaining letters, Seller's reply, etc.; Complaints and Replies; Memos, Circulars and notices;
Papragraph Writing, Writing Scientific and Technical Reports: Types, Structure, Drafting and Delivering a Speech: Understanding the Environment, Understanding the Audience, Text preparing, Composition, Practicing, Commemorative Speeches, Welcome and Introduction, Farewell and Send-offs, Condolence [8Hrs][T1]

Unit IV

Articles: Indefinite, Definite; Tenses: Present, Past, Future, Perfect (Present, Past and Future), Tenses in conditional sentences; Active and Passive Voice: Formation, conversion; Direct and Indirect Speech, Degrees of Comparison, Common errors, Concepts of Learning and Listening [8Hrs][T1]

Textbooks:

1. *English Language Communication Skills* by Urmilla Rai, Himalaya Publishing House, 10th Ed., 2010.

References:

1. *Technical Communication: Principles and Practice* byMeenakshi Raman and Sangeeta Sharma, Oxford University Press, 2015.
2. *Communication Skills for Engineers* by C. Muralikrishna and Sunita Mishra, Pearson, 2011.
3. *Effective Technical Communication* by M. Ashraf Rizvi, McGraw-Hill, 2018.
4. *Business Communication: Skills, Concepts, and Applications* by P.D. Chaturvedi and Mukesh Chaturvedi, Pearson, 2013.
5. *Business Correspondence and Report Writing* by R.C. Sharma and Krishan Mohan, McGraw-Hill, 2016.
6. *English for Technical Communications* by Aysha Viswamohan, Tata McGraw-Hill, 2008.

PaperCode:HS-115 / HS-116	**Paper: Indian Constitution**	**L**	**T/P**	**C**
		2	**-**	**2**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter

1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives:

1:	To create awareness among students about the Indian Constitution
2:	To create consciousness among students about democratic principles and enshrined in the Constitution of India

Course Outcomes (CO):

CO1	To understand institutional mechanism and fundamental values enshrined in the Constitution of India
CO2	To understand the inter-relation between Centre and State Government
CO3	To understand Fundamental Rights and Duties
CO4	To understand the structure and functions of judicial systems in the country.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	3	-	2	-	-	-	1
CO2	-	-	-	-	-	3	-	2	-	-	-	1
CO3	-	-	-	-	-	3	-	2	-	-	-	1
CO4	-	-	-	-	-	3	-	2	-	-	-	1

Unit I

Introduction to Constitution of India: Definition, Source and Framing of the Constitution of India. Salient features of the Indian Constitution. Preamble of the Constitution. [6Hrs]

Unit II

Fundamental Rights and Duties: Rights To Equality (Article 14-18). Rights to Freedom (Article 19-22). Right against Exploitation (Article 23-24). Rights to Religion and Cultural and Educational Rights of Minorities(Article 25- 30). The Directive Principles of State Policy – Its significance and application. Fundamental Duties – Necessary obligations and its nature, legal status and significance [6Hrs]

Unit III

Executives and Judiciary: Office of President, Vice President and Governor: Power and Functions, Parliament, Emergency Provisions-, President Rule; Union Judiciary: Appointment of Judges, Jurisdiction of the Supreme Court, State Judiciary: Power and functions, Writ Jurisdiction [6Hrs]

Unit IV

Center-States Relation: Is Indian Constitution Federalin Nature, Legislative relations between Union and States, Administrative Relations between Union and States, Financial Relations between Union and States [6Hrs]

Textbooks:

1. *Constitutional Law of India* by J.N Pandey, Central Law Publication, 2018.
2. *Introduction to the Indian Constitution of India* by D.D. Basu, PHI, New Delhi, 2021
3. *The Constitution of India* by P.M. Bakshi, Universal Law Publishing Co., 2020.

References:

1. *Indian Constitutional Law* by M.P. Jain, Lexis Nexis, 2013
2. *Constitution of India* by V.N. Shukla, Eastern Book Agency, 2014

PaperCode:HS-117/HS-118	Paper: Human Values and Ethics	L	P	C
		1	-	1

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, the examinations are to be conducted by the concerned teacher.

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives:

1:	To help students regulate their behavior in a professional environment as employees
2:	To make students aware of the impact of taking non-ethical engineering decisions.
3:	To understand that mind and desire control is needed for being ethical.
4:	To understand organizational culture and to adapt to varying cultures without compromising ethical values

Course Outcomes (CO):

CO1	Realize the importance of human values.
CO2	Understand that excessive desires of the mind make a person unethical and restless, while fewer desires lead to peace and professional progress
CO3	Assess different types of risks involved in unethical practices. Know various means of protesting against unethical practices.
CO4	Assess the benefits of restraining from unethical practices like bribery, extortion, nepotism, nexus between politicians and industrialists.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	3	-	3	1	1	-	1
CO2	-	-	-	-	-	3	-	3	1	1	-	1
CO3	-	-	-	-	-	3	-	3	1	1	-	1
CO4	-	-	-	-	-	3	-	3	1	1	-	1

Unit I

Human Values: Morals, Values, Ethics, Integrity, Work ethics, Service learning, Virtues, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Challenges in the work place, Spirituality [3Hrs]

Unit II

Engineering Ethics: Senses of engineering ethics, Variety of moral issues, Types of inquiries, Moral dilemma, Moral autonomy, Moral development (theories), Consensus and controversy, Profession, Models of professional roles, Responsibility, Theories about right action (Ethical theories), Self-control, Self-interest, Customs, Religion, Self-respect, Case study: Choice of the theory

Engineering as experimentation, Engineers as responsible experimenters, Codes of ethics, Industrial standards, A balanced outlook on law, Case study: The challenger [3Hrs]

Unit III

Safety definition, Safety and risk, Risk analysis, Assessment of safety and risk, Safe exit, Risk-benefit analysis

Sefety lessons from ‘the challenger’, Case study: Power plants,Collegiality and loyalty, Collective bargaining,
Confidentiality, Conflict of interests, Occupational crime, Human rights, Employee rights, Whistle blowing, Intellectual property rights. [4Hrs]

Unit IV

Globalization, Multinational corporations, Environmental ethics, Computer ethics, Weapons development, Engineers as managers, Consulting engineers, Engineers as expert witness, Engineers as advisors in planning and policy making, Moral leadership, Codes of ethics, Engineering council of India, Codes of ethics in Business Organizations [3Hrs]

Textbooks:

1. *A Textbook on Professional Ethics and Human Values*, by R. S. Naagarazan, New Age Publishers, 2006.

References:

1. *Professional Ethics and Human Values* by D. R. Kiran, McGraw-Hill, 2014.
2. *Engineering Ethics, by Charles E Harris and Micheal J Rabins, Cengage Learning Pub., 2012.*
3. *Ethics in Engineering, Mike Martin and Roland Schinzinger, McGraw Hill Pub., 2017.*
4. *Unwritten laws of Ethics and Change in Engineering by The America Society of Mechanical Engineers, 2015.*
5. *Engineering Ethics by Charles B. Fleddermann, Pearson, 2014.*
6. *Introduction to Engineering Ethics* by Mike W. Martin and Roland Schinzinger, McGraw-Hill, 2010.
7. *Engineering Ethics: Concept and Cases* by Charles E. Harris, Michael S. Pritchard and Michael J.Rabins, Cengage, 2009.
8. *Ethics in Engineering Practiceand Research* by Caroline Whitbeck, Cambridge University Press, 2007.

PaperCode: ES-119	**Paper: Manufacturing Process**	**L**	**T/P**	**C**
		4	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	The students will have basic understanding of various manufacturing processes. The students will have knowledge about casting process.
2:	The students will have understanding of joining processes.
3:	The students will have understanding of forging and sheet metal works.
4:	The students will have basic idea of powder metallurgy and manufacturing of plastic components.

Course Outcomes (CO):

CO1	Understand casting process.
CO2	Understand joining process.
CO3	Understand forging and sheet metal work.
CO4	Basic understanding of powder metallurgy and manufacturing of plastic components.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	1	1	1	2	-	-	-	-	-	1	1
CO2	2	1	1	1	2	-	-	-	-	-	1	1
CO3	2	1	1	1	2	-	-	-	-	-	1	1
CO4	2	1	1	1	2	-	-	-	-	-	1	1

Unit I

Definition of manufacturing, Importance of manufacturing towards technological and social economic development, Classification of manufacturing processes, Properties of materials.
Metal Casting Processes: Sand casting, Sand moulds, Type of patterns, Pattern materials, Pattern allowances, Types of Moulding sand and their Properties, Core making, Elements of gating system. Description and operation of cupola.
Working principle of Special casting processes - Shell casting, Pressure die casting, Centrifugal casting. Casting defects. [10Hrs]

Unit II

Joining Processes: Welding principles, classification of welding processes, Fusion welding, Gas welding, Equipments used, Filler and Flux materials. Electric arc welding, Gas metal arc welding, Submerged arc welding, Electro slag welding, TIG and MIG welding process, resistance welding, welding defects. [10Hrs]

Unit III

Deformation Processes: Hot working and cold working of metals, Forging processes, Open and closed die forging process. Typical forging operations, Rolling of metals, Principle of rod and wire drawing, Tube drawing. Principle of Extrusion, Types of Extrusion, Hot and Cold extrusion.
Sheet metal characteristics -Typical shearing operations, bending and drawing operations, Stretch forming operations, Metal spinning. [10Hrs]

Unit IV

Powder Metallurgy: Introduction of powder metallurgy process, powder production, blending, compaction, sintering
Manufacturing Of Plastic Components: Types of plastics, Characteristics of the forming and shaping processes, Moulding of Thermoplastics, Injection moulding, Blow moulding, Rotational moulding, Film blowing, Extrusion, Thermoforming. Moulding of thermosets- Compression moulding, Transfer moulding, Bonding of Thermoplastics. [10Hrs]

Textbooks:

1. *Manufacturing Technology: Foundry, Forming and Welding Volume 1*, P. N Rao, , McGrawHill, 5e, 2018.
2. *Elements of Workshop Technology Vol. 1 and 2* by Hajra Choudhury, Media Promoters Pvt Ltd.,2008.

References:

1. *Manufacturing Processes for Engineering Materials*, by Serope Kalpajian and Steven R.Schmid, Pearson Education, 5e, 2014.
2. *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems* by Mikell P. Groover, John Wiley and Sons, 4e, 2010 .
3. *Production Technology* by R.K.Jain and S.C. Gupta, Khanna Publishers. 16th Edition, 2001.

PaperCode: BS-151	**Paper: Applied Physics - I Lab.**	**L**	**P**	**C**
		-	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Applied Physics - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 8 experiments must be performed by the students

1. To determine the wavelength of sodium light by Newton’s Rings.
2. To determine the wavelength of sodium light by Fresnel's biprism.
3. To determine the wavelength of sodium light using diffraction grating.
4. To determine the refractive index of a prism using spectrometer.
5. To determine the dispersive power of prism using spectrometer and mercury source.
6. To determine the specific rotation of cane sugar solution with the help of half shade polarimeter.
7. To find the wavelength of He-Ne laser using transmission diffraction grating.
8. To determine the numeral aperture (NA) of an optical fibre.
9. To plot a graph between the distance of the knife-edge from the center of the gravity and the time period of bar pendulum. From the graph, find (a) The acceleration due to gravity (b) The radius of gyration and the moment of inertia of the bar about an axis.
10. To determine the velocity of ultrasound waves using an ultrasonic spectrometer in a given liquid (Kerosene Oil).
11. To verify inverse square law.
12. To determine Planck’s constant.

Note: Teacher’s may use the prescribed books to choose the practicals in addition to above. Total 8 practicals minimum shall be performed by the students, they may be asked to do more. Atleast 4 experiments must be from the above list.

Textbook:
1. *B.Sc. Practical Physics* by C. L. Arora, S.Chand & Co., 2020.
2. *Practical physics* by R. K. Shukla and A. Srivastava, New Age Int. (P) Ltd., 2006.

PaperCode: ES-153 / ES-154	**Paper: Programming in 'C' Lab.**	**L**	**P**	**C**
		-	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of "Programming in 'C'" as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the office of the Head of Department / Institiution in which the paper is being offered from the list of practicals below. Atleast 8 experiments must be performed by the students

1. Write a program to find divisor or factorial of a given number.

2. Write a program to find sum of a geometric series

3. Write a recursive program for tower of Hanoi problem

4. Write a recursive program to print the first m Fibonacci number

5. Write a menu driven program for matrices to do the following operation depending on whether the operation requires one or two matrices

   a. Addition of two matrices
   b. Subtraction of two matrices
   c. Finding upper and lower triangular matrices
   d. Transpose of a matrix
   e. Product of two matrices.

6. Write a program to copy one file to other, use command line arguments.

7. An array of record contains information of managers and workers of a company. Print all the data of managers and workers in separate files.

8. Write a program to perform the following operators on Strings without using String functions

   a. To find the Length of String.
   b. To concatenate two string.
   c. To find Reverse of a string.
   d. To copy one string to another string.

9. Write a Program to store records of a student in student file. The data must be stored using Binary File.Read the record stored in "Student.txt" file in Binary code.Edit the record stored in Binary File.Append a record in the Student file.

10. Write a programmed to count the no of Lowercase, Uppercase numbers and special Characters presents in the contents of text File.

Note:
1. At least 8 Experiments out of the list shall be performed by the students. Teachers may introduce new experiments for the class in addition to above.
2. In addition Two Mini Projects based on the skills learnt shall be done by the students. Teachers shall create the mini projects so that the same is not repeated every year. These mini projects may be done in a group not exceeding group size of 4 students.
3. Usage of IDE like Visual Studio Community Edition, Codeblocks, etc. are recommended.

PaperCode: BS-155 / BS-156	Paper: Applied Chemistry Lab.	L	P	C
		-	2	1

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of “Applied Chemistry” as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the office of the Head of Department / Instiitiution in which the paper is being offered from the list of practicals below. Atleast 8 experiments must be performed by the students

1. Determination of alkalinity of water sample.
2. Determination of hardness of water sample by EDTA method.
3. Determine the percentage composition of sodium hydroxide in the given mixture of sodium hydroxide and sodium chloride.
4. Determine the amount of oxalic acid and Sulphuric acid in one litre of solution, given standard sodium hydroxide and Potassium Permanganate.
5. Determine the amount of copper in the copper ore solution, provided hypo-solution (Iodometric Titration).
6. Determine the amount of chloride ions present in water using silver nitrate (Mohr’s Precipitation Method).
7. Determine the strength of MgSO4 solution by Complexometric titration.
8. Determine the surface tension of a liquid using drop number method.
9. Determine the viscosity of a given liquid (density to be determined).
10. Determine the cell constant of conductivity cell and titration of strong acid/strong base conductometrically.
11. To determine (a) λ max of the solution of KMnO4. (b) Verify Beer’s law and find out the concentration of unknown solution by spectrophotometer.
12. Determination of the concentration of iron in water sample by using spectrophotometer.
13. Determination of the concentration of Iron (III) by complexometric titration.
14. Proximate analysis of coal.
15. Determination of eutectic point and congruent melting point for a two component system by method of cooling curve.

References:

1. *Vogel’s Text Book of Quantitative Chemical Analysis* by G.H. Jefferey, J. Bassett, J. Mendham, and R.C. Denney, Logmaan Scientific & Technical, 1989
2. *Essentials of Experimental Engineering Chemistry* by S. Chawla, Dhanpat Rai & Co., 2008.
3. Experiments in Applied Chemistry by S. Ratan, S.K. KAtaria & Sons, 2003.
4. *Practical Chemistry* by O.P.Pandey, D. N. Bajpai and S. Giri, S.Chand & Co., 2005.
5. *Engineering Chemistry with Laboratory Experiments* by M. S. Kaurav, PHI Learning Pvt. Ltd., 2011.
6. *Laboratory Manual on Engineering Chemistry* by S. K. Bhasin, and Sudha Rani, Dhanpat Rai &Co., 2006.

Note:
1. At least 8 Experiments out of the list shall be performed by the students. Teachers may introduce new experiments for the class in addition to above.

PaperCode: ES-157	**Paper: Engineering Graphics-I**	**L**	**P**	**C**
		-	**4**	**2**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Course Objectives:

1:	The students will learn the introduction of Engineering graphics, various equipment used, various scales, dimensions and BIS codes used while making drawings for various streams of engineering disciplines.
2:	The students will learn theory of projections and projection of points.
3:	The students will learn projection of lines and projection of planes.
4:	The students will learn the projection of solid and development of surfaces

Course Outcomes (CO):

CO1	To understand the theory of projections and projection of points.
CO2	Ability to do line projections.
CO3	Ability to do plane projections.
CO4	Ability to do solid projections and development of surfaces

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	3	3	2	-	-	-	1	2	1	2
CO2	3	3	3	3	2	-	-	-	1	2	1	2
CO3	3	3	3	3	2	-	-	-	1	2	1	2
CO4	3	3	3	3	2	-	-	-	1	2	1	2

Unit I

Introduction: Engineering Graphics/Technical Drawing, Introduction to drawing equipments and use of instruments, Conventions in drawing practice. Types of lines and their uses, BIS codes for lines, technical lettering as per BIS codes, Introduction to dimensioning, Types, Concepts of scale drawing, Types of scales

Theory of Projections: Theory of projections, Perspective, Orthographic, System of orthographic projection: in reference to quadrants, Projection of Points, Projection in different quadrants, Projection of point on auxiliary planes. Distance between two points, Illustration through simple problems.

Unit II

Projection of Lines: Line Parallel to both H.P. and V.P., Parallel to one and inclined to other, Other typical cases: three view projection of straight lines, true length and angle orientation of straight line: rotation method, Trapezoidal method and auxiliary plane method, traces of line.

Unit III

Projection of Planes: Projection of Planes Parallel to one and perpendicular to other, Perpendicular to one and inclined to other, Inclined to both reference planes, Plane oblique to reference planes, traces of planes.

Planes Other than the Reference Planes: Introduction of other planes (perpendicular and oblique), their traces, inclinations etc., projections of points and lines lying in the planes, conversion of oblique plane into auxiliary plane and solution of related problems.

Unit IV

Projection of Solids: Projection of solids in first or third quadrant, Axis parallel to one and perpendicular to other, Axis parallel to one inclined to other, Axis inclined to both the principal plane, Axis perpendicular to profile plane and parallel to both H.P. and V.P., Visible and invisible details in the projection, Use of rotation and auxiliary plane method.

Development of Surface: Purpose of development, Parallel line, radial line and triangulation method, Development of prism, cylinder, cone and pyramid surface for both right angled and oblique solids, Development of surface.

Note: The sheets to be created shall be notified by the concerned teacher.

Textbooks:

1. *Engineering Drawing* by N.D. Bhatt, 53rd Ed., Charotar Publishing House Pvt. Ltd., Gujarat,2017.

References:

1. *Engineering Drawing* by P.S. Gill, S.K Kataria & Sons, New Delhi, 2013.
2. *Technical Drawing with Engineering Graphics* by Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, and Cindy M. Johnson, 15th Ed., Prentice Hall, USA, 2016
3. *Engineering Drawing* by M.B. Shah and B.C. Rana, 3rd Ed., Pearson Education, New Delhi, 2009.

PaperCode: ES-159 / ES-160	**Paper: Electrical Science Lab.**	**L**	**P**	**C**
		-	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of "Electrical Science" as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the office of the Head of Department / Institiution in which the paper is being offered from the list of practicals below. Atleast 8 experiments must be performed by the students

1. To Design the circuit for a given load and selection of its various Components and instruments from the safety point of view

   OR

   To study different types of symbols and standard currently being used inelectrical engineering.
2. Study and applications of CRO for measurement of voltage, frequencyand phase of signals.
3. Connection of lamp by(1)Single Switch Method.(2) Two-way Switch Method.

   OR

   Performance comparison of fluorescent Tube & CFL Lamp.
3. To Verify Thevenin's & Norton's Theorem

   OR

   To Verify Superposition &Reciprocity Theorem.

   OR

   To Verify Maximum Power Transfer Theorem.
4. To Measure Power & Power Factor in a Single-Phase A.C Circuit usingThree Ammeters or three Voltmeters.
5. To Measure Power & Power Factor in a Balanced Three Phase Circuitusing Two Single Phase Wattmeters.
6. To study of Resonance in a series R-L-C or Parallel R-L-C Circuits.
7. To perform open circuit and short circuit test on 1-phase transformer.
8. Starting, Reversing and speed control of DC shunt Motor
9. Starting, Reversing and speed control of 3-phase Induction Motor
10. To Study different types of Storage Batteries & its charging system.
11. To Study different types of earthing methods including earth leakagecircuit breaker (GFCI)

Note:

1. At least 8 Experiments out of the list shall be performed by the students. Teachers may introduce new experiments for the class in addition to above.

PaperCode: BS-161 /BS-162	**Paper: Environmental Studies Lab.**	**L**	**P**	**C**
		-	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of "Environmental Studies" as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the office of the Head of Department / Institiution in which the paper is being offered from the list of practicals below. Atleast 8 experiments must be performed by the students

1. Determination of pH, conductivity and turbidity in drinking water sample.
2. Determination of pH and conductivity of soil/sludge samples.
3. Determination of moisture content of soil sample.
4. Determination of Total Dissolved Solids (TDS) of water sample.
5. Determination of dissolved oxygen (DO) in the water sample.
6. Determination of Biological oxygen demand (BOD) in the water sample.
7. Determination of Chemical oxygen demand (COD) in the water sample.
8. Determination of Residual Chlorine in the water sample.
9. Determination of ammonia in the water sample.
10. Determination of carbon dioxide in the water sample.
11. Determination of nitrate ions or sulphate ions in water using spectrophotometer.
12. Determination of the molecular weight of polystyrene sample using viscometer method.
13. Base catalyzed aldol condensation by Green Methodology.
14. Acetylation of primary amines using eco-friendly method.
15. To determine the concentration of particulate matter in the ambient air using High Volume Sampler.

Note:

1. For better understanding of various aspects of environment visits to local areas, depending upon easy access and importance may be planned to any nearby river, forest, grassland, hills and students should write a report based on their observations.
2. At least 8 Experiments out of the list shall be performed by the students. Teachers may introduce new experiments for the class in addition to above

References:

1. *Vogel's Text Book of Quantitative Chemical Analysis* by G.H. Jefferey, J. Bassett, J. Mendham, and R.C. Denney, Logmaan Scientific & Technical, 1989.
2. dst.gov.in/green-chem.pdf (monograph of green chemistry laboratory experiments).
3. *Essentials of Experimental Engineering Chemistry* by S. Chawla, Dhanpat Rai & Co., 2008.
4. Experiments in Applied Chemistry by S. Ratan, S.K. KAtaria & Sons, 2003.
5. *Principles of Environment Science: Enquiry and Applications* by W. Cunningham and M. A. Cunningha, Tata McGraw Hill, 2003.
6. *Perspectives in Environment Studies* by A. Kaushik and C. P. Kaushik, New Age Int. (P) Pub., 2013.

PaperCode: BS-106	**Paper: Applied Physics - II**	**L**	**T/P**	**C**
		3	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To learn about the quantum nature of reality.
2:	To learn about quantum statistics and its significance.
3:	To understand the structures of crystals.
4:	To learn about the band theory of solids and properties and characteristics of diodes.

Course Outcomes (CO):

CO1	Understand and appreciate the quantum nature of reality.
CO2	Understand quantum statistics and its significance.
CO3	Understand Crystalline Structure.
CO4	Understand the band theory of solids and properties and characteristics of diodes.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	1

Unit I

Quantum Mechanics: Introduction: Wave particle duality, de Broglie waves, the experiment of Davisson and Germer, electron diffraction, physical interpretation of the wave function, properties, the wave packet, group and phase velocity, the uncertainty principle . The Schrödinger wave equation (1D), Eigen values and Eigen functions, expectation values, simple Eigen value problems – solutions of the Schrödinger's equations for the free particle, the infinite well, the finite well, tunneling effect, the scanning electron microscope, the quantum simple harmonic oscillator (qualitative), zero point energy. [8Hrs][T1,T2]

Unit II

Quantum Statistics: The need for statistics , statistical distributions: Maxwell Boltzmann, Bose-Einstein and Fermi-Dirac statistics, their comparisons, Fermions and Bosons, Applications of quantum statistics: 1. Molecular speed and energies in an ideal gas; 2. The Black body spectrum, the failure of classical statistics to give the correct explanations – Bose-Einstein statistics applied to the Black Body radiation spectrum; Fermi-Dirac distribution, free electron theory, electronic specific heats, Fermi energy and average energy; Dying stars. [8Hrs][T1,T2]

Unit III

Crystal Structure: Types of solids, Unit cell, Types of crystals, Translation vectors, Lattice planes, Miller indices, Simple crystal structures, Interplaner spacing, Crystal structure analysis: Bragg's law, Laue method, Point defects: Schottcky and Frankel defects. [8Hrs][T1,T2]

Unit IV

Band Theory of Solids: Origin of energy bands in solids, motion of electrons in a periodic potential – the Kronig–Penny model (Qualitative). Brillouin zones, effective mass, metals, semi-conductors and insulators and their energy band structures. Extrinsic and Intrinsic semiconductors, doping – Fermi energy for doped and undoped semiconductors, the p-n junction (energy band diagrams with Fermi energy), the unbiased diode, forward and reverse biased diodes – tunnel diodes, zener diode, photo diode its characteristics, LED [8Hrs][T1,T2]

Textbooks:

1. *Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury, McGraw – Hill, 2017.
2. *Modern Physics* by Kenneth S. Krane, Wiley, 2020.

References:

1. *Physics for Scientists and Engineers* by Raymond A. Serway and John W. Jewett, 9th Edition , Cengage, 2017
2. *Principles of Physics* by Robert Resnick, Jearl Walker and David Halliday, Wiley, 2015.
3. *Solid State Electronic Devices ,by* Streetman and Ben G Prentice Hall India Learning Private Limited; 2006

PaperCode: BS-112	Paper: Applied Mathematics – II	L	T/P	C
		4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand Complex series methods.
2:	To understand Complex analysis
3:	To understand Fourier and Laplace methods
4:	To understand how to solve specific formulated engineering problems using PDE methods.

Course Outcomes (CO):

CO1	Ability to use Complex series methods.
CO2	Ability to use Complex analysis to solve formulated engineering problems
CO3	Ability to use Fourier and Laplace methods to solve formulated engineering problems
CO4	Ability to solve specific formulated engineering problems using PDE methods.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	3	3	3	1	-	-	-	-	-	1	2
CO2	2	3	3	3	1	-	-	-	-	-	2	2
CO3	2	3	3	3	1	-	-	-	-	-	2	2
CO4	2	3	3	3	1	-	-	-	-	-	2	2

Unit I

Complex Analysis – I : Complex Numbers and Their Geometric Representation, Polar Form of Complex Numbers. Powers and Roots, Derivative. Analytic Function, Cauchy–Riemann Equations. Laplace’s Equation, Exponential Function, Trigonometric and Hyperbolic Functions. Euler’s Formula, de’Moivre’s theorem (without proof), Logarithm. General Power. Principal Value**.** Singularities and Zeros. Infinity,
Line Integral in the Complex Plane, Cauchy’s Integral Theorem, Cauchy’s Integral Formula, Derivatives of Analytic Functions, Taylor and Maclaurin Series. [10Hrs]

Unit II

Complex Analysis – II: Laurent Series, Residue Integration Method. Residue Integration of Real Integrals,
Geometry of Analytic Functions: Conformal Mapping, Linear Fractional Transformations (Möbius Transformations), Special Linear Fractional Transformations, Conformal Mapping by Other Functions, Applications: Electrostatic Fields, Use of Conformal Mapping. Modeling, Heat Problems, Fluid Flow. Poisson’s Integral Formula for Potentials [10Hrs]

Unit III

Laplace Transforms: Definitions and existence (without proof), properties, First Shifting Theorem (s-Shifting), Transforms of Derivatives and Integrals and ODEs, Unit Step Function (Heaviside Function). Second Shifting Theorem (t-Shifting), Short Impulses. Dirac's Delta Function. Partial Fractions, Convolution. Integral Equations, Differentiation and Integration of Transforms. Solution of ODEs with Variable Coefficients, Solution of
Systems of ODEs. Inverse Laplace transform and its properties.
Fourier Analysis: Fourier Series, Arbitrary Period. Even and Odd Functions. Half-Range Expansions, Sturm–Liouville Problems. Fourier Integral, Fourier Cosine and Sine Transforms, Fourier Transform. Usage of fourier analysis for solution of ODEs. Inverse Fourier transform and its properties. [10Hrs]

Unit IV

Partial Differential Equations (PDEs): Basic Concepts of PDEs. Modeling: Vibrating String, Wave Equation. Solution by Separating Variables. Use of Fourier Series. D'Alembert's Solution of the Wave Equation. Characteristics. Modeling: Heat Flow from a Body in Space. Heat Equation:Solution by Fourier Series. Steady Two-Dimensional Heat Problems. Dirichlet Problem. Heat Equation: Modeling Very Long Bars. Solution by Fourier Integrals and Transforms. Modeling: Membrane, Two-Dimensional Wave Equation. Rectangular Membrane. Laplacian in Polar Coordinates. Circular Membrane. Laplace's Equation in Cylindrical and Spherical Coordinates. Potential. Solution of PDEs by Laplace Transforms. [10Hrs]

Textbooks:

1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10th Ed., 2011.

References:

1. *Engineering Mathematics* by K.A. Stroud withDexter J. Booth, Macmillan, 2020.
2. *Advanced Engineering Mathematics* by Larry Turyn, Taylor and Francis, 2014.
3. *Advanced Engineering Mathematics* by Dennis G. Zill, Jones & Bartlett Learning, 2018.
4. *Advanced Engineering Mathematics with MATLAB* by Dean G. Duffy, Taylor and Francis, 2017.
5. *Advanced Engineering Mathematics* by Merle C. Potter, Jack L. Lessing, and Edward F. Aboufadel, Springer (Switzerland), 2019.
6. *Mathematical Methods for Physics and Engineering*, by K. F. Riley, M. P. Hobson and S. J. Bence, CUP, 2013.

PaperCode: ES-114	**Paper: Engineering Mechanics**	**L**	**T/P**	**C**
		3	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart knowledge to solve problems pertaining to force systems, equilibrium and distributed systems.
2:	To impart knowledge to solve problems of friction and engineering trusses.
3:	To impart knowledge to deal with the problems of kinematics and kinetics of particle
4:	To impart knowledge to deal with the problems of kinematics and kinetics of rigid bodies.

Course Outcomes (CO):

CO1	Ability to solve problems pertaining to force systems, equilibrium and distributed systems.
CO2	Ability to solve problems of friction and engineering trusses.
CO3	Ability to deal with the problems of kinematics and kinetics of particle
CO4	Ability to deal with the problems of kinematics and kinetics of rigid bodies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	3	3	2	-	-	-	1	1	1	2
CO2	3	3	3	3	2	-	-	-	1	1	1	2
CO3	3	3	3	3	2	-	-	-	1	1	1	2
CO4	3	3	3	3	2	-	-	-	1	1	1	2

Unit I

Force System: Introduction, force, principle of transmissibility of force, resultant of a force system, resolution of a force, moment of force about a line, Varigon's theorem, couple, resolution of force into force and a couple, properties of couple and their application to engineering problems.
Equilibrium: Force body diagram, equations of equilibrium and their applications to engineering problems, equilibrium of two force and three force members.
Distributed Forces: Determination of center of gravity, center of mass and centroid by direct integration and by the method of composite bodies, mass moment of inertia and area moment of inertia by direct integration and composite bodies method, radius of gyration, parallel axis theorem, polar moment of inertial. [10Hrs]

Unit II

Structure: Plane truss, perfect and imperfect truss, assumption in the truss analysis, analysis of perfect plane trusses by the method of joints, method of section and graphical method.

Friction: Static and Kinetic friction, laws of dry friction, co-efficient of friction, angle of friction, angle of repose, cone of friction, frictional lock, friction in flat pivot and collar bearing, friction in flat belts. [10Hrs]

Unit III

Kinematics of Particles: Rectilinear motion, plane curvilinear motion, rectangular coordinates, normal and tangential coordinates.
Kinetics of Particles: Equation of motion, rectilinear motion and curvilinear motion, work-energy equation, conservation of energy, concept of impulse and momentum, conservation of momentum, impact of bodies, co-efficient of restitution, loss of energy during impact. [10Hrs]

Unit IV

Kinematics of Rigid Bodies: Concept of rigid body, types of rigid body motion, absolute motion, introduction to relative velocity, relative acceleration (Corioli's component excluded) and instantaneous center of zero velocity, Velocity and acceleration.
Kinetics of Rigid Bodies: Equation of motion, translatory motion and fixed axis rotation, application of work energy principles to rigid bodies conservation of energy.
Beam: Introduction, types of loading, methods for the reactions of a beam, space diagram, types of end supports, beams subjected to couple. [10Hrs]

Textbooks:
1.*Engineering Mechanics* by A.K.Tayal, Umesh Publications.

References:
1. *'Engineering Mechanics'* by K. L. Kumar, Tata Mc-Graw Hill
2. *'Engineering Mechanics'* by S. Timoshenko, D. H. Young, J. V. Rao, Tata Mc-Graw Hill
3. *'Engineering Mechanics-Statics and Dynamics'* by Irwing H. Shames, PHI.
4. *'Engineering Mechanics'* by Basudev Bhattacharya, Oxford University Press.

PaperCode: BS-152	Paper: Applied Physics - II Lab.	L	P	C
		-	2	1

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Applied Physics - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institiution in which the paper is being offered from the list of practicals below. Atleast 8 experiments must be performed by the students

1. To determine the e/m ratio of an electron by J.J. Thomson method.
2. To measure the frequency of a sine-wave voltage obtained from signal generator and to obtain lissajous pattern on the CRO screen by feeding two sine wave signals from two signal generators.
3. To determine the frequency of A.C. mains by using Sonometer.
4. To determine the frequency of electrically maintained tuning fork by Melde's method.
5. Computer simulation (simple application of Monte Carlo): Brownian motion, charging & discharging of a capacitor.
6. To study the charging and discharging of a capacitor and to find out the time constant.
7. To study the Hall effect.
8. To verify Stefan's law.
9. To determine the energy band gap of a semiconductor by four probe method/or by measuring the variation of reverse saturation current with temperature.
10. To study the I-V characteristics of Zener diode.
11. To find the thermal conductivity of a poor conductor by Lee's disk method.
12. To study the thermo emf using thermocouple and resistance using Pt. Resistance thermometer.

Note: Teacher's may use the prescribed books to choose the practicals in addition to above. Total 8 practicals minimum shall be performed by the students, they may be asked to do more. Atleast 4 experiments must be from the above list.

Textbook:
1. *B.Sc. Practical Physics* by C. L. Arora, S.Chand & Co., 2020.
2. *Practical physics* by R. K. Shukla and A. Srivastava, New Age Int. (P) Ltd., 2006.

PaperCode: ES-158	Paper: Engineering Graphics-II	L	P	C
		-	2	1

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Course Objectives:

1:	The students will learn sectioning of solid figures.
2:	The students will understand 3D projections. They will have understanding of isometric and oblique projections.
3:	The students will have understanding of perspective projections,
4:	The students will learn computer aided drafting.

Course Outcomes (CO):

CO1	Ability to draw sectional diagrams of solids
CO2	Ability to draw 3S projections (isometric and oblique).
CO3	Ability to draw perspective projections.
CO4	Understand and use a CAD tool (AutoCAD).

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	3	3	2	-	-	-	1	2	1	2
CO2	3	3	3	3	2	-	-	-	1	2	1	2
CO3	3	3	3	3	2	-	-	-	1	2	1	2
CO4	3	3	3	3	2	-	-	-	1	2	1	2

Unit I

Section of Solids: Definition of Sectioning and its purpose, Procedure of Sectioning, Illustration through examples, Types of sectional planes-application to few examples.

Unit II

Isometric Projection: Classification of pictorial views, Basic Principle of Isometric projection, Difference between isometric projection and drawing, Isometric projection of solids such as cube, prism, pyramid and cylinder.

Oblique Projection: Principle of oblique projection, difference between oblique projection and isometric projection, receding lines and receding angles, oblique drawing of circle, cylinder, prism and pyramid.

Unit III

Perspective Projection: Principle of perspective projection, definitions of perspective elements, visual ray method, vanishing point method.

Conversion of 3D to 2D figures.

Unit IV

Introduction to CADD: Interfacing and Introduction to CAD Software, Coordinate System, 2D drafting: lines, circles, arc, polygon, etc., Dimensioning, 2-D Modelling, Use of CAD Software for engineering drawing practices.

Note: The sheets to be created shall be notified by the concerned teacher.

Textbooks:

1. *Engineering Drawing* by N.D. Bhatt, 53rd Ed., Charotar Publishing House Pvt. Ltd., Gujarat,2017.

References:

1. *Engineering Drawing* by P.S. Gill, S.K Kataria & Sons, New Delhi, 2013.
2. *Technical Drawing with Engineering Graphics* by Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, and Cindy M. Johnson, 15th Ed., Prentice Hall, USA, 2016
3. *Engineering Drawing* by M.B. Shah and B.C. Rana, 3rd Ed., Pearson Education, New Delhi, 2009.
4. *AutoCAD 2017 for Engineers & Designers* by Sham Tickoo,, Dreamtech Press 2016.

PaperCode: ES-164	Paper: Workshop Technology	L	P	C
		-	4	2

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

Course Objectives:

1:	The students will learn basics of safety precautions to be taken in lab. / workshop
2:	The students will have an overview of different machines used in workshop and the operations performed on these machines.
3:	The students will have understanding of various welding processes.
4:	The students will have understanding of sheet metals hop and fitting shop

Course Outcomes (CO):

CO1	Ability to safely work in a Lab./workshop.
CO2	Ability to use machines (lathe, mill, shaper, planer, grinder, drill).
CO3	Ability to weld.
CO4	Ability to use sheet metal tools and fitting shop tools.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	1	2	2	3	3	-	-	-	-	-	2
CO2	2	1	2	2	3	1	-	-	-	-	-	2
CO3	2	1	2	2	3	1	-	-	-	-	-	2
CO4	2	1	2	2	3	1	-	-	-	-	-	2

Unit I

Safety, precautions and maintenance: Safety in shop, safety devices, safety and precautions - moving machine and equipment parts, electrical parts and connections, fire, various driving systems like chain, belt and ropes, electrical accidents, an overview of predictive, preventive and scheduled maintenance, standard guidelines to be followed in shop.

Unit II

Introduction to machine shop: Introduction to Lathe, Milling, shaper, Planer, grinder, drilling and overview of operations performed on these machines by making some jobs.

Unit III

Introduction to welding shop: Welding, types of welding, tools and applications, gas welding and arc welding, edge preparation, various joints formation by gas welding and electric arc welding.

Unit IV

Introduction to sheet metal shop: Sheet metal tools and operations, formation of a box using sheet. Introduction to fitting shop: Introduction to fitting, tools and applications, some jobs in fitting shop.

Textbooks:

1. *Workshop Technology Vol. 1 and Vol. 2*, Hajra Choudhary and Roy, Media Promoters and Publishers, 2018.

References:

1. *A course in Workshop Technology Vol.1 and Vol. 2*, B. S. Raghuvanshi, Dhanpat Rai and Compnay, 2015.
2. *Workshop Technology (Manufacturing Processes)*, Khurmi and Gupta, S. Chand Publication, 2010.

2nd Year Onward Scheme and implementation guideline for Core Branches (Major / Primary Disciplines), namely:

1. **Computer Science and Engineering (CSE)**
2. **Information Technology (IT)**
3. **Computer Science and Technology (CST)**
4. **Information Technology and Engineering (ITE)**
5. **Electronics and Communications Engineering (ECE)**
6. **Electrical Engineering (EE)**
7. **Electrical and Electronics Engineering (EEE)**
8. **Mechanical Engineering (ME)**
9. **Instrumentation and Control Engineering (ICE)**
10. **Civil Engineering (CE)**

Bachelor of Technology in Computer Science and Engineering (CSE)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***<u>NUES</u>:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****<u>NUES</u>:**Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
  i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
  ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
  iii. Attendance / Class Participation - 5 Marks
(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
  i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
  ii. Practical File - 10 Marks
  iii. Attendance / Lab Participation - 10 Marks

***** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	CIE-306T	Advanced Java Programming	3		3
	CIE-306P	Advanced Java Programming Lab		2	1
6	CIE-308T	Visual Basic.NET Programming	3		3
	CIE-308P	Visual Basic.NET Programming Lab		2	1
6	CIE-312	Engineering Optimization	4		4
6	CIE-320	Principles of Programming Languages	4		4
6	CIE-322T	Simulation and Modelling	3		3
	CIE-322P	Simulation and Modelling Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-330T	Introduction to Internet of Things	3		3
	CIE-330P	Introduction to Internet of Things Lab		2	1
6	CIE-332T	Programming in Python	3		3
	CIE-332P	Programming in Python Lab		2	1
6	CIE-334	Quantum Computing	4		4
6	CIE-338T	Graph Theory for Computer Science	3		3
	CIE-338P	Graph Theory for Computer Science Lab		2	1
6	CIE-348T	Software Project Management	3		3
	CIE-348P	Software Project Management Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-354T	Introduction to Digital Signal Processing	3		3
	CIE-354P	Introduction to Digital Signal Processing Lab		2	1
6	CIE-356T	Web Technologies	3		3
	CIE-356P	Web Technologies Lab		2	1
6	CIE-368T	Mobile Computing	3		3
	CIE-368P	Mobile Computing Lab		2	1
6	CIE-370T	Parallel Computing	3		3
	CIE-370P	Parallel Computing Lab		2	1
6	CIE-374T	Artificial Intelligence	3		3
	CIE-374P	Artificial Intelligence Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-403T	Blockchain Technology	3		3
	CIE-403P	Blockchain Technology Lab		2	1
7	CIE-405T	Data Science	3		3
	CIE-405P	Data Science Lab		2	1
7	CIE-407T	Distributed Systems and Cloud Computing	3		3
	CIE-407P	Distributed Systems and Cloud Computing Lab		2	1
7	CIE-409T	Social Network Analysis and Sentiment Analysis	3		3
	CIE-409P	Social Network Analysis and Sentiment Analysis Lab		2	1
7	CIE-413T	Next Generation Web	3		3
	CIE-413P	Next Generation Web Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-417T	C#.NET Programming	3		3
	CIE-417P	C#.NET Programming Lab		2	1
7	CIE-419	Intellectual Property Rights	4		4
7	CIE-421T	Machine Learning	3		3
	CIE-421P	Machine Learning Lab		2	1
7	CIE-425T	Data Warehousing and Data Mining	3		3
	CIE-425P	Data Warehousing and Data Mining Lab		2	1
7	CIE-431T	Web Mining	3		3
	CIE-431P	Web Mining Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters)for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	**Semester (Credits)**						**Total Credits**	**Mandatory Credits**
	III	**IV**	**V**	**VI**	**VII**	**VIII**		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: “***Bachelor of Technology in Computer Science and Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)”***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: “***Bachelor of Technology in Computer Science and Engineering”;*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: “***Bachelor of Technology in Computer Science and Engineering (Honours)***”, if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1or Table 2 (as applicable)**and **Clause 6**), then the student shall be award the degree as “***Bachelor of Technology in Computer Science and Engineering”.*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the

Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.

21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
22. **The medium of instructions shall be English.**

Bachelor of Technology in Information Technology (IT)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	**Paper Code**	**PCE – 1 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-306T	Advanced Java Programming	3		3
	CIE-306P	Advanced Java Programming Lab		2	1
6	CIE-308T	Visual Basic.NET Programming	3		3
	CIE-308P	Visual Basic.NET Programming Lab		2	1
6	CIE-314	Advanced Computer Architecture	4		4
6	CIE-316	Database Modelling and Design	4		4
6	CIE-328T	Analog and Digital Communications	3		3
	CIE-328P	Analog and Digital Communications Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-330T	Introduction to Internet of Things	3		3
	CIE-330P	Introduction to Internet of Things Lab		2	1
6	CIE-332T	Programming in Python	3		3
	CIE-332P	Programming in Python Lab		2	1
6	CIE-334	Quantum Computing	4		4
6	CIE-336	E-Commerce and M-Commerce	4		4
6	CIE-344T	Object Oriented Analysis and Design using UML	3		3
	CIE-344P	Object Oriented Analysis and Design using UML Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-354T	Introduction to Digital Signal Processing	3		3
	CIE-354P	Introduction to Digital Signal Processing Lab		2	1
6	CIE-356T	Web Technologies	3		3
	CIE-356P	Web Technologies Lab		2	1
6	CIE-360T	Introduction to Information and Communication Theory	3		3
	CIE-360P	Introduction to Information and Communication Theory Lab		2	1
6	CIE-366T	Middleware Technologies	3		3
	CIE-366P	Middleware Technologies Lab		2	1
6	CIE-374T	Artificial Intelligence	3		3
	CIE-374P	Artificial Intelligence Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-403T	Blockchain Technology	3		3
	CIE-403P	Blockchain Technology Lab		2	1
7	CIE-405T	Data Science	3		3
	CIE-405P	Data Science Lab		2	1
7	CIE-407T	Distributed Systems and Cloud Computing	3		3
	CIE-407P	Distributed Systems and Cloud Computing Lab		2	1
7	CIE-409T	Social Network Analysis and Sentiment Analysis	3		3
	CIE-409P	Social Network Analysis and Sentiment Analysis Lab		2	1
7	CIE-415T	Wireless Communication and Networks	3		3
	CIE-415P	Wireless Communication and Networks Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-417T	C#.NET Programming	3		3
	CIE-417P	C#.NET Programming Lab		2	1
7	CIE-419	Intellectual Property Rights	4		4
7	CIE-421T	Machine Learning	3		3
	CIE-421P	Machine Learning Lab		2	1
7	CIE-427	Introduction to Mobile Ad Hoc Networks	4		4
7	CIE-431T	Web Mining	3		3
	CIE-431P	Web Mining Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Information Technology with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Information Technology with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Information Technology";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Information Technology (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Information Technology".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the

Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.

21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.

22. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Technology (CST)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES**:Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

******The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	**Paper Code**	**PCE – 1 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-306T	Advanced Java Programming	3		3
	CIE-306P	Advanced Java Programming Lab		2	1
6	CIE-308T	Visual Basic.NET Programming	3		3
	CIE-308P	Visual Basic.NET Programming Lab		2	1
6	CIE-310T	Advanced DBMS	3		3
	CIE-310P	Advanced DBMS		2	1
6	CIE-312	Engineering Optimization	4		4
6	CIE-324	Software Testing	4		4
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-330T	Introduction to Internet of Things	3		3
	CIE-330P	Introduction to Internet of Things Lab		2	1
6	CIE-332T	Programming in Python	3		3
	CIE-332P	Programming in Python Lab		2	1
6	CIE-334	Quantum Computing	4		4
6	CIE-340	IT Project Management	4		4
6	CIE-346T	Service Oriented Architecture	3		3
	CIE-346P	Service Oriented Architecture Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-354T	Introduction to Digital Signal Processing	3		3
	CIE-354P	Introduction to Digital Signal Processing Lab		2	1
6	CIE-356T	Web Technologies	3		3
	CIE-356P	Web Technologies Lab		2	1
6	CIE-358T	Human Computer Interface	3		3
	CIE-358P	Human Computer Interface Lab		2	1
6	CIE-372T	Software Requirements and Estimation	3		3
	CIE-372P	Software Requirements and Estimation Lab		2	1
6	CIE-374T	Artificial Intelligence	3		3
	CIE-374P	Artificial Intelligence Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-403T	Blockchain Technology	3		3
	CIE-403P	Blockchain Technology Lab		2	1
7	CIE-405T	Data Science	3		3
	CIE-405P	Data Science Lab		2	1
7	CIE-407T	Distributed Systems and Cloud Computing	3		3
	CIE-407P	Distributed Systems and Cloud Computing Lab		2	1
7	CIE-409T	Social Network Analysis and Sentiment Analysis	3		3
	CIE-409P	Social Network Analysis and Sentiment Analysis Lab		2	1
7	CIE-411T	Computer Graphics and Multimedia Technologies	3		3
	CIE-411P	Computer Graphics and Multimedia Technologies Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-417T	C#.NET Programming	3		3
	CIE-417P	C#.NET Programming Lab		2	1
7	CIE-419	Intellectual Property Rights	4		4
7	CIE-421T	Machine Learning	3		3
	CIE-421P	Machine Learning Lab		2	1
7	CIE-423T	Data Visualization	3		3
	CIE-423P	Data Visualization Lab		2	1
7	CIE-425T	Data Warehousing and Data Mining	3		3
	CIE-425P	Data Warehousing and Data Mining Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Technology with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Technology with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Technology";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Technology (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Technology".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the

Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.

21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
22. **The medium of instructions shall be English.**

Bachelor of Technology in Information Technology and Engineering (ITE)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	CIE-306T	Advanced Java Programming	3		3
	CIE-306P	Advanced Java Programming Lab		2	1
6	CIE-308T	Visual Basic.NET Programming	3		3
	CIE-308P	Visual Basic.NET Programming Lab		2	1
6	CIE-310T	Advanced DBMS	3		3
	CIE-310P	Advanced DBMS Lab		2	1
6	CIE-318T	Network Security and Cryptography	3		3
	CIE-318P	Network Security and Cryptography Lab		2	1
6	CIE-326T	VHDL Programming	3		3
	CIE-326P	VHDL Programming Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-330T	Introduction to Internet of Things	3		3
	CIE-330P	Introduction to Internet of Things Lab		2	1
6	CIE-332T	Programming in Python	3		3
	CIE-332P	Programming in Python Lab		2	1
6	CIE-334	Quantum Computing	4		4
6	CIE-342T	Multimedia Technologies	3		3
	CIE-342P	Multimedia Technologies Lab		2	1
6	CIE-350	Windows System Administration	4		4
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-354T	Introduction to Digital Signal Processing	3		3
	CIE-354P	Introduction to Digital Signal Processing Lab		2	1
6	CIE-356T	Web Technologies	3		3
	CIE-356P	Web Technologies Lab		2	1
6	CIE-362T	Linux System Administration	3		3
	CIE-362P	Linux System Administration Lab		2	1
6	CIE-364T	Microprocessors and Interfacing	3		3
	CIE-364P	Microprocessors and Interfacing Lab		2	1
6	CIE-374T	Artificial Intelligence	3		3
	CIE-374P	Artificial Intelligence Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-403T	Blockchain Technology	3		3
	CIE-403P	Blockchain Technology Lab		2	1
7	CIE-405T	Data Science	3		3
	CIE-405P	Data Science Lab		2	1
7	CIE-407T	Distributed Systems and Cloud Computing	3		3
	CIE-407P	Distributed Systems and Cloud Computing Lab		2	1
7	CIE-409T	Social Network Analysis and Sentiment Analysis	3		3
	CIE-409P	Social Network Analysis and Sentiment Analysis Lab		2	1
7	CIE-411T	Computer Graphics and Multimedia Technologies	3		3
	CIE-411P	Computer Graphics and Multimedia Technologies Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-417T	C#.NET Programming	3		3
	CIE-417P	C#.NET Programming Lab		2	1
7	CIE-419	Intellectual Property Rights	4		4
7	CIE-421T	Machine Learning	3		3
	CIE-421P	Machine Learning Lab		2	1
7	CIE-423T	Data Visualization	3		3
	CIE-423P	Data Visualization Lab		2	1
7	CIE-429T	Web Intelligence and Big Data Analytics	3		3
	CIE-429P	Web Intelligence and Big Data Analytics Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Information Technology and Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Information Technology and Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Information Technology and Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Information Technology and Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Information Technology and Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.
17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**
18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).
19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
22. **The medium of instructions shall be English.**

Bachelor of Technology in Electronics and Communications Engineering (ECE)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	ECC-205	Signals and Systems	3		3
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	ECC-209	Analog Communications	4		4
PC	ECC-211	Analog Electronics-I	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	ECC-255	Analog Communications Lab		2	1
PC	ECC-257	Analog Electronics-I Lab		2	1
PC	ECC-259	Signals and Systems Lab		2	1
Total			**21**	**10**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	EEC-206	Network Analysis and Synthesis	3		3
PC	ECC-210	Microprocessors and Microcontrollers	3		3
PC	ECC-212	Digital Communications	3		3
PC	ECC-214	Analog Electronics-II	3		3
PC	ECC-216	Electromagnetic Field Theory	3		3
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	ECC-256	Microprocessors and Microcontrollers Lab		2	1
PC	ECC-258	Digital Communications Lab		2	1
PC	ECC-260	Analog Electronics-II Lab		2	1
PC	EEC-262	Network Analysis and Synthesis Lab		2	1
Total			**21**	**10**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	ECC-303	Digital Signal Processing	4		4
PC	ECC-305	Microelectronics	3		3
PC	EEC-307	Introduction to Control Systems	3		3
PC	ECC-309	Transmission Lines, Waveguides and Antenna Design	4		4
PC	ECC-311	Data Communication and Networking	4		4
Practical / Viva Voce					
PC	ECC-351	Digital Signal Processing Lab		2	1
PC	ECC-353	Microelectronics Lab		2	1
PC	EEC-355	Introduction to Control Systems Lab		2	1
PC	ECC-357	Transmission Lines, Waveguides and Antenna Design Lab		2	1
PC	ECC-359	Data Communication and Networking Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

******The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***<u>NUES</u>: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	ECE-306T	VHDL Programming	3		3
	ECE-306P	VHDL Programming Lab		2	1
6	ECE-308T	Digital Image Processing	3		3
	ECE-308P	Digital Image Processing Lab		2	1
6	ECE-310	Mobile Communication	4		4
6	ECE-312T	Advanced Microprocessors and Microcontroller	3		3
	ECE-312P	Advanced Microprocessors and Microcontroller Lab		2	1
6	ECE-314T	RF and Microwave Engineering	3		3
	ECE-314P	RF and Microwave Engineering Lab		2	1
6	ECE-316T	Mobile Computing	3		3
	ECE-316P	Mobile Computing Lab		2	1
6	ECE-318T	Artificial Intelligence	3		3
	ECE-318P	Artificial Intelligence Lab		2	1
6	ECE-320T	Electronic Measurements	3		3
	ECE-320P	Electronic Measurements Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	ECE-322T	Fabrication Technology	3		3
	ECE-322P	Fabrication Technology Lab		2	1
6	ECE-324	Multimedia Communication	4		4
6	ECE-326T	Optical Communication Systems and Networks	3		3
	ECE-326P	Optical Communication Systems and Networks Lab		2	1
6	ECE-328	Advanced Computer Architecture	4		4
6	ECE-330T	Antenna Design and Radiating Systems	3		3
	ECE-330P	Antenna Design and Radiating Systems Lab		2	1
6	ECE-332	Introduction to Information and Coding Theory	4		4
6	ECE-334T	Random Processes and Stochastic Systems	3		3
	ECE-334P	Random Processes and Stochastic Systems Lab		2	1
6	ECE-336T	Radio and Television Engineering	3		3
	ECE-336P	Radio and Television Engineering Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	ECE-338T	CMOS Analog Integrated Circuit Design	3		3
	ECE-338P	CMOS Analog Integrated Circuit Design Lab		2	1
6	ECE-340T	Wavelets	3		3
	ECE-340P	Wavelets Lab		2	1
6	ECE-342T	Wireless Sensor Networks	3		3
	ECE-342P	Wireless Sensor Networks Lab		2	1
6	ECE-344T	Embedded System Architecture and Design	3		3
	ECE-344P	Embedded System Architecture and Design Lab		2	1
6	ECE-346	Solid State Microwave Device and their application	4		4
6	ECE-348	Radar and Satellite Communications	4		4
6	ECE-350T	Machine Learning	3		3
	ECE-350P	Machine Learning Lab		2	1
6	ECE-354T	Introduction to Power Electronics	3		3
	ECE-354P	Introduction to Power Electronics Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	ECE-403T	RF Components and Circuit Design	3		3
	ECE-403P	RF Components and Circuit Design Lab		2	1
7	ECE-405T	Pattern Recognition	3		3
	ECE-405P	Pattern Recognition Lab		2	1

7	ECE-407	Next Generation Networks	4		4
7	ECE-409T	Micro-electromechanical Systems (MEMS) and Sensors	3		3
	ECE-409P	Micro-electromechanical Systems (MEMS) and Sensors Lab		2	1
7	ECE-411T	Fuzzy Logic and Neural Networks	3		3
	ECE-411P	Fuzzy Logic and Neural Networks Lab		2	1
7	ECE-413T	Ad hoc and Sensor Networks	3		3
	ECE-413P	Ad hoc and Sensor Networks Lab		2	1
7	ECE-415	Engineering Optimization	4		4
7	ECE-417T	Optoelectronics Devices	3		3
	ECE-417P	Optoelectronics Devices Lab		2	1
7	ECE-435T	Logic Design and Analysis using Verilog	3		3
	ECE-435P	Logic Design and Analysis using Verilog Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	ECE-419T	Low Power VLSI Design	3		3
	ECE-419P	Low Power VLSI Design Lab		2	1
7	ECE-421T	Medical Image Processing, Analysis and Reconstruction	3		3
	ECE-421P	Medical Image Processing, Analysis and Reconstruction Lab		2	1
7	ECE-423T	Network Security and Cryptography	3		3
	ECE-423P	Network Security and Cryptography Lab		2	1
7	ECE-425	Real Time Operating Systems	4		4
7	ECE-427T	Smart Antennas	3		3
	ECE-427P	Smart Antennas Lab		2	1
7	ECE-429T	Introduction to Internet of Things	3		3
	ECE-429P	Introduction to Internet of Things Lab		2	1
7	ECE-431T	Nature Inspired Biological Optimization Techniques	3		3
	ECE-431P	Nature Inspired Biological Optimization Techniques Lab		2	1
7	ECE-433	Introduction to Robotics Engineering	4		4

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Electronics and Communications Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Electronics and Communications Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Electronics and Communications Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Electronics and Communications Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Electronics and Communications Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
22. **The medium of instructions shall be English.**

Bachelor of Technology in Electrical Engineering (EE)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	ECC-205	Signals and Systems	3		3
PC	EEC-209	Electrical Materials	3		3
PC	EEC-211	Electrical Machines - I	4		4
PC	ECC-213	Electromagnetic Field Theory	3		3
PC	ECC-215	Electronics – I	3		3
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	EEC-257	Electrical Machines – I Lab		2	1
PC	EEC-259	Electrical Engineering Workshop		2	1
PC	ECC-261	Electronics - I Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	EEC-206	Network Analysis and Synthesis	3		3
PC	EEC-210	Electrical Machines - II	4		4
PC	EEC-212	Power Systems - I	4		4
PC	ECC-218	Electronics - II	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-256	Electrical Machines - II Lab		2	1
PC	EEC-260	Power Systems - I Lab		2	1
PC	EEC-262	Network Analysis and Synthesis Lab		2	1
PC	ECC-264	Electronics - II Lab		2	1
Total			**21**	**10**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	EEC-303	Power Systems – II	4		4
PC	EEC-305	Electrical and Electronics Measuring Instruments	4		4
PC	EEC-307	Introduction to Control Systems	3		3
PC	EEC-309	Power Electronics	4		4
PC	ECC-313	Microprocessors and Microcontrollers	3		3
Practical / Viva Voce					
PC	EEC-351	Power Systems – II Lab		2	1
PC	EEC-353	Electrical and Electronics Measuring Instruments Lab		2	1
PC	EEC-355	Introduction to Control Systems Lab		2	1
PC	EEC-357	Power Electronics Lab		2	1
PC	ECC-363	Microprocessors and Microcontrollers Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	**Paper Code**	**PCE – 1 (Choose Any One)**	**L**	**P**	**Credits**
6	EEE-308	Artificial Intelligence and Machine Learning for Electrical Systems	4		4
6	EEE-310T	Bio Medical Instrumentation	3		3
	EEE-310P	Bio Medical Instrumentation Lab		2	1
6	EEE-312T	Introduction to Digital Signal Processing	3		3
	EEE-312P	Introduction to Digital Signal Processing Lab		2	1
6	EEE-318	Stochastic Processes and Systems	4		4
6	EEE-320T	Utilization of Electrical Energy	3		3
	EEE-320P	Utilization of Electrical Energy Lab		2	1
6	EEE-358	Electrical Power Generation Systems	4		4
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	EEE-322T	Computer Aided Electrical Machine Design	3		3
	EEE-322P	Computer Aided Electrical Machine Design Lab		2	1
6	EEE-324T	Introduction to Data Communication and Networking	3		3
	EEE-324P	Introduction to Data Communication and Networking Lab		2	1
6	EEE-326T	Discrete Control Systems	3		3
	EEE-326P	Discrete Control Systems Lab		2	1
6	EEE-334T	Research Methodology for Electrical & Electronics Engineering	3		3
	EEE-334P	Research Methodology for Electrical & Electronics Engineering Lab		2	1
6	EEE-336T	Introduction to Transmission Lines, Waveguides and Antenna Design	3		3
	EEE-336P	Introduction to Transmission Lines, Waveguides and Antenna Design Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	EEE-340T	Electric Drives	3		3
	EEE-340P	Electric Drives Lab		2	1
6	EEE-356T	Optimization using Controllers	3		3
	EEE-356P	Optimization using Controllers lab		2	1
6	EEE-360	Process Control	4		4
6	EEE-362T	VLSI	3		3
	EEE-362P	VLSI Lab		2	1
6	EEE-364T	Systems Design and Simulation	3		3
	EEE-364P	Systems Design and Simulation Lab		2	1
6	EEE-366	Introduction to Information and Coding Theory	4		4
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	EEE-403	Electricity Distribution Schemes and Policies	4		4
7	EEE-405T	Mathematical Analysis of Complex Systems	3		3
	EEE-405P	Mathematical Analysis of Complex Systems Lab		2	1
7	EEE-407	Renewable Energy and Policies	4		4
7	EEE-409T	Solid State Drives	3		3
	EEE-409P	Solid State Drives Lab		2	1
7	EEE-411T	Switchgear and Protection	3		3
	EEE-411P	Switchgear and Protection Lab		2	1
7	EEE-413T	Digital Image Processing	3		3
	EEE-413P	Digital Image Processing Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	EEE-421T	e-Mobility	3		3
	EEE-421P	e-Mobility Lab		2	1
7	EEE-423	Energy Conservation Schemes	4		4
7	EEE-425	Energy Economics and Policies	4		4
7	EEE-427	High Voltage Engineering	4		4

7	EEE-429T	Mathematical Model for Reliability of Transmission and Distribution	3		3
	EEE-429P	Mathematical Model for Reliability of Transmission and Distribution Lab		2	1
7	EEE-431	Smart Grid and Distributed Generation	4		4
7	EEE-433T	Systems Restructuring for Optimization	3		3
	EEE-433P	Systems Restructuring for Optimization Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Electrical Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Electrical Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Electrical Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Electrical Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Electrical Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the

Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.

21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.

22. **The medium of instructions shall be English.**

Bachelor of Technology in Electrical and Electronics Engineering (EEE)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	ECC-205	Signals and Systems	3		3
PC	EEC-209	Electrical Materials	3		3
PC	EEC-211	Electrical Machines - I	4		4
PC	ECC-213	Electromagnetic Field Theory	3		3
PC	ECC-215	Electronics – I	3		3
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	EEC-257	Electrical Machines – I Lab		2	1
PC	EEC-259	Electrical Engineering Workshop		2	1
PC	ECC-261	Electronics - I Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	EEC-206	Network Analysis and Synthesis	3		3
PC	EEC-210	Electrical Machines - II	4		4
PC	EEC-212	Power Systems - I	4		4
PC	ECC-218	Electronics - II	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-256	Electrical Machines - II Lab		2	1
PC	EEC-260	Power Systems - I Lab		2	1
PC	EEC-262	Network Analysis and Synthesis Lab		2	1
PC	ECC-264	Electronics - II Lab		2	1
Total			**21**	**10**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	EEC-303	Power Systems – II	4		4
PC	EEC-305	Electrical and Electronics Measuring Instruments	4		4
PC	EEC-307	Introduction to Control Systems	3		3
PC	EEC-309	Power Electronics	4		4
PC	ECC-313	Microprocessors and Microcontrollers	3		3
Practical / Viva Voce					
PC	EEC-351	Power Systems – IILab		2	1
PC	EEC-353	Electrical and Electronics Measurements Lab		2	1
PC	EEC-355	Introduction to Control Systems Lab		2	1
PC	EEC-357	Power Electronics Lab		2	1
PC	ECC-363	Microprocessors and Microcontrollers Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES**:Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
  i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
  ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
  iii. Attendance / Class Participation - 5 Marks
(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
  i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
  ii. Practical File - 10 Marks
  iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	EEE-306T	Analog and Digital Communications	3		3
	EEE-306P	Analog and Digital Communications Lab		2	1
6	EEE-308	Artificial Intelligence and Machine Learning for Electrical Systems	4		4
6	EEE-310T	Bio Medical Instrumentation	3		3
	EEE-310P	Bio Medical Instrumentation Lab		2	1
6	EEE-312T	Introduction to Digital Signal Processing	3		3
	EEE-312P	Introduction to Digital Signal Processing Lab		2	1
6	EEE-314	Powerline Carrier Communication	4		4
6	EEE-320T	Utilization of Electrical Energy	3		3
	EEE-320P	Utilization of Electrical Energy Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	EEE-324T	Introduction to Data Communication and Networking	3		3
	EEE-324P	Introduction to Data Communication and Networking Lab		2	1
6	EEE-326T	Discrete Control Systems	3		3
	EEE-326P	Discrete Control Systems Lab		2	1
6	EEE-330	Nano Electronics	4		4
6	EEE-332	Opto Electronics	4		4
6	EEE-334T	Research Methodology for Electrical & Electronics Engineering	3		3
	EEE-334P	Research Methodology for Electrical & Electronics Engineering Lab		2	1
6	EEE-336T	Introduction to Transmission Lines, Waveguides and Antenna Design	3		3
	EEE-336P	Introduction to Transmission Lines, Waveguides and Antenna Design Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	EEE-338T	Digital Systems Design	3		3
	EEE-338P	Digital Systems Design Lab		2	1
6	EEE-340T	Electric Drives	3		3
	EEE-340P	Electric Drives Lab		2	1
6	EEE-354	Electrical Power Generation Systems	4		4
6	EEE-356T	Optimization using Controllers	3		3
	EEE-356P	Optimization using Controllers lab		2	1
6	EEE-362T	VLSI	3		3
	EEE-362P	VLSI Lab		2	1
6	EEE-366	Introduction to Information and Coding Theory	4		4
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	EEE-403	Electricity Distribution Schemes and Policies	4		4
7	EEE-405T	Mathematical Analysis of Complex Systems	3		3
	EEE-405P	Mathematical Analysis of Complex Systems Lab		2	1
7	EEE-407	Renewable Energy and Policies	4		4
7	EEE-409T	Solid State Drives	3		3
	EEE-409P	Solid State Drives Lab		2	1
7	EEE-413T	Digital Image Processing	3		3
	EEE-413P	Digital Image Processing Lab		2	1
7	EEE-415T	Wireless Sensor Networks	3		3
	EEE-415P	Wireless Sensor Networks Lab		2	1
7	EEE-435T	Systems Design and Simulation	3		3
	EEE-435P	Systems Design and Simulation Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	EEE-417T	Advanced Semiconductor Devices	3		3
	EEE-417P	Advanced Semiconductor Devices Lab		2	1

7	EEE-419T	Communication Systems Analysis	3		3
	EEE-419P	Communication Systems Analysis Lab		2	1
7	EEE-421T	e-Mobility	3		3
	EEE-421P	e-Mobility Lab		2	1
7	EEE-423	Energy Conservation Schemes	4		4
7	EEE-425	Energy Economics and Policies	4		4
7	EEE-431	Smart Grid and Distributed Generation	4		4
7	EEE-433T	Systems Restructuring for Optimization	3		3
	EEE-433P	Systems Restructuring for Optimization Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Electrical and Electronics Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an

Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Electrical and Electronics Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Electrical and Electronics Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Electrical and Electronics Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Electrical and Electronics Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
22. **The medium of instructions shall be English.**

Bachelor of Technology in Instrumentation and Control Engineering (ICE)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	ICC-205	Engineering Electromagnetics	4		4
PC	EEC-207	Electrical Machines	4		4
PC	EEC-213	Circuits and Systems	4		4
PC	ECC-219	Analog Electronics	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	EEC-253	Circuits and Systems Lab		2	1
PC	EEC-255	Electrical Machines Lab		2	1
PC	ECC-265	Analog Electronics Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	ECC-206	Communication Systems	4		4
PC	ECC-208	Digital Electronics	4		4
PC	ICC-210	Sensors and Transducers	4		4
PC	EEC-214	Electrical and Electronics Measurements	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	ECC-254	Digital Electronics Lab		2	1
PC	ICC-256	Sensors and Transducers Lab		2	1
PC	EEC-258	Electrical and Electronics Measurements Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	ECC-303	Digital Signal Processing	4		4
PC	EEC-307	Introduction to Control Systems	3		3
PC	ICC-309	Industrial and Optical Instrumentation	4		4
PC	CIC-313	Computer Networks	4		4
PC	ECC-313	Microprocessors and Microcontrollers	3		3
Practical / Viva Voce					
PC	ECC-351	Digital Signal Processing Lab		2	1
PC	EEC-355	Introduction to Control Systems Lab		2	1
PC	ICC-357	Industrial and Optical Instrumentation Lab		2	1
PC	ECC-363	Microprocessors and Microcontrollers Lab		2	1
PC	CIC-365	Computer Networks Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***<u>NUES</u>:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****<u>NUES</u>:**Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	ICE-306T	Process Control	3		3
	ICE-306P	Process Control Lab		2	1
6	ICE-308	Measurement Data Analysis	4		4
6	ICE-310	Control System Components	4		4
6	ICE-312	Energy Harvesting Techniques	4		4
6	ICE-314T	Advanced Control Systems for Instrumentation	3		3
	ICE-314P	Advanced Control Systems for Instrumentation Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	ICE-316T	Embedded Systems	3		3
	ICE-316P	Embedded Systems Lab		2	1
6	ICE-318T	Industrial Automation and Control	3		3
	ICE-318P	Industrial Automation and Control Lab		2	1
6	ICE-320T	Hydraulics and Pneumatics	3		3
	ICE-320P	Hydraulics and Pneumatics Lab		2	1
6	ICE-322T	Neural Networks and Fuzzy Logic	3		3
	ICE-322P	Neural Networks and Fuzzy Logic Lab		2	1
6	ICE-324T	Smart and Wireless Instrumentation	3		3
	ICE-324P	Smart and Wireless Instrumentation Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	ICE-326T	Instrumentation Devices	3		3
	ICE-326P	Instrumentation Devices Lab		2	1
6	ICE-328T	Introduction to Internet of Things	3		3
	ICE-328P	Introduction to Internet of Things Lab		2	1
6	ICE-330T	Logic and Distributed Control	3		3
	ICE-330P	Logic and Distributed Control Lab		2	1
6	ICE-332T	Industrial Data Communication	3		3
	ICE-332P	Industrial Data Communication Lab		2	1
6	ICE-334T	Industrial Electric Drives	3		3
	ICE-334P	Industrial Electric Drives Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	ICE-403T	Virtual Instrumentation	3		3
	ICE-403P	Virtual Instrumentation Lab		2	1
7	ICE-405T	Soft Computing	3		3
	ICE-405P	Soft Computing Lab		2	1
7	ICE-407T	Bio Medical Instrumentation	3		3
	ICE-407P	Bio Medical Instrumentation Lab		2	1
7	ICE-409T	Control System Design	3		3
	ICE-409P	Control System Design Lab		2	1
7	ICE-411T	Power Plant Instrumentation	3		3
	ICE-411P	Power Plant Instrumentation Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	ICE-413T	Instrumentation System Design	3		3
	ICE-413P	Instrumentation System Design Lab		2	1
7	ICE-415T	Design of Sensors and Transducers	3		3
	ICE-415P	Design of Sensors and Transducers Lab		2	1
7	ICE-417T	Advanced Process Control	3		3
	ICE-417P	Advanced Process Control Lab		2	1
7	ICE-419T	Cyber Security for Industrial Automation	3		3
	ICE-419P	Cyber Security for Industrial Automation Lab		2	1
7	ICE-421T	Digital Control System	3		3
	ICE-421P	Digital Control System Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Instrumentation and Control Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an

Honours degree and the nomenclature shall be as: “***Bachelor of Technology in Instrumentation and Control Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)”***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: “***Bachelor of Technology in Instrumentation and Control Engineering”;*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: “***Bachelor of Technology in Instrumentation and Control Engineering (Honours)***”, if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as “***Bachelor of Technology in Instrumentation and Control Engineering”.*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
22. **The medium of instructions shall be English.**

Bachelor of Technology in Mechanical Engineering (ME)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	MEC-205	Theory of Machines	4		4
PC	MEC-207	Strength of Materials	4		4
PC	MEC-209	Manufacturing Science and Technology-I	4		4
PC	MEC-211	Thermal Engineering - I	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	MEC-253	Theory of Machines Lab		2	1
PC	MEC-255	Strength of Materials Lab		2	1
PC	MEC-257	Thermal Engineering – I Lab		2	1
PC	MEC-259	Manufacturing Science and Technology-I Lab		2	1
Total			**22**	**10**	**27**

***<u>NUES</u>:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	MEC-206	Manufacturing Science and Technology-II	4		4
PC	MEC-208	Material Science and Metallurgy	4		4
PC	MEC-210	Thermal Engineering - II	4		4
PC	MEC-212	Machine Design-I	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	MEC-254	Manufacturing Science and Technology-II Lab		2	1
PC	MEC-256	Thermal Engineering - II Lab		2	1
PC	MEC-258	Machine Design - I Lab		2	1
Total			**22**	**8**	**26**

***<u>NUES</u>:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	MEC-303	Machine Design-II	3		3
PC	MEC-305	Fluid Mechanics and Hydraulic Machines	4		4
PC	MEC-307	Metrology and Instrumentation	3		3
PC	MEC-309	Industrial Engineering	4		4
PC	MEC-311	Heat and Mass Transfer	4		4
Practical / Viva Voce					
PC	MEC-351	Machine Design-II Lab		2	1
PC	MEC-353	Fluid Mechanics and Hydraulic Machines Lab		2	1
PC	MEC-355	Metrology and Instrumentation Lab		2	1
PC	MEC-357	Heat and Mass Transfer Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**8**	**25**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor which the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***<u>NUES</u>: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	**Paper Code**	**PCE – 1 (Choose Any One)**	**L**	**P**	**Credits**
6	MEE-306T	Automobile Engineering and Electric Vehicles	3		3
	MEE-306P	Automobile Engineering and Electric Vehicles Lab		2	1
6	MEE-308T	Turbomachines	3		3
	MEE-308P	Turbomachines Lab		2	1
6	MEE-310T	Finite Element Methods	3		3
	MEE-310P	Finite Element Methods Lab		2	1
6	MEE-312T	IC Engines and Gas Turbines	3		3
	MEE-312P	IC Engines and Gas Turbines Lab		2	1
6	MEE-314T	Gas Dynamics & Jet Propulsion	3		3
	MEE-314P	Gas Dynamics & Jet Propulsion Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	MEE-316T	Refrigeration and Airconditioning	3		3
	MEE-316P	Refrigeration and Airconditioning Lab		2	1
6	MEE-318T	Power Plant Engineering	3		3
	MEE-318P	Power Plant Engineering Lab		2	1
6	MEE-320T	Mechanical Vibrations	3		3
	MEE-320P	Mechanical Vibrations Lab		2	1
6	MEE-322T	Reliability & Maintenance Engineering	3		3
	MEE-322P	Reliability & Maintenance Engineering Lab		2	1
6	MEE-324T	Advanced Machine Design	3		3
	MEE-324P	Advanced Machine Design Lab		2	1
6	MEE-326T	Introduction to CAD/CAM	3		3
	MEE-326P	Introduction to CAD/CAM Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	MEE-328T	Robotics Engineering	3		3
	MEE-328P	Robotics Engineering Lab		2	1
6	MEE-330T	Advance Material Science and Metallurgy	3		3
	MEE-330P	Advance Material Science and Metallurgy Lab		2	1
6	MEE-332T	Metal Forming and Press Working	3		3
	MEE-332P	Metal Forming and Press Working Lab		2	1
6	MEE-334T	Advances in Welding & Casting	3		3
	MEE-334P	Advances in Welding & Casting Lab		2	1
6	MEE-336T	System Modeling, simulation and Analysis	3		3
	MEE-336P	System Modeling, Simulation and Analysis Lab		2	1
6	MEE-338T	Elastic & Plastic Behaviour of Materials	3		3
	MEE-338P	Elastic & Plastic Behaviour of Materials Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	MEE-403T	Geometric Modelling and Analysis	3		3
	MEE-403P	Geometric Modelling and Analysis Lab		2	1
7	MEE-405T	Computer integrated Manufacturing	3		3
	MEE-405P	Computer integrated Manufacturing Lab		2	1
7	MEE-407T	Control Systems and Applications	3		3
	MEE-407P	Control Systems and Applications Lab		2	1
7	MEE-409T	Rapid prototyping Tooling and Manufacturing	3		3
	MEE-409P	Rapid prototyping Tooling and Manufacturing Lab		2	1
7	MEE-411T	Automation in Manufacturing	3		3
	MEE-411P	Automation in Manufacturing Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	MEE-413T	Strength of Materials-II	3		3
	MEE-413P	Strength of Materials-II Lab		2	1

7	MEE-415T	Design of Mechanical Drives	3		3
	MEE-415P	Design of Mechanical Drives Lab		2	1
7	MEE-417T	Design of Experiments	3		3
	MEE-417P	Design of Experiments Lab		2	1
7	MEE-419T	Advance Metal Cutting and Tool Design	3		3
	MEE-419P	Advance Metal Cutting and Tool Design Lab		2	1
7	MEE-421T	Design of Mechanical Assemblies	3		3
	MEE-421P	Design of Mechanical Assemblies Lab		2	1
7	MEE-423T	Non Traditional Manufacturing	3		3
	MEE-423P	Non Traditional Manufacturing Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	**Semester (Credits)**						**Total Credits**	**Mandatory Credits**
	III	**IV**	**V**	**VI**	**VII**	**VIII**		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Mechanical Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Mechanical Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Mechanical Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Mechanical Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Mechanical Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the

Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.

21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
22. **The medium of instructions shall be English.**

Bachelor of Technology in Civil Engineering (CE)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CEC-205	Structural Analysis - I	4		4
PC	CEC-207	Structural Design - I	4		4
PC	CEC-209	Fluid Mechanics	4		4
PC	CEC-211	Geomatics Engineering	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	CEC-253	Civil Engineering Drawing Lab		2	1
PC	CEC-255	Fluid Mechanics Lab		2	1
PC	CEC-257	Geomatics Engineering Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CEC-206	Soil Mechanics	4		4
PC	CEC-208	Hydraulics and Hydrology	4		4
PC	CEC-210	Environmental Engineering - I	4		4
PC	CEC-212	Transportation Engineering	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	CEC-254	Soil Mechanics Lab		2	1
PC	CEC-256	Hydraulics Lab		2	1
PC	CEC-258	Transportation Engineering Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CEC-303	Structural Analysis - II	4		4
PC	CEC-305	Structural Design - II	3		3
PC	CEC-307	Geotechnical Engineering	4		4
PC	CEC-309	Environmental Engineering - II	4		4
PC	CEC-311	Traffic Engineering and Pavement Design	4		4
Practical / Viva Voce					
PC	CEC-351	Structural Design Lab		2	1
PC	CEC-353	Building Material and Concrete Testing Lab		2	1
PC	CEC-355	Geotechnical Engineering Lab		2	1
PC	CEC-357	Environmental Engineering Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**21**	**8**	**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be doneby the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***<u>NUES</u>:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****<u>NUES</u>:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES**:Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

**The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES**: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	**Paper Code**	**PCE – 1 (Choose Any One)**	**L**	**P**	**Credits**
6	CEE-306	Advance Structural Analysis	4		4
6	CEE-308	Irrigation Engineering and Design of Hydraulic Structures	4		4
6	CEE-310	Environmental Impact Assessment	4		4
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	CEE-312T	Advanced Structural Design	3		3
	CEE-312P	Advanced Structural Design Lab		2	1
6	CEE-314	Water Resource Planning	4		4
6	CEE-316	Pollution Control and Monitoring	4		4
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	CEE-318T	Non Destructive Evaluation of Structures	3		3
	CEE-318P	Non Destructive Evaluation of Structures Lab		2	1
6	CEE-320	Open Chanel Flow and Sediment Transportation	4		4
6	CEE-322	Disaster Management	4		4
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	CEE-403	Recent Construction Technologies	4		4
7	CEE-405T	Arc GIS and Remote Sensing	3		3
	CEE-405P	Arc GIS and Remote Sensing Lab		2	1
7	CEE-407T	Transport Planning and Intelligent Transportation System	3		3
	CEE-407P	Transport Planning and Intelligent Transportation System Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	CEE-409	Structural Dynamics	4		4
7	CEE-411	Lean Construction Technology and Management	4		4
7	CEE-413T	Advanced Surveying	3		3
	CEE-413P	Advanced Surveying Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Civil Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Civil Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Civil Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Civil Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Civil Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the

Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.

21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.

22. The medium of instructions shall be English.

MINOR SPECIALIZATION TO BE OFFERED TO CORE ENGINEERING DISCIPLINES ONLY

Emerging Area Elective Groups (for Minor Specialization) – Applicable only for Core Disciplines (EAE)

The minor specialization is offered through a set of five papers that the student has to study to acquire the minor specialization. The number of papers to be studied is two in 6th semester and three in 7th semester. The minor specialization shall be awarded if and only if 20 credits are earned from an individual / specific minor specialization area. From each paper group associated with a paper slot in a particular semester, the student shall be allowed to study only one paper group. The papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Minor specialization is not necessary for award of the degree, the student may choose five papers from the groups offered by the institution to a particular student (belonging to a major discipline) across groups. Minimum two minor specialization groups should be offered by the institution to students of any particular major discipline from either of the open area or emerging area groups

An elective shall be offered to the student for each Minor Specialization group in Emerging Area (That is for EAE-1, EAE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective.

Each EAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of EAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required. The nomenclature of the paper group is *<ACRONYM OF EMERGING AREA>* - EAE - <SLOT NUMBER>< A or B or C etc., if required>. The major disciplines to which the Emerging Area Elective Group papers can be offered is specified as acronym together with the name of the minor specialization.

In lieu of Emerging Area Elective, students can study papers from Open Area Elective groups also as offered to them.

Emerging Area Specialization: Artificial Intelligence (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	AI-EAE-1	AI-302T	Artificial Intelligence	3		3
		AI-302P	Artificial Intelligence Lab		2	1
6	AI-EAE-2	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
7	AI-EAE-3	SC-401T	Soft Computing	3		3
		SC-401P	Soft Computing Lab		2	1
7	AI-EAE-4	AI-403T	Artificial Intelligence Applications	3		3
		AI-403P	Artificial Intelligence Applications Lab		2	1
7	AI-EAE-5	AI-405T	Intelligent and Expert Systems	3		3
		AI-405P	Intelligent and Expert Systems Lab		2	1

Emerging Area Specialization: Artificial Intelligence and Machine Learning (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	AIML-EAE-1	AI-302T	Artificial Intelligence	3		3
		AI-302P	Artificial Intelligence Lab		2	1
6	AIML-EAE-2	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
7	AIML-EAE-3	ML-407T	Machine Learning	3		3
		ML-407P	Machine Learning Lab		2	1
7	AIML-EAE-4	ML-409T	Reinforcement Learning and Deep Learning	3		3
		ML-409P	Reinforcement Learning and Deep Learning Lab		2	1
7	AIML-EAE-5	ML-411T	Pattern Recognition and Computer Vision	3		3
		ML-411P	Pattern Recognition and Computer Vision Lab		2	1

Emerging Area Specialization: Data Science (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	DS-EAE-1	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
6	DS-EAE-2	AI-316T	Artificial Intelligence and Machine Learning	3		3
		AI-316P	Artificial Intelligence and Machine Learning Lab		2	1
7	DS-EAE-3	DS-427T	Data Science using R	3		3
		DS-427P	Data Science using R Lab		2	1
7	DS-EAE-4	DS-429T	Big Data Analytics	3		3
		DS-429P	Big Data Analytics Lab		2	1
7	DS-EAE-5A OR	DS-431T	Business Intelligence	3		3
		DS-431P	Business Intelligence Lab		2	1
	DS-EAE-5B	DS-433T	Exploratory Data Analytics and Data Visualization	3		3
		DS-433P	Exploratory Data Analytics and Data Visualization Lab		2	1

Emerging Area Specialization: Block Chain Technology (for CSE / IT / CST / ITE/ECE/EE/EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	BT-EAE-1	CS-306T	Mathematics of Modern Cryptography	3		3
		CS-306P	Mathematics of Modern Cryptography Lab		2	1
6	BT-EAE-2	BT-308T	Blockchain Technology	3		3
		BT-308P	Blockchain Technology Lab		2	1
7	BT-EAE-3	BT-413T	Bitcoin and Cryptocurrency Technologies	3		3
		BT-413P	Bitcoin and Cryptocurrency Technologies Lab		2	1
7	BT-EAE-4	BT-415T	Smart Contracts	3		3
		BT-415P	Smart Contracts Lab		2	1
7	BT-EAE-5A OR	BT-417T	Blockchain for Cyber Security	3		3
		BT-417P	Blockchain for Cyber Security Lab		2	1
	BT-EAE-5B	BT-419T	Blockchain Technology in Web Development	3		3
		BT-419P	Blockchain Technology in Web Development Lab		2	1

Emerging Area Specialization: Internet of Things (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	IOT-EAE-1A OR	IOT-324T	Introduction to Internet of Things	3		3
		IOT-324P	Introduction to Internet of Things Lab		2	1
	IOT-EAE-1B	IOT-326T	Introduction to Sensors and Transducers	3		3
		IOT-326P	Introduction to Sensors and Transducers Lab		2	1
6	IOT-EAE-2A OR	ES-328T	Embedded Linux	3		3
		ES-328P	Embedded Linux Lab		2	1
	IOT-EAE-2B OR	IOT-330T	Programming in Python	3		3
		IOT-330P	Programming in Python Lab		2	1
	IOT-EAE-2C	IOT-332T	Wireless Sensor Networks	3		3
		IOT-332P	Wireless Sensor Networks Lab		2	1
7	IOT-EAE-3	IOT-441T	IoT with Arduino, ESP and Raspberry Pi	3		3
		IOT-441P	IoT with Arduino, ESP and Raspberry Pi Lab		2	1
7	IOT-EAE-4	IOT-443T	Design of Smart Systems	3		3
		IOT-443P	Design of Smart Systems Lab		2	1
7	IOT-EAE-5A OR	IOT-445T	Internet of Things Industrial and Medical Case Studies	3		3
		IOT-445P	Internet of Things Industrial and Medical Case Studies Lab		2	1
	IOT-EAE-5B OR	IOT-447T	Internet of Things Frameworks	3		3
		IOT-447P	Internet of Things Frameworks Lab		2	1
	IOT-EAE-5C	IOT-449	Privacy and Security issues in IoT	4		4

Emerging Area Specialization: Internet of Things and Cyber Security including Block Chain Technology (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	ICB-EAE-1A OR	IOT-324T	Introduction to Internet of Things	3		3
		IOT-324P	Introduction to Internet of Things Lab		2	1
	ICB-EAE-1B	IOT-326T	Introduction to Sensors and Transducers	3		3
		IOT-326P	Introduction to Sensors and Transducers Lab		2	1
6	ICB-EAE-2A OR	ES-328T	Embedded Linux	3		3
		ES-328P	Embedded Linux Lab		2	1
	ICB-EAE-2B OR	IOT-330T	Programming in Python	3		3
		IOT-330P	Programming in Python Lab		2	1
	ICB-EAE-2C	IOT-332T	Wireless Sensor Networks	3		3
		IOT-332P	Wireless Sensor Networks Lab		2	1
7	ICB-EAE-3	CS-423T	Cyber Security and Forensics	3		3
		CS-423P	Cyber Security and Forensics Lab		2	1
7	ICB-EAE-4	IOT-441T	IoT with Arduino, ESP and Raspberry Pi	3		3
		IOT-441P	IoT with Arduino, ESP and Raspberry Pi Lab		2	1
7	ICB-EAE-5	BT-443T	Blockchain Technology	3		3
		BT-443P	Blockchain Technology Lab		2	1

Emerging Area Specialization: Networks (for CSE / IT / CST / ITE / ECE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	NET-EAE-1	NET-344T	Advanced Computer Networks and Administration	3		3
		NET-344P	Advanced Computer Networks and Administration Lab		2	1
6	NET-EAE-2	NET-346T	Linux System Administration	3		3
		NET-346P	Linux System Administration Lab		2	1
7	NET-EAE-3	NET-471T	Network Programming	3		3
		NET-471P	Network Programming Lab		2	1
7	NET-EAE-4	NET-473T	Cloud Computing and Security	3		3
		NET-473P	Cloud Computing and Security Lab		2	1
7	NET-EAE-5	NET-475T	Wireless Sensor Networks	3		3
		NET-475P	Wireless Sensor Networks Lab		2	1

Emerging Area Specialization: Cyber Security (for CSE / IT / CST / ITE / ECE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	CS-EAE-1	CS-310T	Information Theory and Coding	3		3
		CS-310P	Information Theory and Coding Lab		2	1
6	CS-EAE-2A OR	CS-312T	Network Security and Cryptography	3		3
		CS-312P	Network Security and Cryptography Lab		2	1
	CS-EAE-2B	CS-314T	Network Security Issues and Challenges	3		3
		CS-314P	Network Security Issues and Challenges Lab		2	1
7	CS-EAE-3	CS-421T	Cyber Crime and Cyber Laws	3		3
		CS-421P	Cyber Crime and Cyber Laws Lab		2	1
7	CS-EAE-4	CS-423T	Cyber Security and Forensics	3		3
		CS-423P	Cyber Security and Forensics Lab		2	1
7	CS-EAE-5	CS-425T	Ethical Hacking	3		3
		CS-425P	Ethical Hacking Lab		2	1

Emerging Area Specialization: Soft Computing (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	SC-EAE-1	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
6	SC-EAE-2	ML-348T	Artificial Neural Networks and Deep Learning	3		3
		ML-348P	Artificial Neural Networks and Deep Learning Lab		2	1
7	SC-EAE-3	SC-477T	Fuzzy Systems and Applications	3		3
		SC-477P	Fuzzy Systems and Applications Lab		2	1
7	SC-EAE-4	SC-479T	Global Optimization Methods	3		3
		SC-479P	Global Optimization Methods Lab		2	1
7	SC-EAE-5	SC-481T	Soft Computing and Expert Systems	3		3
		SC-481P	Soft Computing and Expert Systems Lab		2	1

Emerging Area Specialization: Machine Learning & Data Analytics (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	MLDA-EAE-1	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
6	MLDA-EAE-2A OR	DA-338T	Data Analytics	3		3
		DA-338P	Data Analytics Lab		2	1
	MLDA-EAE-2B OR	DS-340T	Data Visualization	3		3
		DS-340P	Data Visualization Lab		2	1
	MLDA-EAE-2C	ML-342T	Machine Learning	3		3
		ML-342P	Machine Learning Lab		2	1
7	MLDA-EAE-3	ML-463T	Supervised and Deep Learning	3		3
		ML-463P	Supervised and Deep Learning Lab		2	1
7	MLDA-EAE-4	ML-465T	Unsupervised Learning	3		3
		ML-465P	Unsupervised Learning Lab		2	1
7	MLDA-EAE-5A OR	ML-467T	Machine Learning and Data Analytics Case Studies	3		3
		ML-467P	Machine Learning and Data Analytics Case Studies Lab		2	1
	MLDA-EAE-5B	ML-469T	Machine Learning and Data Analytics Frameworks	3		3
		ML-469P	Machine Learning and Data Analytics Frameworks Lab		2	1

Emerging Area Specialization: Software Engineering (for CSE / IT / CST / ITE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	SE-EAE-1	SE-350T	Software Measurements, Metrics and Modelling	3		3
		SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-EAE-2A OR	SE-352T	Service Oriented Architecture	3		3
		SE-352P	Service Oriented Architecture Lab		2	1
	SE-EAE-2B	SE-354T	Software Project Management	3		3
		SE-354P	Software Project Management Lab		2	1
7	SE-EAE-3	SE-483T	Mining Software Repositories and Predictive Modelling	3		3
		SE-483P	Mining Software Repositories and Predictive Modelling Lab		2	1
7	SE-EAE-4A OR	SE-485	Software Security	4		4
	SE-EAE-4B	SE-487T	Software Verification, Validation and Testing	3		3
		SE-487P	Software Verification, Validation and Testing Lab		2	1
7	SE-EAE-5	SE-489	Software Engineering Standards	4		4

Emerging Area Specialization: Full Stack Development (for CSE / IT / CST / ITE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	FSD-EAE-1	FSD-318T	Advanced Java Programming	3		3
		FSD-318P	Advanced Java Programming Lab		2	1
6	FSD-EAE-2A OR	FSD-320T	Web Development using MEAN Stack	3		3
		FSD-320P	Web Development using MEAN Stack Lab		2	1
	FSD-EAE-2B	FSD-322T	Web Development using MERN Stack	3		3
		FSD-322P	Web Development using MERN Stack Lab		2	1
7	FSD-EAE-3	FSD-435T	PHP Programming and MySQL	3		3
		FSD-435P	PHP Programming and MySQL Lab		2	1
7	FSD-EAE-4	FSD-437T	Mobile App Development	3		3
		FSD-437P	Mobile App Development Lab		2	1
7	FSD-EAE-5	FSD-439T	Web and Mobile Application Testing and Deployment	3		3
		FSD-43P	Web and Mobile Application Testing and Deployment Lab		2	1

Emerging Area Specialization: Image Processing and Computer Vision (for CSE/IT/CST/ITE/ECE/ EE / EEE / ICE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	IPCV-EAE-1A OR	IPCV-334T	Digital Image Processing	3		3
		IPCV-334P	Digital Image Processing Lab		2	1
	IPCV-EAE-1B	IPCV-356T	Digital Signal and Image Processing	3		3
		IPCV-356P	Digital Signal and Image Processing Lab		2	1
6	IPCV-EAE-2	IPCV-336T	Pattern Recognition	3		3
		IPCV-336P	Pattern Recognition Lab		2	1
7	IPCV-EAE-3	IPCV-451T	Computer Vision	3		3
		IPCV-451P	Computer Vision Lab		2	1
7	IPCV-EAE-4A OR	IPCV-453T	Biometrics	3		3
		IPCV-453P	Biometrics Lab		2	1
	IPCV-EAE-4B OR	IPCV-455T	Medical Image Processing, Analysis and Reconstruction	3		3
		IPCV-455P	Medical Image Processing, Analysis and Reconstruction Lab		2	1
	IPCV-EAE-4C	IPCV-457T	Remote Sensing Image Analysis and Classification	3		3
		IPCV-457P	Remote Sensing Image Analysis and Classification Lab		2	1
7	IPCV-EAE-5A OR	IPCV-459T	Deep Learning for Image Processing and Computer Vision	3		3
		IPCV-459P	Deep Learning for Image Processing and Computer Vision Lab		2	1
	IPCV-EAE-5B	IPCV-461T	Machine Learning for Image and Vision Analysis	3		3
		IPCV-461P	Machine Learning for Image and Vision Analysis Lab		2	1

Emerging Area Specialization: Robotics and Automation (for ECE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	RA-EAE-1	RA-324T	Robot Kinematics and Dynamics	3		3
		RA-324P	Robot Kinematics and Dynamics Lab		2	1
6	RA-EAE-2	IOT-326T	Introduction to Sensors and Transducers	3		3
		IOT-326P	Introduction to Sensors and Transducers Lab		2	1
7	RA-EAE-3	RA-437T	Robot Actuation Systems	3		3
		RA-437P	Robot Actuation Systems Lab		2	1
7	RA-EAE-4	RA-439T	Control Hardware and Interfacing	3		3
		RA-439P	Control Hardware and Interfacing Lab		2	1
7	RA-EAE-5	RA-441T	AI in Robotics	3		3
		RA-441P	AI in Robotics Lab		2	1

Emerging Area Specialization: Embedded Systems (for CSE/IT/CST/ITE/ECE/EE/EEE /ICE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	ES-EAE-1A OR	ES-302T	Microprocessors and Interfacing	3		3
		ES-302P	Microprocessors and Interfacing Lab		2	1
	ES-EAE-1B OR	ES-308T	Introduction to Data Communication and Networking	3		3
		ES-308P	Introduction to Data Communication and Networking Lab		2	1
	ES-EAE-1C	ES-310T	Advanced Microprocessors (ARM) & Interfacing	3		3
		ES-310P	Advanced Microprocessors (ARM) & Interfacing Lab		2	1
6	ES-EAE-2A OR	ES-304	Real Time Operating Systems	4		4
	ES-EAE-2B	ES-306T	Embedded System Architecture and Design	3		3
		ES-306P	Embedded System Architecture and Design Lab		2	1
7	ES-EAE-3A OR	ES-401T	Programming in C for Embedded Systems	3		3
		ES-401P	Programming in C for Embedded Systems Lab		2	1
	ES-EAE-3B	ES-403T	VHDL Programming	3		3
		ES-403P	VHDL Programming Lab		2	1
7	ES-EAE-4	ES-405T	Real Time Embedded System Programming	3		3
		ES-405P	Real Time Embedded System Programming Lab		2	1
7	ES-EAE-5A OR	ES-407T	Embedded Linux	3		3
		ES-407P	Embedded Linux Lab		2	1
	ES-EAE-5B OR	IOT-409T	Introduction to Sensors and Transducers	3		3
		IOT-409P	Introduction to Sensors and Transducers Lab		2	1
	ES-EAE-5C	ES-411T	Logic Design and Analysis using Verilog	3		3
		ES-411P	Logic Design and Analysis using Verilog Lab		2	1

Emerging Area Specialization: VLSI Design (for ECE/ EE /EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	VLSI-EAE-1	VLSI-328T	Semiconductor Devices and Modelling	3		3
		VLSI-328P	Semiconductor Devices and Modelling Lab		2	1
6	VLSI-EAE-2	VLSI-330T	VLSI	3		3
		VLSI-330P	VLSI Lab		2	1
7	VLSI-EAE-3	VLSI-443T	CMOS Analog Integrated Circuit Design	3		3
		VLSI-443P	CMOS Analog Integrated Circuit Design Lab		2	1
7	VLSI-EAE-4	VLSI-445T	CMOS Digital Circuits Design	3		3
		VLSI-445P	CMOS Digital Circuits Design Lab		2	1
7	VLSI-EAE-5A OR	VLSI-447	CMOS Mixed Signal Circuit Design	4		4
	VLSI-EAE-5B OR	VLSI-449T	Low Power VLSI Design	3		3
		VLSI-449P	Low Power VLSI Design Lab		2	1
	VLSI-EAE-5C	VLSI-451	VLSI Testing	4		4

Emerging Area Specialization: Wireless and Mobile Communications (for ECE/ EE /EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	WMC-EAE-1A OR	WMC-332T	Optical Networks	3		3
		WMC-332P	Optical Networks Lab		2	1
	WMC-EAE-1B OR	WMC-334T	Random Processes and Stochastic Systems	3		3
		WMC-334P	Random Processes and Stochastic Systems Lab		2	1
	WMC-EAE-1C	WMC-336T	Wireless Communication and Networks	3		3
		WMC-336P	Wireless Communication and Networks Lab		2	1
6	WMC-EAE-2	WMC-338T	Cellular and Mobile Communication	3		3
		WMC-338P	Cellular and Mobile Communication Lab		2	1
7	WMC-EAE-3A OR	WMC-453T	Ad hoc and Sensor Networks	3		3
		WMC-453P	Ad hoc and Sensor Networks Lab		2	1
	WMC-EAE-3B	WMC-455T	Mobile Computing	3		3
		WMC-455P	Mobile Computing Lab		2	1
7	WMC-EAE-4	WMC-457	Cognitive Radio & Networks	4		4
7	WMC-EAE-5	WMC-459	Privacy and Security in Wireless Networks	4		4

Emerging Area Specialization: Electrical Vehicles (for EE / EEE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	EV-EAE-1	EV-308T	Electric Vehicle Powertrain and Motor Design	3		3
		EV-308P	Electric Vehicle Powertrain and Motor Design Lab		2	1
6	EV-EAE-2	EV-310T	Battery Management Systems	3		3
		EV-310P	Battery Management Systems Lab		2	1
7	EV-EAE-3	EV-413T	EV Charging Infrastructure Technology	3		3
		EV-413P	EV Charging Infrastructure Technology Lab		2	1
7	EV-EAE-4	EV-415	Economics and Policies of e-Mobility	4		4
7	EV-EAE-5	EV-417T	Embedded Systems for Electric Vehicles	3		3
		EV-417P	Embedded Systems for Electric Vehicles Lab		2	1

Emerging Area Specialization: Microgrid Technologies (for EE / EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	MT-EAE-1	MT-312T	Energy Storage Systems in Microgrids	3		3
		MT-312P	Energy Storage Systems in Microgrids Lab		2	1
6	MT-EAE-2	MT-314T	Modeling and Analysis of Microgrids	3		3
		MT-314P	Modeling and Analysis of Microgrids Lab		2	1
7	MT-EAE-3	MT-419T	Microgrid Stability Assessment and Protection	3		3
		MT-419P	Microgrid Stability Assessment and Protection Lab		2	1
7	MT-EAE-4	MT-421T	Human Machine Interface for Microgrids	3		3
		MT-421P	Human Machine Interface for Microgrids Lab		2	1
7	MT-EAE-5	MT-423T	Power Quality for Microgrids	3		3
		MT-423P	Power Quality for Microgrids Lab		2	1

Emerging Area Specialization: Power Systems (for EE / EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	PS-EAE-1	PS-320T	Electricity Generation, Transmission and Utilization	3		3
		PS-320P	Electricity Generation, Transmission and Utilization Lab		2	1
6	PS-EAE-2	PS-322T	EHVAC and HVDC Transmission	3		3
		PS-322P	EHVAC and HVDC Transmission Lab		2	1
7	PS-EAE-3	PS-431T	Power System Operation and Control	3		3
		PS-431P	Power System Operation and Control Lab		2	1
7	PS-EAE-4	PS-433T	Flexible AC Transmission System	3		3
		PS-433P	Flexible AC Transmission System Lab		2	1
7	PS-EAE-5	PS-435T	Power System Analysis and Stability	3		3
		PS-435P	Power System Analysis and Stability Lab		2	1

Emerging Area Specialization: Power Electronics and Drives (for EE / EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	PED-EAE-1	PED-316T	Advanced Power Electronic Converters	3		3
		PED-316P	Advanced Power Electronic Converters Lab		2	1
6	PED-EAE-2	PED-318T	Industrial Control Electronics	3		3
		PED-318P	Industrial Control Electronics Lab		2	1
7	PED-EAE-3	PED-425T	Switch Mode Power Conversion	3		3
		PED-425P	Switch Mode Power Conversion Lab		2	1
7	PED-EAE-4	PED-427T	Solid State Drives	3		3
		PED-427P	Solid State Drives Lab		2	1
7	PED-EAE-5	PED-429T	Solar Photovoltaic Systems	3		3
		PED-429P	Solar Photovoltaic Systems Lab		2	1

Emerging Area Specialization: Control and Instrumentation (for EE / EEE / ICE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	CI-EAE-1	CI-306T	PLC and SCADA Systems	3		3
		CI-306P	PLC and SCADA Systems Lab		2	1
6	CI-EAE-2	IOT-326T	Introduction to Sensors and Transducers	3		3
		IOT-326P	Introduction to Sensors and Transducers Lab		2	1
7	CI-EAE-3	CI-407T	Advanced Control Systems for Instrumentation	3		3
		CI-407P	Advanced Control Systems for Instrumentation Lab		2	1
7	CI-EAE-4	CI-409T	Neuro Fuzzy Systems	3		3
		CI-409P	Neuro Fuzzy Systems Lab		2	1
7	CI-EAE-5	CI-411T	Non-linear System Design	3		3
		CI-411P	Non-linear System Design Lab		2	1

Emerging Area Specialization: Computer Aided Design and Manufacturing (for ME)

Semester	Group	Paper Code	Paper Name	L	P	Credits
6	CADM-EAE-1	CADM-302T	Introduction to CAD/CAM	3		3
		CADM-302P	Introduction to CAD/CAM Lab		2	1
6	CADM-EAE-2	CADM-304T	Injection Moulding and Mould Design	3		3
		CADM-304P	Injection Moulding and Mould Design Lab		2	1
7	CADM-EAE-3	CADM-401T	Computational Fluid Dynamics	3		3
		CADM-401P	Computational Fluid Dynamics Lab		2	1
7	CADM-EAE-4	CADM-403T	Computer Aided Design and Drafting	3		3
		CADM-403P	Computer Aided Design and Drafting Lab		2	1
7	CADM-EAE-5	CADM-405T	Industrial Robotics	3		3
		CADM-405P	Industrial Robotics Lab		2	1

Emerging Area Specialization: Design and Measurement Systems (for ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	DMS-EAE-1	DMS-312T	Industrial Tribology	3		3
		DMS-312P	Industrial Tribology Lab		2	1
6	DMS-EAE-2	DMS-314T	Quality Management & Quality Control	3		3
		DMS-314P	Quality Management & Quality Control Lab		2	1
7	DMS-EAE-3	DMS-419T	Fracture Mechanics	3		3
		DMS-419P	Fracture Mechanics Lab		2	1
7	DMS-EAE-4	DMS-421T	Advance Manufacturing Process	3		3
		DMS-421P	Advance Manufacturing Process Lab		2	1
7	DMS-EAE-5	DMS-423T	Pressure vessels and Piping Technology	3		3
		DMS-423P	Pressure vessels and Piping Technology Lab		2	1

Emerging Area Specialization: Design Trends (for EE / EEE / ICE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	DT-EAE-1	DMS-314T	Quality Management & Quality Control	3		3
		DMS-314P	Quality Management & Quality Control Lab		2	1
6	DT-EAE-2	DT-316T	Automobile Engineering	3		3
		DT-316P	Automobile Engineering Lab		2	1
7	DT-EAE-3	DMS-421T	Advance Manufacturing Process	3		3
		DMS-421P	Advance Manufacturing Process Lab		2	1
7	DT-EAE-4	DT-425T	Mechanical Vibrations	3		3
		DT-425P	Mechanical Vibrations Lab		2	1
7	DT-EAE-5	DT-427T	Industrial Tribology	3		3
		DT-427P	Industrial Tribology Lab		2	1

Emerging Area Specialization: Thermal Energy Sources (for ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	TES-EAE-1	TES-330T	Cryogenic Engineering	3		3
		TES-330P	Cryogenic Engineering Lab		2	1
6	TES-EAE-2	TES-332T	Energy Systems and Technologies	3		3
		TES-332P	Energy Systems and Technologies Lab		2	1
7	TES-EAE-3	TES-447T	Compressible Flow and Jet Propulsion	3		3
		TES-447P	Compressible Flow and Jet Propulsion Lab		2	1
7	TES-EAE-4	TES-449T	Green Energy Technology	3		3
		TES-449P	Green Energy Technology Lab		2	1
7	TES-EAE-5	TES-451T	Advanced IC Engines	3		3
		TES-451P	Advanced IC Engines Lab		2	1

Emerging Area Specialization: Quality Management (for ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	QM-EAE-1	QM-326T	Supply Chain Management	3		3
		QM-326P	Supply Chain Management Lab		2	1
6	QM-EAE-2	QM-328T	Flexible Manufacturing Systems	3		3
		QM-328P	Flexible Manufacturing Systems Lab		2	1
7	QM-EAE-3	QM-441T	Total Quality Management	3		3
		QM-441P	Total Quality Management Lab		2	1
7	QM-EAE-4	QM-443T	Statistical Quality Control	3		3
		QM-443P	Statistical Quality Control Lab		2	1
7	QM-EAE-5	QM-445	Organizational Behaviour	4		4

Emerging Area Specialization: Construction Technology and Management (for CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	CTM-EAE-1	CEC-308	Contract Management	4		4
6	CTM-EAE-2	CEC-310	Advanced Construction Materials and Practices	4		4
7	CTM-EAE-3	CEC-413	Quality and Safety Management	4		4
7	CTM-EAE-4	CEC-415	Lean Construction Technology and Management	4		4
7	CTM-EAE-5	CEC-417	Recent Construction Technologies	4		4

Emerging Area Specialization: Infrastructure Engineering (for CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	IE-EAE-1	IE-322	Water Resource Planning	4		4
6	IE-EAE-2	IE-324	Advanced Environmental Engineering and Design	4		4
7	IE-EAE-3	IE-435	Metro Systems Engineering	4		4
7	IE-EAE-4	IE-437T	Transport Planning and Intelligent Transportation System	3		3
		IE-437P	Transport Planning and Intelligent Transportation System Lab		2	1
7	IE-EAE-5	IE-439	Analysis and Design of High-rise Buildings and Bridges	4		4

Emerging Area Specialization: Green Technology and Sustainability Engineering (for CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	GTSE-EAE-1	GTSE-318	Planning and Design of Green Buildings	4		4
6	GTSE-EAE-2	GTSE-320	Sustainable Materials and Practices	4		4
7	GTSE-EAE-3	GTSE-429	Green Energy Concepts in Smart Cities	4		4
7	GTSE-EAE-4	GTSE-431	Intelligent Transportation System	4		4
7	GTSE-EAE-5	GTSE-433	Sustainable Engineering Technologies	4		4

Open Area Elective Groups (for Minor Specialization) – Applicable only for Core Disciplines (OAE)

The minor specialization is offered through a set of five papers that the student has to study to acquire the minor specialization. The number of papers to be studied is two in 6th semester and three in 7th semester. The minor specialization shall be awarded if and only if 20 credits are earned from an individual / specific minor specialization area. From each paper group associated with a paper paper slot in a particular semester, the student shall be allowed to study only one paper group. The papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Minor specialization is not necessary for award of the degree, the student may choose five papers from the groups offered by the institution to a particular student (belonging to a major discipline) across groups. Minimum two minor specialization groups should be offered by the institution to students of any particular major discipline from either of the open area or emerging area groups.

An elective shall be offered to the student for each Minor Specialization group in Open Area (That is for OAE-1, OAE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective.

Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required. The nomenclature of the paper group is <ACRONYM OF EMERGING AREA> - OAE - <SLOT NUMBER><A or B or C etc., if required>. The major disciplines to which the open Area Elective Group papers can be offered is specified as acronym together with the name of the minor specialization.

In lieu of Open Area Elective, students can study papers from Emerging Area Elective groups also as offered to them.

The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as Open Area Electives to engineering students (approved by the University Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for Open Area Electives.

Open Area Specialization: Computer Science and Engineering (for ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	CSE-OAE-1A OR	OCSE-306T	C++ Programming	3		3
		OCSE-306P	C++ Programming Lab		2	1
	CSE-OAE-1B	OCSE-308	Digital Logic and Computer Design	4		4
6	CSE-OAE-2A OR	OCSE-310T	Data Structures and Algorithms	3		3
		OCSE-310P	Data Structures and Algorithms Lab		2	1
	CSE-OAE-2B	OCSE-342T	Programming in Java	3		3
		OCSE-342P	Programming in Java Lab		2	1
7	CSE-OAE-3	OCSE-407T	Introduction to Database Management Systems	3		3
		OCSE-407P	Introduction to Database Management Systems Lab		2	1
7	CSE-OAE-4	OCSE-409	Operating Systems	4		4
7	CSE-OAE-5A OR	OCSE-411T	Introduction to Computer Networks	3		3
		OCSE-411P	Introduction to Computer Networks Lab		2	1
	CSE-OAE-5B	OCSE-413T	Introduction to Software Engineering	3		3
		OCSE-413P	Introduction to Software Engineering Lab		2	1

Open Area Specialization: Electronics and Communications Engineering (for CSE / IT / CST / ITE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	ECE-OAE-1AOR	OECE-312T	Introduction to Circuits and Systems	3		3
		OECE-312P	Introduction to Circuits and Systems Lab		2	1
	ECE-OAE-1B	OECE-344T	Introduction to Analog Electronics	3		3
		OECE-344P	Introduction to Analog Electronics Lab		2	1
6	ECE-OAE-2	OECE-314T	Electronic Devices and Circuits	3		3
		OECE-314P	Electronic Devices and Circuits Lab		2	1
7	ECE-OAE-3A OR	OECE-415	Digital Logic and Computer Design	4		4
	ECE-OAE-3B	OECE-417T	Microprocessors and Interfacing	3		3
		OECE-417P	Microprocessors and Interfacing Lab		2	1
7	ECE-OAE-4A OR	OECE-419T	Analog and Digital Communications	3		3
		OECE-419P	Analog and Digital Communications Lab		2	1
	ECE-OAE-4B	OECE-421T	Wireless Sensor Networks	3		3
		OECE-421P	Wireless Sensor Networks Lab		2	1
7	ECE-OAE-5A OR	OECE-423	Control Systems	4		4
	ECE-OAE-5B	OECE-425T	Introduction to Computer Networks	3		3
		OECE-425P	Introduction to Computer Networks Lab		2	1

Open Area Specialization: Electrical Engineering (for CSE / IT / CST / ITE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	EE-OAE-1A OR	OEE-316T	Introduction to Circuits and Systems	3		3
		OEE-316P	Introduction to Circuits and Systems Lab		2	1
	EE-OAE-1B	OEE-346T	Introduction to Analog Electronics	3		3
		OEE-346P	Introduction to Analog Electronics Lab		2	1
6	EE-OAE-2	OEE-318T	Introduction to Electrical Machines	3		3
		OEE-318P	Introduction to Electrical Machines Lab		2	1
7	EE-OAE-3	OEE-427T	Control Systems for Electrical Engineering	3		3
		OEE-427P	Control Systems for Electrical Engineering Lab		2	1
7	EE-OAE-4	OEE-429T	Generation, Transmission and Distribution	3		3
		OEE-429P	Generation, Transmission and Distribution Lab		2	1
7	EE-OAE-5	OEE-431T	Introduction to Power Electronics	3		3
		OEE-431P	Introduction to Power Electronics Lab		2	1

Open Area Specialization: Software Development (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	SD-OAE-1A OR	OSD-328T	C++ Programming	3		3
		OSD-328P	C++ Programming Lab		2	1
	SD-OAE-1B OR	OSD-330T	Programming in Windows Environment	3		3
		OSD-330P	Programming in Windows Environment Lab		2	1
	SD-OAE-1C	OSD-332T	Programming in Java	3		3
		OSD-332P	Programming in Java Lab		2	1
6	SD-OAE-2A OR	OSD-334T	Android App Development	3		3
		OSD-334P	Android App Development Lab		2	1
	SD-OAE-2B	OSD-336T	Introduction to Database Management Systems	3		3
		OSD-336P	Introduction to Database Management Systems Lab		2	1
7	SD-OAE-3A OR	OSD-445T	Data Structures and Algorithms	3		3
		OSD-445P	Data Structures and Algorithms Lab		2	1
	SD-OAE-3B	OSD-447T	Project Management	3		3
		OSD-447P	Project Management Lab		2	1
7	SD-OAE-4A OR	OSD-449T	Design Patterns	3		3
		OSD-449P	Design Patterns Lab		2	1
	SD-OAE-4B	OSD-451T	Introduction to Software Engineering	3		3
		OSD-451P	Introduction to Software Engineering Lab		2	1
7	SD-OAE-5A OR	OSD-453T	Advanced Java Programming	3		3
		OSD-453P	Advanced Java Programming Lab		2	1
	SD-OAE-5B	OSD-455T	Programming in Linux Environment	3		3
		OSD-455P	Programming in Linux Environment Lab		2	1

Open Area Specialization: Mechanical Engineering (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	ME-OAE-1	OME-324T	Theory of Machines	3		3
		OME-324P	Theory of Machines Lab		2	1
6	ME-OAE-2	OME-326T	Materials and Machine Technology	3		3
		OME-326P	Materials and Machine Technology Lab		2	1
7	ME-OAE-3	OME-439T	Fluids and Thermal Engineering	3		3
		OME-439P	Fluids and Thermal Engineering Lab		2	1
7	ME-OAE-4	OME-441T	Mechanics and Design of Solids	3		3
		OME-441P	Mechanics and Design of Solids Lab		2	1
7	ME-OAE-5	OME-443T	Automation in Manufacturing	3		3
		OME-443P	Automation in Manufacturing Lab		2	1

Open Area Specialization: Instrumentation and Control Engineering (for CSE / IT / CST / ITE / ECE / EE / EEE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	ICE-OAE-1	OICE-320T	Introduction to Sensors and Transducers	3		3
		OICE-320P	Introduction to Sensors and Transducers Lab		2	1
6	ICE-OAE-2	OICE-322T	Measurement and Control	3		3
		OICE-322P	Measurement and Control Lab		2	1
7	ICE-OAE-3	OICE-433	Process Control	4		4
7	ICE-OAE-4	OICE-435T	Introduction to Industrial Instrumentation	3		3
		OICE-435P	Introduction to Industrial Instrumentation Lab		2	1
7	ICE-OAE-5	OICE-437T	Bio Medical Instrumentation	3		3
		OICE-437P	Bio Medical Instrumentation Lab		2	1

Open Area Specialization: Civil Engineering (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	CE-OAE-1	OCE-302	Structural Analysis and Design	4		4
6	CE-OAE-2	OCE-304	Pipe and Open Channel Hydraulics	4		4
7	CE-OAE-3	OCE-401	Green Building Construction Materials and Practices	4		4
7	CE-OAE-4	OCE-403	Public Health Engineering	4		4
7	CE-OAE-5	OCE-405	Geotechnical and Transportation Engineering	4		4

Open Area Specialization: Universal Human Values (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	UHV-OAE-1	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	UHV-OAE-2	OUHV-340	Vision for Humane Society	4		4
7	UHV-OAE-3A OR	OUHV-457	Human Values and Madhyasth Darshan	4		4
	UHV-OAE-3B OR	OUHV-459	Human Values in Buddh and Jain Darshan	4		4
	UHV-OAE-3C	OUHV-461	Human Values in Vedic Darshan (Sankhya, Yoga and Vedanta)	4		4
7	UHV-OAE-4A OR	OUHV-463	Holistic Human Health	4		4
	UHV-OAE-4B	OUHV-465	Human Sociology	4		4
7	UHV-OAE-5	OUHV-467	Human Economics	4		4

2nd Year Onward Scheme and Implementation Guideline for Bachelor of Technology Programme(s) in Emerging Areas Disciplines:

The programmes in the emerging areas shall have the first year curriculum as specified in the beginning of this document. The fundamental change in these programmes is that these programmes are oriented towards not only core area expertise but also expertise in emerging areas and multi-disciplinary areas(s) of engineering and technology. Therefore, the major change in the structure of the curriculum vis-à-vis the core area programme is reduction in the number of electives so that emerging areas can be given a complete coverage. The following emerging area and / or multi-disciplinary area degree programmes shall be offered:

1. **Mechanical and Automation Engineering (MAE)**
2. **Computer Science and Engineering (Artificial Intelligence) (CSE-AI)**
3. **Computer Science and Engineering (Artificial Intelligence and Machine Learning) (CSE-AIML)**
4. **Computer Science and Engineering (Data Science) (CSE-DS)**
5. **Computer Science and Engineering (Internet of Things) (CSE-IoT)**
6. **Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology) (CSE-ICB)**
7. **Computer Science and Engineering (Networks) (CSE-Net)**
8. **Computer Science and Engineering (Cyber Security) (CSE-CS)**

Bachelor of Technology in Mechanical and Automation Engineering (MAE)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	MEC-205	Theory of Machines	4		4
PC	MEC-207	Strength of Materials	4		4
PC	MEC-209	Manufacturing Science and Technology-I	4		4
PC	ECC-217	Analog and Digital Electronics	3		3
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	MEC-253	Theory of Machines Lab		2	1
PC	MEC-255	Strength of Materials Lab		2	1
PC	MEC-259	Manufacturing Science and Technology-I Lab		2	1
PC	ECC-263	Analog and Digital Electronics Lab		2	1
Total			**21**	**10**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	MEC-206	Manufacturing Science and Technology-II	4		4
PC	MEC-208	Material Science and Metallurgy	4		4
PC	MAC-210	Database Management Systems	4		4
PC	MAC-212	Thermodynamics and Applications	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	MEC-254	Manufacturing Science and Technology-II Lab		2	1
PC	MAC-256	Database Management Systems Lab		2	1
PC	MAC-258	Thermodynamics and Applications Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	MAC-303	Machine Design-I	4		4
PC	MEC-305	Heat and Mass Transfer	4		4
PC	MEC-309	Industrial Engineering	4		4
PC	MAC-311	Sensors and Transducers	4		4
PC	MAC-313	Control Systems and Applications	3		3
Practical / Viva Voce					
PC	MAC-351	Machine Design-I Lab		2	1
PC	MEC-353	Heat and Mass Transfer Lab		2	1
PC	MAC-355	Sensors and Transducers Lab		2	1
PC	MAC-359	Control Systems and Applications Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**21**	**5**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PC	MAC-306	Machine Design-II	4		4
PC	MEC-308	Fluid Mechanics and Hydraulic Machines	4		4
PC	MAC-310	Mechatronics	4		4
PC	MAC-312	CAD/CAM	4		4
Practical / Viva Voce					
PC	MAC-352	Machine Design-II Lab		2	1
PC	MEC-354	Fluid Mechanics and Hydraulic Machines Lab		2	1
PC	MAC-356	Mechatronics Lab		2	1
PC	MAC-358	CAD/CAM Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total			**20**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	MAC-403	Computer Integrated Manufacturing	3		3
PC	MAC-405	Embedded Systems and Internet of Things	3		3
PC	MAC-407	Introduction to Metrology and Instrumentation	3		3
PC	MAC-409	Robotics Engineering	3		3
OAE		Open Area Elective Paper (OAE)			4
Practical / Viva Voce					
PC	MAC-455	Computer Integrated Manufacturing Lab		2	1
PC	MAC-457	Embedded Systems and Internet of Things Lab		2	1
PC	MAC-459	Introduction to Metrology and Instrumentation Lab		2	1
PC	MAC-461	Robotics Engineering Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

******The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.
The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE (Choose Any One)	L	P	Credits
7	MAO-411T	Additive Manufacturing	3		3
	MAO-411P	Additive Manufacturing Lab		2	1
7	MAO-413T	Advance Metal Cutting and Tool Design	3		3
	MAO-413P	Advance Metal Cutting and Tool Design Lab		2	1
7	MAO-415T	Automation in Manufacturing	3		3
	MAO-415P	Automation in Manufacturing Lab		2	1
7	MAO-417T	Data Science	3		3
	MAO-417P	Data Science Lab		2	1
7	MAO-419T	Design of Experiments	3		3
	MAO-419P	Design of Experiments Lab		2	1
7	MAO-421T	Design of Mechanical Assemblies	3		3
	MAO-421P	Design of Mechanical Assemblies Lab		2	1
7	MAO-423T	Design of Mechanical Drives	3		3
	MAO-423P	Design of Mechanical Drives Lab		2	1
7	MAO-425T	Geometric Modelling and Analysis	3		3
	MAO-425P	Geometric Modelling and Analysis Lab		2	1
7	MAO-427	Non Traditional Manufacturing	4		4
7	MAO-429T	Rapid prototyping Tooling and Manufacturing	3		3
	MAO-429P	Rapid prototyping Tooling and Manufacturing Lab		2	1
7	MAO-431T	Artificial Intelligence and Machine Learning	3		3
	MAO-431P	Artificial Intelligence and Machine Learning Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required. The nomenclature of the paper code is <*MAO*> - <PAPER CODE><T (for Theory or P (for practical)., if required>.

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	20	20	20	**122**	**108**
OAE						4		**4**	**0**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	20	20	20	**122**	**108**
OAE					4		**4**	**0**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 1 subject from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded the degree without any minor specialization under the following conditions:

        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

    The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Mechanical and Automation Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Mechanical and Automation Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

    b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1**

or Table 2 (as applicable) and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Mechanical and Automation Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence) (CSE-AI)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PC	AI-302T	Artificial Intelligence	3		3
PC	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
PC	AI-318T	Fuzzy Systems and Applications	3		3
PC	ML-350T	Artificial Neural Networks	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	AI-302P	Artificial Intelligence Lab		2	1
PC	DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
PC	AI-318P	Fuzzy Systems and Applications Lab		2	1
PC	ML-350P	Artificial Neural Networks Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	AI-403T	Artificial Intelligence Applications	3		3
PC	AI-405T	Intelligent and Expert Systems	3		3
PC	AI-407T	Evolutionary Computation	3		3
PC	AI-409T	Natural Language Processing	3		3
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	AI-403P	Artificial Intelligence Applications Lab		2	1
PC	AI-405P	Intelligent and Expert Systems Lab		2	1
PC	AI-407P	Evolutionary Computation Lab		2	1
PC	AI-409P	Natural Language Processing Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

******The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.
The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE – 1 (Choose Any One)	L	P	Credits
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479T	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	**Semester (Credits)**						**Total Credits**	**Mandatory Credits**
	III	**IV**	**V**	**VI**	**VII**	**VIII**		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.
12. The following degree route can be taken by a student **(also refer point 13)**:
    a. The students shall be awarded the degree without any minor specialization under the following conditions:
        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.
        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

    The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence)";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence) (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

- b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning) (CSE-AIML)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PC	AI-302T	Artificial Intelligence	3		3
PC	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
PC	AI-320T	Optimization Techniques	3		3
PC	ML-352T	Supervised and Unsupervised Learning	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	AI-302P	Artificial Intelligence Lab		2	1
PC	DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
PC	AI-320P	Optimization Techniques Lab		2	1
PC	ML-352P	Supervised and Unsupervised Learning Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***<u>NUES</u>:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****<u>NUES</u>:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	SC-401T	Soft Computing	3		3
PC	ML-407T	Machine Learning	3		3
PC	ML-409T	Reinforcement Learning and Deep Learning	3		3
PC	ML-411T	Pattern Recognition and Computer Vision	3		3
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	SC-401P	Soft Computing Lab		2	1
PC	ML-407P	Machine Learning Lab		2	1
PC	ML-409P	Reinforcement Learning and Deep Learning Lab		2	1
PC	ML-411P	Pattern Recognition and Computer Vision Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

******The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.
The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE – 1 (Choose Any One)	L	P	Credits
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479PT	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	**Semester (Credits)**						**Total Credits**	**Mandatory Credits**
	III	**IV**	**V**	**VI**	**VII**	**VIII**		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.
12. The following degree route can be taken by a student **(also refer point 13)**:
    a. The students shall be awarded the degree without any minor specialization under the following conditions:
        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.
        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

    The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning)";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning) (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Data Science) (CSE-DS)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PC	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
PC	AI-316T	Artificial Intelligence and Machine Learning	3		3
PC	DS-342T	Programming in R and Python	3		3
PC	DS-344T	Data Pre-processing and Post Processing	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
PC	AI-316P	Artificial Intelligence and Machine Learning Lab		2	1
PC	DS-342P	Programming in R and Python Lab		2	1
PC	DS-344P	Data Pre-processing and Post Processing Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	DS-427T	Data Science using R	3		3
PC	DS-429T	Big Data Analytics	3		3
PC	DS-431T	Business Intelligence	3		3
PC	DS-433T	Exploratory Data Analytics and Data Visualization	3		3
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	DS-427P	Data Science using R Lab		2	1
PC	DS-429P	Big Data Analytics Lab		2	1
PC	DS-431P	Business Intelligence Lab		2	1
PC	DS-433P	Exploratory Data Analytics and Data Visualization Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***<u>NUES</u>: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
    i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
    ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
    iii. Attendance / Class Participation - 5 Marks
(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
    i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
    ii. Practical File - 10 Marks
    iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.
The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	**Paper Code**	**OAE – 1 (Choose Any One)**	**L**	**P**	**Credits**
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479T	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.
12. The following degree route can be taken by a student **(also refer point 13)**:
    a. The students shall be awarded the degree without any minor specialization under the following conditions:
        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.
        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

        The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering (Data Science)";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Data Science) (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.
    b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1**

or Table 2 (as applicable) and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Data Science)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Internet of Things) (CSE-IoT)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be doneby the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PC	IOT-320T	Programming in Python	3		3
PC	IOT-324T	Introduction to Internet of Things	3		3
PC	IOT-326T	Introduction to Sensors and Transducers	3		3
PC	IOT-328T	Wireless Sensor Networks	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	IOT-320P	Programming in Python Lab		2	1
PC	IOT-324P	Introduction to Internet of Things Lab		2	1
PC	IOT-326P	Introduction to Sensors and Transducers Lab		2	1
PC	IOT-328P	Wireless Sensor Networks Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	IOT-441T	IoT with Arduino, ESP and Raspberry Pi	3		3
PC	IOT-443T	Design of Smart Systems	3		3
PC	IOT-447T	Internet of Things Frameworks	3		3
PC	IOT-449T	Privacy and Security issues in IoT	4		4
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	IOT-441P	IoT with Arduino, ESP and Raspberry Pi Lab		2	1
PC	IOT-443P	Design of Smart Systems Lab		2	1
PC	IOT-447P	Internet of Things Frameworks Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES**: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE – 1 (Choose Any One)	L	P	Credits
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479T	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.
12. The following degree route can be taken by a student **(also refer point 13)**:
    a. The students shall be awarded the degree without any minor specialization under the following conditions:
        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.
        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering (Internet of Things)";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Internet of Things) (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

    b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1**

or Table 2 (as applicable) and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Internet of Things)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology) (CSE-ICB)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be doneby the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PC	BT-308T	Blockchain Technology	3		3
PC	IOT-320T	Programming in Python	3		3
PC	IOT-324T	Introduction to Internet of Things	3		3
PC	IOT-326T	Introduction to Sensors and Transducers	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	BT-308P	Blockchain Technology Lab		2	1
PC	IOT-320P	Programming in Python Lab		2	1
PC	IOT-324P	Introduction to Internet of Things Lab		2	1
PC	IOT-326P	Introduction to Sensors and Transducers Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	BT-415T	Smart Contracts	3		3
PC	CS-421	Cyber Crime and Cyber Laws	4		4
PC	CS-427T	Network Security and Cryptography	3		3
PC	IOT-441T	IoT with Arduino, ESP and Raspberry Pi	3		3
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	BT-415P	Smart Contracts Lab		2	1
PC	CS-427P	Network Security and Cryptography Lab		2	1
PC	IOT-441P	IoT with Arduino, ESP and Raspberry Pi Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***<u>NUES</u>: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE – 1 (Choose Any One)	L	P	Credits
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479T	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.
9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:
    a. The students shall be awarded the degree without any minor specialization under the following conditions:
        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.
        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

    The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology)";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology) (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Networks) (CSE-NET)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be doneby the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PC	CS-312T	Network Security and Cryptography	3		3
PC	WMC-340T	Wireless Communication and Networks	3		3
PC	NET-344T	Advanced Computer Networks and Administration	3		3
PC	NET-346T	Linux System Administration	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	CS-312P	Network Security and Cryptography Lab		2	1
PC	WMC-340P	Wireless Communication and Networks Lab		2	1
PC	NET-344P	Advanced Computer Networks and Administration Lab		2	1
PC	NET-346P	Linux System Administration Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	NET-471T	Network Programming	3		3
PC	NET-473T	Cloud Computing and Security	3		3
PC	NET-475T	Wireless Sensor Networks	3		3
PC	NET-477T	Network Simulation and Optimization	3		3
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	NET-471P	Network Programming Lab		2	1
PC	NET-473P	Cloud Computing and Security Lab		2	1
PC	NET-475P	Wireless Sensor Networks Lab		2	1
PC	NET-477P	Network Simulation and Optimization Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

******The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.
The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE – 1 (Choose Any One)	L	P	Credits
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479T	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	**IV**	**V**	**VI**	**VII**	**VIII**		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded the degree without any minor specialization under the following conditions:

        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

    The degree nomenclature of the degree shall be as: “***Bachelor of Technology in Computer Science and Engineering (Networks)”;*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: “***Bachelor of Technology in Computer Science and Engineering (Networks) (Honours)***”, if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

    b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1**

or Table 2 (as applicable) and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Networks)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Cyber Security) (CSE-CS)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be doneby the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PC	BT-308T	Blockchain Technology	3		3
PC	CS-310T	Information Theory and Coding	3		3
PC	CS-312T	Network Security and Cryptography	3		3
PC	CS-316T	Cloud Computing and Security	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	BT-308P	Blockchain Technology Lab		2	1
PC	CS-310P	Information Theory and Coding Lab		2	1
PC	CS-312P	Network Security and Cryptography Lab		2	1
PC	CS-316P	Cloud Computing and Security Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	CS-421	Cyber Crime and Cyber Laws	4		4
PC	CS-423T	Cyber Security and Forensics	3		3
PC	CS-425T	Ethical Hacking	3		3
PC	CS-429T	Network Security Issues and Challenges	3		3
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	CS-423P	Cyber Security and Forensics Lab		2	1
PC	CS-425P	Ethical Hacking Lab		2	1
PC	CS-429P	Network Security Issues and Challenges Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***<u>NUES</u>: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
  i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
  ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
  iii. Attendance / Class Participation - 5 Marks
(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
  i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
  ii. Practical File - 10 Marks
  iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	**Paper Code**	**OAE – 1 (Choose Any One)**	**L**	**P**	**Credits**
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479T	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	**Semester (Credits)**						**Total Credits**	**Mandatory Credits**
	III	**IV**	**V**	**VI**	**VII**	**VIII**		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.
9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded the degree without any minor specialization under the following conditions:

        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

    The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering (Cyber Security)";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Cyber Security) (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

    b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1**

or Table 2 (as applicable) and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Cyber Security)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Assessment of Outcomes Achieved in a Course / Paper. That is, Learning Outcome Assessment Alignment Grid.

Learning Outcome	Course/Project	How Learning Will Be Assessed	Resources	Attainment Level

To complete the alignment grid, start by listing one learning outcome per row beneath the “Learning Outcome” column. Make sure that each learning outcome can be assessed by a single method.

Next, beneath the "Course/ Project" column, list the course(s) or project(s) or assignments or tests that students will complete in order to achieve the learning outcome.

In the "How Learning Will Be Assessed" column, list the assessment(s) tool that will be used for that particular learning outcome. It is fine for there to be more than one assessment used for a particular outcome, so long as each assessment captures the outcome in its entirety. Likewise, it is fine for a single assessment to be used for multiple outcomes.

In the column entitled "Resources", list any additional materials, technologies, or resources needed for students to meet the learning outcome.

In the column entitled "Attainment Level", list in a quantifiable manner the average attainment level.

Every teacher must make this sheet for every paper taught. Be that a paper with only theory component, only practical component or with both theory and practical component.

Syllabus of 2nd Year Papers

(3rd Semester for Lateral Entry Students only)

Paper Code(s): BC-181	L / P
Paper: Bridge Course in Mathematics	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is NUES, non-credit and qualifying Paper. All examinations to be conducted by the concerned teacher.

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand the limits, differentiation and integration.
2:	To understand differential equations.
3:	To understand the concepts of matrices.
4:	To understand the concept of vectors and to find out Eigen values.

Course Outcomes (CO):

CO1	Ability to understand the use of limits, differentiation and integration.
CO2	Ability to understand and apply the ordinary differential equations.
CO3	Ability to use matrices to solve linear equations.
CO4	Ability to understand linear independence and dependence of vectors.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I

Differentiation: Limits, Definition, Formulas, Differentiation Rules, Real life applications of Differentiation
Integration: Definition, Indefinite Integral, Integration formulas, Definite Integral and its properties,
Real life applications of Integration

Unit II

Ordinary Differential Equations: Definition, Solution of ordinary differential equation, linear differential equation of first order, initial value problem, linear differential equation of higher order with constant coefficients

Unit III

Matrices-I: Definition of Matrix and Determinant, Type of Matrices, Properties of Determinants, Transpose of a matrix, Inverse of a matrix, Solution of system of linear equations using the inverse of a matrix, Rank of a matrix.

Unit IV

Matrices-II: Vectors, Linear independence and dependence of vectors; Eigen values and Eigen vectors or matrix.

Textbooks:

1. *Higher Engineering Mathematics* by B S Grewal, Khanna Publishing.

References:

1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10th Ed., 2011.

Paper Code(s): BC-183	**L / P**
Paper: Bridge Course in Programming in C	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is NUES, non-credit and qualifying Paper. All examinations to be conducted by the concerned teacher.

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart basic knowledge about simple algorithms for arithmetic and logical problems so that students can understand how to write a program, syntax and logical errors in 'C'.
2:	To impart knowledge about how to implement conditional branching, iteration and recursion in 'C'.
3:	To impart knowledge about using arrays, pointers and structures to develop programs in 'C'.
4:	To impart knowledge about using structures, unions and strings to develop programs in 'C'.

Course Outcomes (CO):

CO1	Ability to write simple programs in in 'C'.
CO2	Ability to implement conditional branching, iteration and arrays in 'C'
CO3	Ability to implement functions and pointers in 'C'
CO4	Ability to use structures, unions and strings in the programs in 'C'.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I

Introduction to Programming: Creating and running programs, Preprocessor, Compilation process, role of linker, idea of invocation and execution of a programme.

Introduction to C language: Basic structure of C programs, C tokens, variables, data types, I/O statements. Inter-conversion of variables.

Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators operator precedence and associativity, evaluation of expressions, type conversions in expressions.

Unit II

Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements.

Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi-dimensional arrays.

Unit III

Functions: User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion.

Pointers: Pointer basics, pointer arithmetic, functions returning pointers, Dynamic memory allocation. Pointers and Strings.

Unit IV

Structures and unions: Structure definition, initialization, accessing structures, structures and functions, self-referential structures, unions, typedef.

Strings: Arrays of characters, variable length character strings, inputting character strings, character library function.

Textbooks:

1. *The C programming language* by B W Kernighan and D M Ritchie, Pearson Education, 1988.

References:

1. *Engineering Problem Solving With C* by Delores M. Etter, Pearson, 2013.
2. *Problem Solving and Program Design in C* by Jeri R. Hanly and Elliot B. Koffman, Pearson, 2016.
3. *ANSI/ISO 9899-1990, American National Standard for Programming Languages 'C'* by American National Standards Institute, Information Technology Industry Council, 1990 (C89).

Syllabus of 2nd Year Papers

Paper Code(s): ES-201	L	P	C
Paper: Computational Methods	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand numerical methods to find roots of functions and first order unconstrained minimization of functions.
2.	To introduce concept of interpolation methods and numerical integration.
3.	To understand numerical methods to solve systems of algebraic equations and curve fitting by splines.
4.	To understand numerical methods for the solution of Ordinary and partial differential equations.

Course Outcomes (CO)

CO 1	Ability to develop mathematical models of low level engineering problems
CO 2	Ability to apply interpolation methods and numerical integration.
CO 3	Ability to solve simultaneous linear equations and curve fitting by splines
CO 4	Ability to numerically solve ordinary differential equations that are initial value or boundary value problems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	2	2	3
CO 2	3	2	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	3	3	2	-	-	-	2	2	2	3
CO 4	3	3	3	3	2	-	-	-	2	2	2	3

UNIT-I

Review of Taylor Series, Rolle ’s Theorem and Mean Value Theorem, Approximations and Errors in numerical computations, Data representation and computer arithmetic, Loss of significance in computation
Location of roots of equation: Bisection method (convergence analysis and implementation), Newton Method (convergence analysis and implementation), Secant Method (convergence analysis and implementation). Unconstrained one variable function minimization by Fibonacci search, Golden Section Search and Newton’s method. Multivariate function minimization by the method of steepest descent, Nelder- Mead Algorithm.

UNIT-II

Interpolation: Assumptions for interpolation, errors in polynomial interpolation, Finite differences, Gregory-Newton’s Forward Interpolation, Gregory-Newton’s backward Interpolation, Lagrange’s Interpolation, Newton’s divided difference interpolation
Numerical Integration: Definite Integral, Newton-Cote’s Quadrature formula, Trapezoidal Rule, Simpson’s one-third rule, simpson’s three-eight rule, Errors in quadrature formulae, Romberg’s Algorithm, Gaussian Quadrature formula.

UNIT-III

System of Linear Algebraic Equations: Existence of solution, Gauss elimination method and its computational effort, concept of Pivoting, Gauss Jordan method and its computational effort, Triangular Matrix factorization methods: Dolittle algorithm, Crout's Algorithm, Cholesky method, Eigen value problem: Power method
Approximation by Spline Function: First-Degree and second degree Splines, Natural Cubic Splines, B Splines, Interpolation and Approximation

UNIT - IV

Numerical solution of ordinary Differential Equations: Picard's method, Taylor series method, Euler's and Runge-Kutta's methods, Predictor-corrector methods: Euler's method, Adams-Bashforth method, Milne's method.
Numerical Solution of Partial Differential equations: Parabolic, Hyperbolic, and elliptic equations
Implementation to be done in C/C++

Textbook(s):
1. E. Ward Cheney & David R. Kincaid , "Numerical Mathematics and Computing" Cengage; 7th ed (2013).

References:

1. R. L. Burden and J. D. Faires, "Numerical Analysis", CENGAGE Learning Custom Publishing; 10th Edition (2015).
2. S. D. Conte and C. de Boor, "Elementary Numerical Analysis: An Algorithmic Approach", McGraw Hill, 3rd ed. (2005).
3. H. M. Antia, "Numerical Methods for Scientists & Engineers", Hindustan Book Agency, (2002).
4. E Balagurusamy "Numerical Methods" McGraw Hill Education (2017).

Paper Code(s): HS-203	**L**	**P**	**C**
Paper: Indian Knowledge System	**2**	**-**	**2**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the Indian knowledge System.
2.	To understand the foundational concepts for science and technology.
3.	To understand the ancient Indian mathematics and astronomy.
4.	To understand the ancient Indian engineering and technology.

Course Outcomes (CO)

CO 1	Ability to understand the Indian knowledge System.
CO 2	Ability to understand and apply foundational concepts for science and technology.
CO 3	Ability to understand and apply ancient Indian mathematics and astronomy
CO 4	Ability to understand ancient Indian engineering and technology.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	-	-	-	-	2
CO 2	-	-	-	-	-	3	-	-	-	2	-	2
CO 3	3	3	-	-	-	-	-	-	-	-	-	2
CO 4	3	3	-	-	-	-	-	-	-	-	-	2

UNIT-I

Indian Knowledge System (IKS) - An Introduction:
Overview of IKS - Importance of Ancient Knowledge; Defining IKS; The IKS Corpus – A Classification Framework; Chaturdaśa-Vidyāsthāna; History of IKS, Some unique aspects of IKS;
The Vedic Corpus – Introduction to Vedas; The Four Vedas and their divisions; Vedāngas; Vedic Life;
Philosophical Systems – Indian Philosophical Systems; Vedic Schools of Philosophy; Non-Vedic Philosophical Systems; Wisdom through the Ages – Purānas, Itihāsa as source of wisdom, Rāmāyana, Mahābhārata, Niti-śāstras, Subhāssitas.

UNIT-II

Foundational Concepts for Science and Technology:
Linguistics - Components of Language; Pānini's work on Sanskrit Grammar; Phonetics in Sanskrit; Patterns in Sanskrit Vocabulary; Computational Concepts in Astādhyāyi, Logic for Sentence Construction; Importance of Verbs; Role of Sanskrit in Natural Language Processing
Number System and Units of Measurement – Number System in India; Salient Features of the Indian Numeral System; Unique approaches to represent numbers; Measurements for Time, Distance and Weight; Pingala and

the Binary System
Knowledge: Framework and Classification – The Knowledge Triangle; Prameya; Pramāna; Samśaya; Framework for establishing Valid Knowledge

UNIT-III

Mathematic and Astronomy in IKS:
Mathematics – Unique aspects of Indian Mathematics; Great Mathematicians and their Contributions; Arithmetic; Geometry; Trigonometry; Algebra; Binary Mathematics and Combinatorial Problems in Chandah-śāstra of Pingala, Magic Squares in India
Astronomy - Unique aspects of Indian Astronomy; Historical Development of Astronomy in India; The Celestial Coordinate System; Elements of the Indian Calendar; Āryabhatiya and the Siddhāntic Tradition; Pancānga; Astronomical Instruments; Jantar Mantar of Rājā Jai Singh Sawai

UNIT - IV

Engineering and Technology in IKS:
Engineering and Technology: Metals and Metalworking – The Indian S & T Heritage; Mining and Ore Extraction; Metals and Metalworking Technology; Iron and Steel in India; Lost wax casting of Idols and Artefacts; Apparatuses used for Extraction of Metallic Components
Engineering and Technology: Other Applications – Literary sources for Science and Technology; Physical Structures in India; Irrigation and Water Management; Dyes and Painting Technology; Surgical Techniques; Shipbuilding; Sixty-four Art Forums; Status of Indigenous S & T

Textbook(s):
1. B. Mahadevan, Vinayaka Rajat Bhat & Nagendra Pavana R.N., "Introduction to Knowledge System: Concepts and Applications" PHI (2022).

References:
1. C.M Neelakandhan & K.A. Ravindran, "Vedic Texts and The Knowledge Systems of India", Sri Sankaracharya University of Sanskrit, Kalady (2010).
2. P.P. Divakaran, "The Mathematics of India: Concepts, Methods, Connections", Springer (2018)
3. C.A. Sharma, "Critical Survey of Indian Philosophy", Motilal Banarasidass Publication (1964)
4. G. Huet, A. Kulkarni & P. Scharf, "Sanskrit Computational Linguistics", Springer (2009).
5. A.K. Bag, "History of Technology in India", Indian National Science Academy, Vol 1, (1997)

Paper Code(s): CIC-205	L	P	C
Paper: Discrete Mathematics	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the concept of Mathematical Logic, concepts of sets, relation and functions
2.	To introduce the concept of Algorithm and number theory
3.	To understand Group theory and related examples
4.	To use Graph theory for solving problems

Course Outcomes (CO)

CO1:	Ability for constructing mathematical logic to solve problems
CO2:	Ability to Analyze/ quantify the efficiency of a developed solution (algorithm) of a computational problem
CO3:	Ability to Understand mathematical preliminaries to be used in the subsequent courses of the curriculum. This includes Boolean algebra, number theory, group theory, and combinatorics.
CO4:	Ability to Understand diverse relevant topics in discrete mathematics and computation theory with an emphasis on their applicability as mathematical tools in computer science.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	-	-	-	2	2	3	3
CO 2	3	3	3	2	2	-	-	-	2	2	3	3
CO 3	3	3	3	3	2	-	-	-	2	2	3	3
CO 4	3	3	3	3	2	-	-	-	2	2	3	3

UNIT – I

Sets, Logic, and Relation: Sets, Subsets, powerset, operations on sets, Propositional Logic, Rules of inferences in propositional logic, Quantifiers, Predicates and validity, Predicate Logic, normal forms. Proof Techniques- Direct Proof, Proof by Contraposition, and proof by contradiction. Principle of inclusion and exclusion, pigeonhole principle, permutation and combination. Principle of Well Ordering, principle of mathematical induction, principle of complete induction. Relation, properties of binary relation, equivalence relation and class, closures (symmetric, reflexive, and transitive).

UNIT – II

Functions, Order relations and Boolean Algebra: Functions, Growth of functions, Permutation functions, Partially ordered sets, lattices, Boolean algebra, Minimization of Boolean Expressions. GCD, LCM, prime numbers.

Recurrence relations, solution methods for linear, first-order recurrence relations with constant coefficients, generating functions, Analysis of Algorithms involving recurrence relations, solution method for a divide-and-conquer recurrence relation. Masters theorem (with proof).

UNIT – III

Group theory: Semi-group, Monoid, Groups, Group identity and uniqueness, inverse and its uniqueness, isomorphism and homomorphism, subgroups, Cosets and Lagrange's theorem, Permutation group and Cayley's theorem (without proof), Normal subgroup and quotient groups. Groups and Coding.

UNIT – IV

Graph theory: Graph Terminology, Planar graphs, Euler's formula (proof), Euler and Hamiltonian path/circuit. Chromatic number of a graph, five color theorem (proof), Shortest path and minimal spanning trees and algorithms, Depth-first and breadth first search, trees associated with DFS & BFS, Connected components. Complexity Analysis of the graph MST.

Textbook(s):
1. B. Kolman, R. C. Busby & S.C. Ross "Discrete Mathematical Structures", 6th edition, PHI/Pearson, 2009.
2. R. L. Graham, D. E. Knuth & O. Patashnik, "Concrete Mathematics", Pearson Education, 2000.

References:
1. Neal Koblitz, "A course in number theory and cryptography", Springer – Verlag, 1994.
2. J.P. Tremblay & R. Manohar, "Discrete Mathematical Structure with Application to Computer Science," TMH, New Delhi (2000).
3. Norman L. Biggs, "Discrete Mathematics", Second edition, Oxford University Press, New Delhi (2002).
4. T .H . Cormen, C . E . Leiserson, R .L . Rivest "Introduction to Algorithms", 3rd edition, PHI/Pearson.
5. Anne Benoit, Yves Robert, Frédéric Vivien "A Guide to Algorithm Design: Paradigms, Methods, and Complexity Analysis", CRC Press, 2013.

Paper Code(s): ECC-207	L	P	C
Paper: Digital Logic and Computer Design	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce basic concepts of Boolean Algebra and Combinational Logic
2.	To introduce various sequential circuits, designing with examples
3.	To relate combination circuit design and sequential circuit design with respect to the design of a computer system
4.	To introduce machine learning, computer arithmetic, modes of data transfer with respect to I/O and Memory organization of a computer

Course Outcomes (CO) :

CO 1	Ability to understand Boolean Algebra and Design Combinational Circuits .
CO 2	Ability to understand and Design Sequential Circuits.
CO 3	Ability to understand Design of a basic computer.
CO 4	Ability to understand Input-Output and Memory Organization of a Computer.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	-	-	-	3	2	2	3
CO 2	3	2	3	2	2	-	-	-	3	2	2	3
CO 3	3	2	3	3	2	-	-	-	3	2	2	3
CO 4	3	3	3	3	3	-	-	-	3	2	2	3

UNIT – I

Boolean Algebra and Combinational Logic: Review of number systems , signed, unsigned, fixed point, floating point numbers, Binary Codes, Boolean algebra – basic postulates, theorems , Simplification of Boolean function using Karnaugh map and Quine-McCluskey method – Implementations of combinational logic functions using gates, Adders, Subtractors, Magnitude comparator, encoder and decoders, multiplexers, code converters , parity generator/checker, implementation of combinational circuits using multiplexers.

UNIT – II

Sequential Circuits: General model of sequential circuits, Flip-flops, latches , level triggering, edge triggering, master slave configuration , concept of state diagram , state table, state reduction procedures , Design of synchronous sequential circuits , up/down and modulus counters , shift registers, Ring counter , Johnson counter , timing diagram , serial adder , sequence detector, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Memory Unit, Random Access Memory

UNIT – III

Basic Computer organization: Stored Program, Organization, Computer registers, bus system, instruction set completeness, instruction cycle, Register Transfer Language, Arithmetic, Logic and Shift Micro-operations, Instruction Codes, Design of a simple computer, Design of Arithmetic Logic unit, shifter, Design of a simple hardwired control unit, Programming the basic computer, Machine language instructions, assembly language, Microprogrammed control, Horizontal and Vertical Microprogramming, Central Processing Unit, instruction sets and formats, addressing modes, data paths, RISC and CISC characteristics.

UNIT – IV

Computer Arithmetic, addition, subtraction, multiplication and division algorithms, Input-Output Organization, Modes of data transfer, Interrupt cycle, direct memory access, Input-Output processor, Memory Organization, Memory Hierarchy, Associative Memory, Cache Memory, Internal and external Memory, Virtual Memory.

Text Book(s)
1. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016
2. M. Morris Mano, Rajib Mall "Computer System Architecture", 3rd Edition Pearson Education, 2017

References:

1. Leach, D. P., Albert P. Malvino, "Digital Principles and Applications", McGraw Hill Education, 8th Edition , 2014
2. Jain, R.P. ,"Modern Digital Electronics", McGraw Hill Education, 4th Edition , 2010
3. Floyd, Thomas L. , "Digital Fundamentals" Pearson Education, 11th Edition, 2017
4. M. Rafiquzzaman, "Fundamentals of Digital Logic and Microcomputer Design", Wiley, 5th Ed., 2005.

Paper Code(s): CIC-209	L	P	C
Paper: Data Structures	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce basics of Data structures (Arrays, strings, linked list etc.)
2.	To understand the concepts of Stacks, Queues and Trees, related operations and their implementation
3.	To understand sets, heaps and graphs
4.	To introduce various Sorting and searching Algorithms

Course Outcomes (CO)

CO 1	To be able to understand difference between structured data and data structure
CO 2	To be able to create common basic data structures and trees
CO 3	To have a knowledge of sets, heaps and graphs
CO 4	To have basic knowledge of sorting and searching algorithms

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	2	2	2	3
CO 2	3	2	2	2	3	-	-	-	2	2	2	3
CO 3	3	2	2	2	3	-	-	-	2	2	2	3
CO 4	3	2	2	2	3	-	-	-	2	2	2	3

UNIT – I

Overview of data structure, Basics of Algorithm Analysis including Running Time Calculations, Abstract Data Types, Arrays, Arrays and Pointers, Multidimensional Array, String processing, General Lists and List ADT, List manipulations, Single, double and circular lists. Stacks and Stack ADT, Stack Manipulation, Prefix, infix and postfix expressions, recursion. Queues and Queue ADT, Queue manipulation.

UNIT – II

Sparse Matrix Representation (Array and Link List representation) and arithmetic (addition, subtraction and multiplication), polynomials and polynomial arithmetic.

Trees, Properties of Trees, Binary trees, Binary Tree traversal, Tree manipulation algorithms, Expression trees and their usage, binary search trees, AVL Trees, Heaps and their implementation, Priority Queues, B-Trees, B* Tree, B+ Tree

UNIT – III

Sorting concept, order, stability, Selection sorts (straight, heap), insertion sort (Straight Insertion, Shell sort), Exchange Sort (Bubble, quicksort), Merge sort (External Sorting) (Natural merge, balanced merge and polyphase merge). Searching – List search, sequential search, binary search, hashing methods, collision resolution in hashing.

UNIT – IV

Disjoint sets representation, union find algorithm, Graphs, Graph representation, Graph Traversals and their implementations (BFS and DFS). Minimum Spanning Tree algorithms, Shortest Path Algorithms

Textbook(s):

1. Richard Gilberg , Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C, 2nd Edition, Cengage Learning, Oct 2004
2. E. Horowitz, S. Sahni, S. Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, Silicon Press (US), 2007.

References:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson, September, 1996
2. Robert Kruse, "Data Structures and Program Design in C", 2nd Edition, Pearson, November, 1990
3. Seymour Lipschutz, "Data Structures with C (Schaum's Outline Series)", McGrawhill, 2017
4. A. M. Tenenbaum, "Data structures using C". Pearson Education, India, 1st Edition 2003.
5. Weiss M.A., "Data structures and algorithm analysis in C++", Pearson Education, 2014.

Paper Code(s): CIC-211	L	P	C
Paper: Object-Oriented Programming Using C++	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the basic Concepts of Object Oriented Programming (data types, operators and functions) using C++
2.	To introduce concepts of Classes and Objects with the examples of C++ programming
3.	To understand object oriented features such as Inheritance and Polymorphism
4.	To use various object oriented concepts (exceptional handling) to solve different problems

Course Outcomes (CO)

CO 1	Ability to have an in-depth knowledge of object oriented programming paradigm
CO 2	To be able to develop basic C++ programming skills
CO 3	To be able to apply various object oriented features using C++
CO 4	Ability to have an understanding of generic programming & standard templates

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT – I

Object Oriented Programming Paradigm, Basic Concepts of Object Oriented Programming, Benefits of Object Oriented Programming, Object Oriented Languages, Applications of Object Oriented Programming, C++ Programming Language, Tokens, Keywords, Identifiers and Constants, Data Types, Type Compatibility, Variables, Operators in C++, Implicit Type Conversions, Operator Precedence, The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Function Overloading, Friend Functions, default parameter value.

UNIT – II

Specifying a class, Member Functions, Encapsulation, information hiding, abstract data types, objects & classes, Static Member Functions, Arrays of Objects, Constructors & Destructors, Parameterized Constructors, Copy Constructors, Dynamic Constructors, Destructors, identity and behaviour of an object, C++ garbage collection, dynamic memory allocation, Explicit Type Conversions, Operator Overloading.

UNIT – III

Inheritance, inheritance methods, Class hierarchy, derivation – public, private & protected, aggregation, Inheritance Constructors, composition vs. classification hierarchies, Containership, Initialization List, Polymorphism, categorization of polymorphic techniques, polymorphism by parameter, parametric polymorphism, generic function – template function, function overriding, run time polymorphism, virtual functions.

UNIT – IV

Standard C++ classes, using multiple inheritance, persistant objects, streams and files, namespaces, exception handling, generic classes, standard template library: Library organization and containers, standard containers, algorithm and Function objects, iterators and allocators, strings, streams, manipulators, user defined manipulators, vectors.

Textbook(s):
1. Stanley B. Lippman, Josée Lajoie, Barbara E. Moo, “C++ Primer”, Addison-Wesley Professional, 2012.
2. Ivor Horton, “Using the C++ Standard Template Libraries”, Apress, 2015.
3. R. Lafore, “Object Oriented Programming using C++”, Galgotia.

References:
1. A.R.Venugopal, Rajkumar, T. Ravishanker “Mastering C++”, TMH
2. Bjarne Stroustrup, “Programming: principles and practice using C++”, Addison-Wesley, 2015.
3. Bjarne Stroustrup, “A Tour of C++”, Addison-Wesley Professional, 2018.
4. Bjarne Stroustrup, “The C++ Programming Language”, 4th Edition, Addison-Wesley Professional, 2013.
5. Peter Van Weert and Marc Gregoire, “C++17 Standard Library Quick Reference: A Pocket Guide to Data Structures, Algorithms, and Functions”, Apress (2019)
6. Rumbaugh et. al. “ Object Oriented Modelling & Design”, Prentice Hall
7. G . Booch “Object Oriented Design & Applications”, Benjamin,Cummings.
8. E.Balaguruswamy, “Objected Oriented Programming with C++”, TMH
9. Steven C. Lawlor, “The Art of Programming Computer Science with C++”, Vikas Publication.
10. Slobodan Dmitrović, Modern C++ for Absolute Beginners”:A Friendly Introduction to C++ Programming Language and C++11 to C++20 Standards”, Apress, 2020.

Paper Code(s): ECC-205	**L**	**P**	**C**
Paper: Signals and Systems	**3**	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To impart understanding about various types of signals and systems, their classifications, analysis and operations.
2.	To impart knowledge of use of transforms in analysis of signals and system.
3.	To impart skill to carry out simulation on signals and systems for observing effects of applying various properties and operations.
4.	To impart strong foundation of communication and signal processing to be studied in the subsequent semester

Course Outcome (CO):

CO 1	Ability to understand about various types of signals and systems, classify them, analyze them, and perform various operations on them.
CO 2	Ability to understand use of transforms in analysis of signals and system.
CO 3	Ability to carry out simulation on signals and systems for observing effects of applying various properties and operations.
CO 4	Ability to create strong foundation of communication and signal processing to be studied in the subsequently.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	2	-	-	-	1	1	1	1
CO 2	3	3	3	3	2	-	-	-	1	1	1	1
CO 3	3	3	3	3	2	-	-	-	1	1	1	1
CO 4	3	3	3	3	2	-	-	-	1	1	1	1

Unit I

Continuous and discrete time signals: Classification of Signals – Periodic aperiodic even – odd – energy and power signals – Deterministic and random signals – complex exponential and sinusoidal signals – periodicity – properties of discrete time complex exponential unit impulse – unit step impulse functions – Transformation in independent variable of signals: time scaling, time shifting. Determination of Fourier series representation of continuous time and discrete time periodic signals – Explanation of properties of continuous time and discrete time Fourier series. Representation of continuous time signals by its sample - Sampling theorem – Reconstruction of a Signal from its samples, aliasing – discrete time processing of continuous time signals, sampling of band pass signals.

Unit II

Continuous time Fourier Transform and Laplace Transform analysis with examples – properties of the Continuous-time Fourier Transform and Laplace Transform basic properties, Parseval's relation, and convolution in time and frequency domains.
Basic properties of continuous time systems: Linearity, Causality, time invariance, stability, magnitude and Phase representations of frequency response of LTI systems -Analysis and characterization of LTI systems using Differential Equations and Continuous time LTI systems. Laplace transform: Computation of impulse response and transfer function using Laplace transform.

Unit III

Discrete time system analysis using Difference equations, Discrete Time Fourier Transform, Discrete Fourier Transform, FFT and their property and usage in the analysis of Discrete time systems.

Unit IV

Basic principles of z-transform - z-transform definition – region of convergence – properties of ROC – Properties of z-transform – Poles and Zeros – inverse z-transform using Contour integration - Residue Theorem, Power Series expansion and Partial fraction expansion, Relationship between z-transform and Fourier transform. Properties of convolution and the interconnection of LTI Systems – Causality and stability of LTI Systems. Computation of Impulse & response & Transfer function using Z Transform.

Textbook(s):
1. Alan V. Oppenheim, Alan S. Willsky with S. Hamid Nawab, "Signals & Systems", 2nd ed., Pearson Education, 1997.
2. Simon Haykin and Barry Van Veen, "Signals and Systems", John Wiley, 1999

References:
1. M. J. Roberts, "Signals and Systems Analysis using Transform method and MATLAB", TMH 2003.
2. K. Lindner, "Signals and Systems", McGraw Hill International, 1999.
3. Moman .H. Hays," Digital Signal Processing ", Schaum's outlines, Tata McGraw-Hill Co Ltd., 2004.
4. B. P. Lathi, "Signal Processing and Linear System", Berkeley Cambridge Press, 1998.
5. H. P. Hsu, "Schaum's Outlines of The Theory and Problems of Signals and Systems", McGraw-Hill, 1995.
6. John G.Proakis and Dimitris G.Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications, 3rd edn., PHI, 2000.

Paper Code(s): ECC-209	**L**	**P**	**C**
Paper: Analog Communication	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To impart understanding of the concepts of analog communication systems.
2.	To impart understanding of various modulation and demodulation techniques of analog communication.
3.	To impart understanding of transmitters and receivers in analog communication.
4.	To impart understanding of the causes of noise and noise performance of analog communication.

Course Outcome (CO):

CO 1	To understand the concepts of analog communication systems.
CO 2	To understand various modulation and demodulation techniques of analog communication.
CO 3	To understand transmitters and receivers in analog communication.
CO 4	To understand the causes of noise and noise performance of analog communication.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

The Communication Process, Review of Fourier Transforms and Dirac Delta Functions, Transmission through Linear Systems, Filters (low pass and band pass signals), Phase and Group Delay, Sources of Information.
Amplitude Modulation: Introduction, Double Sideband – Suppressed Carrier Modulation, Quadrature – Carrier Multiplexing, Single-Sideband and Vestigial-Sideband methods of modulation, Frequency Translation, Frequency-Division Multiplexing

UNIT II

Angle Modulation: Introduction, Basic Definitions, Frequency Modulation, Phase-Locked Loop, Nonlinear Effects in FM Systems, Superheterodyne receiver.

UNIT III

Probability and Random Processes: Introduction; Probability; Random Variables, Statistical Averages; Random Processes; Mean, Correlation, and Covariance functions; Transmission of a Random Process Through a Linear Filter, Power Spectral Density, Gaussian Process, Noise, Narrowband Noise

UNIT IV

Noise: Introduction, Receiver Model, Noise in DSB-SC Receivers, Noise in AM Receivers, Noise in FM Receivers, Pre-emphasis and De-emphasis in FM.

Textbook(s):

1. Simon Haykins and Michael Moher, "Communication Systems" John Wiley &sons Inc, 5th edition, 2009.

References:

1. B P Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", OUP, 5th edition, 2019.
2. H. Taub, D. L. Schilling and Gaotam Saha, "Taub's Principles of Communication Systems", McGraw Hill Eduction, 4th edition, 2017.
3. J. G. Proakis, M. Salehi, "Fundamentals of Communications Systems", Pearson, 2nd Edition, 2014.
4. W. Tomasi, "Electronic communications systems (Fundamentals Through Advanced)", Pearson Education, 5th Edition, 2008.
5. G. Kennedy and B. Davis, "Electronic communication systems", TMH, 4th Edition, 2008 (reprint)

Paper Code(s): ECC-211	L	P	C
Paper: Analog Electronics – I	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To develop understanding of operation, characteristics, parameters and applications of p-n junction diode
2.	To develop understanding about BJT and FET in terms of structure, operation, configurations and characteristics. Also analyse stability and amplifier circuit using small signal models
3.	To impart knowledge of cascade amplifiers, coupling schemes, power amplifiers and their analysis
4.	To impart knowledge of Feedback amplifiers and oscillators

Course Outcome (CO):

CO 1	Ability to understand of operation, characteristics, parameters and applications of p-n junction diode
CO 2	Ability to understand about BJT and FET in terms of structure, operation, configurations and characteristics and able to analyse stability and amplifier circuit using small signal models
CO 3	Ability to understand and analyse cascade amplifiers, coupling schemes in amplifiers and power amplifiers
CO 4	Ability to understand feedback amplifiers and oscillators

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT – I

Open circuit P-N junction diode, Forward and reverse biased diode, I-V characteristics of diode, Diode Equation, Temperature dependence of diode. Breakdown phenomena, diffusion and transition capacitance of diode. Diode equivalent circuit, Ideal diode. Solar cell.

Diode circuits: half-wave and full-wave rectifiers with capacitor filter, clamping and clipping circuits. Zener diodes as voltage regulator.

UNIT – II

Bipolar Junction transistor (BJT): Structure, modes of operation, Configurations, I-V characteristics, early effect, junction voltages; Transistor Biasing: Need of biasing, load line concept, fixed bias, self-bias, collector to base bias, stability factors, Current Mirrors; hybrid model of BJT amplifier, small signal analysis of CE BJT amplifier using h parameter

JFET: Physical structure, I-V characteristics; MOSFET: Depletion and enhancement types, Physical structure and I-V characteristics; FET small-signal model (low & high frequency); MOSFET as resistance and switch,

UNIT – III

Cascade amplifiers: Analysis of cascade amplifier (voltage gain, current gain, input and output impedances); Darlington pair, Cascode amplifier; Types of coupling: DC, RC and Transformer; RC coupled Amplifier and its frequency response; Differential Amplifier: differential and Common mode operation, CMRR.
Power Amplifiers: Classification of output stages (Class A, B, C & AB), Class A Amplifier, Transformer coupled class A amplifier, Push pull amplifiers: Class A and Class B, Harmonic distortion, efficiency, crossover distortion, class AB operation, Class C amplifier.

UNIT – IV

Feedback Amplifiers: classification, Feedback concept, basic feedback topologies, Characteristics of Negative Feedback, Feedback and stability, gain margin, Noise margin,
Sinusoidal Oscillator, Barkhausen criterion, RC phase shift, LC (Colpitt's, Hartley, Clapp), Crystal Oscillator.

Textbook(s):

1. J. Millman, C.C. Halkias and Satyabrata Jit, "Electronic Devices and Circuits", Tata McGraw Hill, 4th ed. , 1998
2. R. L. Boylestad and N. Nashlesky, "Electronic Devices and Circuit Theory", Pearson Education, 11th Ed., 2014

References:

1. Adel S. Sedra and Kenneth C. Smith, "Micro Electronic Circuits Theory and Applications," 5th Edition , OUP, 2004.
2. B. Kumar and S. B. Jain, "Electronic Devices and Circuits"", Prentice Hall of India, 2007
3. S Salivahanan, and N. Suresh Kumar, "Electronic Devices and Circuits", McGraw Hill Education (India), 2018
4. B.P. Singh and Rekha Singh, "Electronic Devices and Integrated Circuits", Pearson Education, 2009.
5. J. J. Cathey, "Schaum's Outline of Theory and Problems in Electronic Devices and Circuits", McGraw Hill, 2002.

Paper Code(s): EEC-209	L	P	C
Paper: Electrical Materials	**3**	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of conducting materials.
2.	To impart the knowledge of insulating materials.
3.	To impart the knowledge of magnetic materials.
4.	To impart the knowledge of special materials.

Course Outcomes (CO)

CO 1	Ability to understand properties and applications of conducting materials.
CO 2	Ability to understand properties and applications of insulating materials.
CO 3	Ability to understand properties and applications of magnetic materials.
CO 4	Ability to understand properties and applications of special materials.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	1	1	2	1	-	1	1	-	1
CO 2	3	2	2	1	1	2	1	-	1	1	-	1
CO 3	3	2	2	1	1	2	1	-	1	1	-	1
CO 4	3	2	2	1	1	2	1	-	1	1	-	1

UNIT I

Conducting Materials: Energy band diagram of conductors, semiconductors and insulators. Conductivity and Resistivity, factors affecting the resistivity, classification of conducting materials, electrical, mechanical and thermal properties and applications of low resistance materials like copper, aluminium, steel, silver, gold, platinum, brass and bronze. Electrical, mechanical and thermal properties and applications of high resistance materials like manganin, constantan, nichrome, mercury, tungsten and carbon. Introduction of super conductors. [T1,T2]

UNIT II

Insulating Materials: Classification of insulating materials, electrical, physical, thermal, chemical, mechanical properties of insulating materials. Thermoplastic and natural insulating materials, Gaseous and liquid insulating materials, properties and applications of ceramics and synthetic insulating materials. . [T1,T2]

UNIT III

Magnetic Materials: Introduction and classification of magnetic materials, permeability, B-H curve, magnetic saturation, hysteresis loop, coercive force and residual magnetism, concept of eddy current and hysteresis loss, curie temperature, magnetostriction effect. Soft and hard magnetic materials, ferro and ferri magnetic materials, special purpose magnetic materials. [T1,T2]

UNIT IV

Special Materials and components: Properties and applications of different materials used in electrical systems like – thermocouples, bimetallic, fusing, and soldering. Introduction to different types of materials used in electromagnetic and electromechanical systems, resistors, capacitors, inductors, special semiconductors used in electrical engineering. [T1,T2]

Textbook(s):

1. Electrical properties of materials by L. Solymer, Oxford University Press, 2014
2. An Introduction to Electrical Engineering Materials, C.S. Indulkar, S.Thiruvengadam, S. Chand Publishing, 4th edition, 2004

Reference Books:

1. Electronic Engineering Materials and Devices,J. Allison, Tata McGraw Hill Education,1973
2. Electrical Materials, Rob Zachariason, Delmar Cengage Learning, 2nd Revised edition 2011
3. Electrical Engineering Materials, Dekker Adrianu., PHI,1st edition, 2011
4. A Course In Electrical Engineering Materials, Seth S P, Dhanpat Rai, 3rd edition, 2011
5. Electrical and Electronic Engineering Materials by S.K. Bhattacharya, Khanna Publishers, New Delhi.

Paper Code(s): EEC-211	L	P	C
Paper: Electrical Machines – I	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of magnetic circuit and EMEC devices.
2.	To understand the concept of DC machines.
3.	To impart the knowledge of single phase transformer.
4.	To impart the knowledge of three phase transformer.

Course Outcomes (CO)

CO 1	Ability to understand the magnetic circuit and working of EMEC devices.
CO 2	Ability to understand the working and applications of DC motors.
CO 3	Ability to analyse of single phase transformer and solution of numerical problems.
CO 4	Ability to analyse of three phase transformer and solution of numerical problems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	1	2	1	-	2	2	-	3
CO 2	3	3	2	2	1	2	1	-	2	2	-	2
CO 3		2	1	2	1	2	1	-	2	2	-	2
CO 4	3	2	2	2	1	2	1	-	2	2	-	2

UNIT I

Principles of EMEC: Fundamentals of Magnetic Circuits, Energy in Electro-Magnetic Systems, Flow of Energy in Electro-Mechanical Devices, Energy and co-energy in Magnetic field, Singly and doubly excited systems, Electromagnetic and Reluctance Torque.
DC Generators: Constructional features, Armature winding details, lap & wave connections, EMF equation, separately excited, shunt, series and compound connected D.C. generators process of voltage build up in shunt generators, Characteristics and applications of separately/self-excited generators. [T1,T2]

UNIT II

DC Generators (Contd.): Armature Reaction, Demagnetizing and Cross-magnetizing armature MMF, Interpoles and compensating windings, commutation process and its improvement.
D.C. Motors: Speed and Torque Equation of D.C. motors, Characteristics of D.C. series, shunt and compound motors and their applications, Starting and speed control of D.C. motors, Braking of D.C. motors, Efficiency and testing of D.C. Machines, Introduction of D.C. servo motor and permanent magnet / brushless D.C. motors.
[T1,T2]

UNIT III

Single phase Transformers: Transformer construction and practical considerations. Equivalent circuit(Exact and approximate), per unit values, Phasor diagram, Transformer testing : open circuit test, Short Circuit test, Sumpner's test, Efficiency and voltage regulation, All day efficiency. [T1,T2]

UNIT IV

3 phase Transformers: Three-phase Bank of Single-phase Transformers, Parallel operations of 1-phase and 3-phase transformers, load division between transformers in parallel. Three winding transformers, Zigzag connections, vector grouping with clock convention, tertiary winding, tap changing, phase conversions-3phase to 2 phase and 3phase to 6 phase.

Special Purpose Transformers: Auto-transformers. Welding, Traction, Instruments and pulse Transformers.

[T1,T2]

Textbook(s):

1. Electric Machinery, A Fitzgerald, Charles Kingsley, Stephen Umans, Tata McGraw Hill Education, 6th Edition, 2002.
2. Electrical Machines with MATLAB, Turan Gnen, CRC Press,Taylor&Francis, 2nd edition, 1998.

Reference Books:

1. The Performance and Design of Alternating Current Machines, M.G. Say, CBS Publishers, 2005
2. Electro-Mechanical Energy Conversion with Dynamics of Machines, Rakosh Das Begamudre, Wiley-Blackwell, 1988.
3. Performance and Design of Direct Current Machines: AE Clayton and NN Hancock, CBSPublishers, 2014
4. Oblems in Electrical Engineering: Power engineering and electronics with answers Partly Solved in I. Units: Parker Smith , CBS Publishers, 9th edition, 2003
5. Electric Machines, I J Nagrath D P Kothari, Mc Graw-Hill Education, 3rd edition, 2011
6. Samarjit Ghosh, "Electrical Machines", Pearson.

Paper Code(s): ECC-213 / ECC-216	L	P	C
Paper: Electromagnetic Field Theory	**3**	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic laws of electrostatics.
2.	To impart the knowledge of electromagnetics.
3.	To impart the knowledge of solution to real life plan wave problems for various boundary conditions.
4.	To impart the knowledge of characteristics and impudence transformation on high frequency transmission lines.

Course Outcomes (CO)

CO 1	Ability to understand the basic laws of electrostatics.
CO 2	To understand the basic laws of electromagnetics.
CO 3	Ability to provide solution of real life plan wave problems for various boundary conditions.
CO 4	To understand the characteristics and impudence transformation on high frequency transmission lines

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Introduction: Review of scalar and vector field, Dot and Cross products, Coordinate Systems-Cartesian, cylindrical and spherical. Vector representation of surface, Physical interpretation of gradient divergence and curl, Transformation of vectors in different co-ordinate systems, dirac-delta function.
Electrostatics: Electric field due to point-charges, line charges and surface charges, Electrostatic potential, Solution of Laplace and Poisson's equation in one dimension, M-method of image applied to plain boundaries, field mapping and conformal transformation, Electric flux density, Boundary conditions. Capacitance: calculation of capacitance for simple rectangular, cylindrical and spherical geometries, Electrostatic energy.
[T1,T2]

UNIT II

Magnetostatics : Magnetic Induction and Faraday's Law, Magnetic Flux Density, Magnetic Field Strength H, Ampere, Gauss Law in the Differential Vector Form, Permeability, Energy Stored in a Magnetic Field, Ampere's Law for a Current Element, Volume Distribution of Current , Ampere's Law Force Law, Magnetic Vector Potential, The Far Field of a Current Distribution, Maxwell's Equations: The Equation of Continuity for Time Varying Fields, Inconsistency of Ampere's Law, Maxwell's Equations, Conditions at a Boundary Surface.
[T1,T2]

UNIT III

Electromagnetic Waves: Continuity equations, Displacement current, Maxwell's equation, Boundary conditions, Plane wave equation and its solution in conducting and non-conducting media, Phasor notation, Phase velocity, Group velocity, Depth of penetration, Conductors and dielectrics, Impedance of conducting medium. Polarization, Reflection and refraction of plane waves at plane boundaries, Poynting vectors, and Poynting theorem. [T1,T2]

UNIT IV

Transmission Lines: Transmission line equations, Characteristic impendence, Distortion-less lines, Input impendence of a loss less line, computation of primary and secondary constants, Open and Short circuited lines, Standing wave and reflection losses, Impedance matching, Loading of lines, Input impedance of transmission lines, RF lines, Relation between reflection coefficient and voltage standing wave ratio (VSWR), Lines of different lengths – λ/2, λ/4, λ/8 lines, Losses in transmission lines, Smith chart and applications, impedance matching Single stub, Double stub. [T1,T2]

Textbook(s):

1. Matthew N. O. Sadiku , "Elements of Electromagnetics", Oxford University Press
2. E. C. Jordon, K. G. Balman, "Electromagnetic Waves & Radiation System" PHI – 2nd Edition

Reference Books:

1. William H. Hayt, "Engineering Electromagnetics", TMH
2. J.D. Kraus, "Electromagnetics", TMH
3. David K. Cheng," Field and Wave Electromagnetic", 2nd Edition, Pearson Education Asia,2001
4. John R. Reitz, "Foundations of Electromagnetic Theory". Pearson

Paper Code(s): ECC-215	**L**	**P**	**C**
Paper: Electronics – I	**3**	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Impart the knowledge of semi-conductor diodes and their applications.
2.	To Impart the knowledge of Transistors.
3.	To Impart the knowledge of code, logic gates and combinational logic circuits
4.	To Impart the knowledge of sequential logic circuits.

Course Outcomes (CO)

CO 1	The students are able to understand the working of various diodes.
CO 2	The students are able to understand the working of transistor and their applications.
CO 3	The students are able to understand the function of logic gates and design of combinational logic circuits.
CO 4	The students are able to understand the function and design of sequential logic circuits.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT-I

Evaluation of Electronics: Energy Band Structures In Metals, Semiconductors And Insulators, Theory Of Semiconductors: Classification Of Semiconductors, Conductivity Of Semiconductors, Carrier Concentration In Intrinsic & Extrinsic Semiconductors, Properties Of Intrinsic And Extrinsic Semiconductors, Fermi Level In A Semiconductor Drift And Diffusion Currents.

Theory of p-n junction Diode: Diode Current Equation, Diode Resistance, Transition Capacitance, Diffusion Capacitance, (Elementary treatment only), Effect of Temperature on p-n Junction Diode, Switching Characteristics,

Special Diodes: Zener Diode, Varactor Diode, Tunnel Diode, Photodiode, Light Emitting Diodes, Schottky Barrier Diode, Applications of Diodes: Half-Wave Diode Rectifier, Full-Wave Rectifier, Clippers and Clampers (Elementary treatment only). [T1]

Unit – II

Bipolar junction transistor: Introduction of transistor, construction, transistor operations, BJT characteristics, load line, operating point, leakage currents, saturation and cut off mode of operations CB, CE, CC configurations, hybrid model for transistor at low frequencies, Introduction to FETs and MOSFETs. [T1]

Unit – III

Number Systems and Codes:- Decimal, Binary, Octal and Hexadecimal Number systems, Codes- BCD, Gray Code, Excess-3 Code, ASCII, EBCDIC, Conversion between various Codes.
Combinational Logic Circuits:- Review of basic gates- Universal gates, Adder, Subtractor ,Serial Adder, Parallel Adder- Carry Propagate Adder, Carry Look-ahead Adder, Carry Save Adder, Comparators, Parity Generators, Decoder and Encoder, Multiplexer and De-multiplexer, ALU, PLA and PAL. [T2]

UNIT- IV

Sequential Logic Circuits: - Latches and Flip Flops- SR, , D, T and MS-JK Flip Flops, Asynchronous Inputs.
Counters and Shift Registers:- Design of Synchronous and Asynchronous Counters:- Binary, BCD, Decade and Up/Down Counters , Shift Registers, Types of Shift Registers, Counters using Shift Registers- Ring Counter and Johnson Counter. [T2]

Textbook(s):
1. S. Salivahanan, N. Suresh Kr. & A. Vallavaraj, “Electronic Devices & Circuit”, Tata McGraw Hill, 2008
2. R.P. Jain, “Modern Digital Electronics”, TMH, 2nd Ed.

Reference:
1. Sedra & Smith, “Micro Electronic Circuits” Oxford University Press, 2000.
2. B.Kumar & Shail Bala Jain, “Electronic Devices And Circuits” PHI.
3. Boylestad & Nashelsky, “Electronic Devices & Circuits”, Pearson Education, 10TH Edition.
4. Morris Mano, Digital Logic and Computer Design”, Pearson.

Paper Code(s): ICC-205	L	P	C
Paper: Engineering Electromagnetics	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic laws of electromagnetism.
2.	To impart the knowledge of solution to real life plane wave problems for various boundary conditions and analyse the field equations for the wave propagation in special cases.
3.	To impart the knowledge of characteristics and carryout impudence transformation on high frequency transmission lines.
4.	To impart the knowledge of the wave propagation on metallic waveguides.

Course Outcomes (CO)

CO 1	To understand the basic laws of electromagnetism.
CO 2	To provide solution of real life plane wave problems for various boundary conditions and analyse the field equations for the wave propagation in special cases.
CO 3	Understand the characteristics and carryout impudence transformation on high frequency transmission lines.
CO 4	Analyze wave propagation on metallic waveguides in modal form.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Vector algebra and vector calculus with significance of del operators-theorems and applications, Maxwell's equations (for static, time varying fields) in integral and differential forms, Continuity equation, boundary conditions for electric magnetic fields, Programmatic solutions to Maxwell's equations using MATLAB, Poisson's and Laplace's equations.

UNIT II

Electromagnetic waves: wave generation and equations in free space, lossy and lossless dielectrics, conductors-skin depth – Plane wave reflection and refraction – Standing Wave – Applications. Wave propagation in lossless and conducting medium, phase and group velocity, Reflection by a perfect conductor, insulator, Brewster Angle, surface impedance. Guided waves and flow of power: Poynting vector and Poynting theorem, applications, power less in a conductor.

UNIT III

Transmission Lines: General solution for transmission lines – Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, meaning of reflection coefficient wavelength and velocity of propagation, distortion less transmission line, impedance matching – quarter wave line, single stub matching, double stub matching, Power transfer, Microstrip transmission line, Smith chart.

UNIT IV

Waveguides: Rectangular waveguide, characteristic of TE and TM waves-cutoff wavelength and phase velocity impossibility of TEM waves in waveguides-dominant mode, Surface currents, Attenuation, impedances. Circular wave guides-solution of field equations in cylindrical coordinates-TE and TM waves in circular guides – wave impedance and characteristic impedance, Microwave cavities: rectangular cavity resonators, circular cavity resonators-Q-factor.
Introduction to antenna: monopole and dipole antenna.

Textbook(s):
1. M. N. O. Sadiku , “Elements of Electromagnetics”, Oxford University Press 2007
2. W. H. Hayt, “Engineering Electromagnetics”, Tata McGraw Hill, 2006

Reference Books:
1. E. C. Jordon, K. G. Balman, “Electromagnetic Waves & Radiation System” Prentice Hall, India
2. G. S. Rao, “Electromagnetic Field Theory and Transmission lines” Wiley India.
3. David M. Pozar, “Microwave Engineering” John Wiley – 2nd edition.

Paper Code(s): EEC-207	L	P	C
Paper: Electrical Machines	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the concepts of DC Machines.
2.	To impart the concepts of Transformers.
3.	To impart the concepts of Induction Motors.
4.	To impart the concepts of Synchronous Motors.

Course Outcomes (CO)

CO 1	Ability to understand working and applications of DC Motors.
CO 2	Ability to understand working and analysis of Transformers.
CO 3	Ability to understand working and applications of Induction Motors.
CO 4	Ability to understand working and applications of Synchronous Machines

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	-	2	1	-	2
CO 2	3	3	1	3	3	2	1	-	3	1	-	2
CO 3	3	3	3	3	3	3	1	-	2	1	-	1
CO 4	3	3	3	3	3	2	1	-	2	1	-	2

UNIT- I

Principles of Electromechanical Energy Conversion.DC machines: construction, armature windings, induced EMF equation, torque production, magnetization curve. Types of generators and motors, characteristics, commutation and interpoles, armature reaction, Speed control of dc motor and starting.
PMDC machine: Introduction and need of brushless motors [T1, T2]

UNIT- II

Transformers: construction, ideal and practical transformer, equivalent circuits, voltage regulation, maximum efficiency criterion. Open circuit and short circuit tests. Phasor diagrams on no load, full load, lagging and leading power factor loads. Three phase transformer.
Introduction to polyphase induction machines, production of rotating magnetic flux vector, principle of operation, importance of air gap, comparison with transformer, types of rotor. [T1, T2]

UNIT- III

Induction motors: Development of an equivalent circuit, estimation of parameters, no load and block rotor tests. Torque slip characteristics, starting of induction motors methods, deep bar and double cage rotor, power relations, speed control of induction motors.

Single phase induction motor, double field revolving theory, starting methods of single phase induction motors, universal motor and introduction to switched reluctance motor. [T1, T2]

UNIT- IV

Synchronous Machine: construction, pitch factor and distribution factor, induced emf equation, equivalent circuits and phasor diagrams, power relations, OCC and SCC characteristics for voltage regulation of alternator, salient pole and cylindrical rotor machines and phasors. Effect of excitation and V curves. Power factor correction and parallel operation of synchronous generator. [T1, T2]

Textbook(s):

1. I.J Nagrath and D.P.Kothari, “Electrical Machines”, Tata Mc Graw Hill, 2010, Fourth Edition.
2. Bhag S. Guru, Huseyin R. Hiziroglu, “Electric Machinery and Transformers”, Oxford Pub., 3rd Ed.

Reference Books:

1. M. V. Deshpande, “Electrical Machines” PHI.
2. PC Sen, “Principles of Electric Machinery and Power Electronics”, Wiley and Sons, Third Edition.
3. Ashfaq Hussain, “Electrical Machines”, Dhanpat Rai.
4. Fitzgeral, A.E. , C.Kingslay & Umans, “Electrical Machines”, Mc Graw Hill.
5. Ghosh, “ Electrical Machines”, Pearson.

Paper Code(s): EEC-213 / EEC-208	L	P	C
Paper: Circuits and Systems	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of various signal and system.
2.	To understand modelling of circuit.
3.	To impart knowledge of theorems in AC circuit.
4.	To impart knowledge of two port network and transfer function.

Course Outcomes (CO)

CO 1	Ability to understand properties of signal and system.
CO 2	Ability to determine transient respond of circuit.
CO 3	Ability to solve AC circuit.
CO 4	Ability to determine two port parameter and transfer function.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	-	-	-	1	1	1	1
CO 2	3	3	3	3	2	-	-	-	1	1	1	1
CO 3	3	3	3	3	2	-	-	-	1	1	1	1
CO 4	3	3	3	3	2	-	-	-	1	1	1	1

UNIT – I

Signals, Classification of Signals, Systems, Classification of Systems, Linear Time Invariant (LTI) Systems; Laplace Transform, z-Transform, Fourier Series and Transform (Continuous and Discrete) and their properties. Laplace Transform and Continuous Time LTI systems, z-Transform and Discrete Time LTI systems, Fourier analysis of signals and systems, State Space Analysis. [T1]

UNIT-II

System modeling in terms of differential equations and transient response of R, L, C, series and parallel circuits for impulse, step, ramp, sinusoidal and exponential signals by classical method and using Laplace transform. [T2]

UNIT – III

AC Circuits: Circuits containing Capacitors and Inductors, Transient Response, Alternating Current and Voltages, Phasors, Impedances and Admittance, Mesh Analysis, Loop Analysis, Nodal Analysis, Thevenin’s and Norton’s Theorem, Y - D and D- Y Transformation, Bridge Circuits. Resonant Circuits, Complex Frequency and Network Function, Two port Networks. Passive Filters. [T2]

UNIT – IV

Graph theory: concept of tree, tie set matrix, cut set matrix and application to solve electric networks.

Two port networks – Introduction of two port parameters and their interconversion, interconnection of two 2-port networks, open circuit and short circuit impedances and ABCD constants, relation between image impedances and short circuit and open circuit impedances. Network functions, their properties and concept of transform impedance, Hurwitz polynomial. [T2]

Textbook(s):

1. B. P. Lathi, "Signal Processing and Linear System", Berkeley Cambridge Press, 1998.
2. A. H. Robbins and W. C. Miller, "Circuit Analysis: Theory and Practice", Thomson Learning/Delmar Pub., 2007.

Reference Books:

1. S. Haykin and B. V. Veen, "Signal and Systems", John Wiley and Sons, 1999.
2. H. P. Hsu, "Schaum's Outlines of The Theory and Problems of Signals and Systems", McGraw-Hill, 1995.
3. S. Madhu, "Linear Circuit Analysis", Prentice Hall, 1988.
4. S. Ghosh, "Signals and Systems", Pearson Education, 2006.
5. S. Poornachandra, "Signal and Systems", Thomson Learning, 2004.
6. M. Nahvi and J. A. Edminister, "Schaum's Outline of Theory and Problems of Electric Circuits", McGraw-Hill, 2003.

Paper Code(s): ECC-219	L	P	C
Paper: Analog Electronics	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of Diodes.
2.	To understand the working of transistor based amplifiers.
3.	To impart the knowledge of operational amplifier and its applications.
4.	To impart the knowledge of various wave form generators.

Course Outcomes (CO)

CO 1	Ability to understand working and application of various Diodes.
CO 2	Ability to analyse various amplifier circuits.
CO 3	Ability to understand working and applications of operational amplifier.
CO 4	Ability to analyse different waveform generators.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	2	2	2	2	1	2	1	-	2	2	-	3
CO 2	3	3	2	2	1	2	1	-	2	2	-	2
CO 3	2	2	1	2	1	2	1	-	2	2	-	2
CO 4	2	2	2	2	1	2	1	-	2	2	-	2

Unit I

Evaluation Of Electronics: Energy Band Structures In Metals, Semiconductors And Insulators, Properties Of Intrinsic And Extrinsic Semiconductors,
Theory of p-n junction Diode: Diode Current Equation, Diode Resistance, Transition Capacitance, Diffusion Capacitance, Switching Characteristics, Special Diodes: Zener Diode, Varactor Diode, Tunnel Diode, Photodiode, Light Emitting Diodes, Schottky Barrier Diode, Applications of Diodes: Half-Wave Rectifier, Full-Wave Rectifier, Clippers and Clampers (Elementary treatment only). [T1]

Unit II

Bipolar junction transistor: Introduction of transistor, construction, transistor operations, BJT characteristics, load line, operating point, leakage currents, saturation and cut off mode of operations CB, CE, CC configurations
Small signal amplifiers: CB, CE, CC configurations, hybrid model for transistor at low frequencies, RC coupled amplifiers, mid band model, gain & impedance, comparisons of different configurations, Emitter follower, Darlington pair, Multistage amplifiers, Feedback amplifiers. [T1]

UNIT III

Linear & Non Linear Wave shaping: , Inverting and non-inverting amplifiers, voltage follower, difference amp, adders, Voltage to current with floating & grounded load, current to voltage converter, practical integrator & differentiator, Clipping & Clamping circuits, Comparators, log/antilog circuits using Op-Amps, precision rectifiers(half & full wave),peak detector, Inverting & non inverting Schmitt trigger circuit.
Waveform generations: Sine wave generator (Phase shift, Wein bridge, Hartley & Colpitts), Barkhausen criteria of oscillations, conditions for oscillation, cystal oscillator. [T2]

UNIT IV

Waveform generators: Square and triangular waveform generators (determine period and frequency), saw tooth wave generator, Astable multi-vibrator, Monostable and Bistable Multivibrator.
Active RC Filters: Idealistic & Realistic response of filters (LPF, BPF, HPF, BRF), Butter worth & Chebyshev approximation filter functions All pass, Notch Filter. IC phase locked loops, IC voltage regulators, IC VCO.
[T2]

Textbook(s):
1. Salivahanan , Suresh Kumar, Vallavaraj, “Electronic Devices and Circuits” TMH, 1999
2. D. Roy Choudhary, Shail B Jain, “Linear Integrated Circuits” New Age Publisher, 1999.

Reference Books:
1. B. Kumar ,Shail Bala Jain, “Electronic Devices and Circuits” PHI.
2. M.Rashid , “Microelectronic Circuit”, Cengage Learning Publication.
3. Sedra & Smith, “Micro Electronic Circuits” Oxford University Press, 2000
4. David A Bell, “Operational Amplifiers and Linear IC’s”, PHI.

Paper Code(s): MEC-205	L	P	C
Paper: Theory of Machines	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge of various types of mechanisms and perform their synthesis by analytical and graphical method.
2.	To develop the understanding of Gears, Gear trains and Gyroscope.
3.	To facilitate students to understand the function and working of flywheels and governor.
4.	To learn and study the phenomena of balancing and mechanical vibrations.

Course Outcomes (CO)

CO 1	Examine various types of mechanisms and execute their kinematic analysis.
CO 2	Explain the concept of Gears, Gear Trains and Gyroscope.
CO 3	Describe the working principle of flywheel and governor.
CO 4	Understand the concept of balancing and mechanical vibration system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	2	-	-	-	-	-	2
CO 3	3	3	3	3	-	2	-	-	-	-	-	2
CO 4	3	3	3	3	-	2	-	-	-	-	-	2

UNIT-I

Mechanisms And Machines: Introduction of Simple mechanism, Different types of Kinematics pair, Grubler's rule for degree of freedom, Grashof's Criterion for mobility determination, Inversions of 4R, 3R-P, and 2R-2P chains. Kinematic Analysis of Planar Mechanisms: Velocity and acceleration diagrams, Application of relative velocity method in Slider crank and four bar mechanism, Instantaneous centre method, Kennedy-Arnold theorem, Acceleration diagrams for simple mechanism.

Cams: Classification, Construction of Cam profile, Analysis of Cams with uniform acceleration, and retardation, SHM, Cycloidal motion.

UNIT-II

Gears and Gear Trains: Classification of gears, Terminology, Geometry of tooth profiles, Law of gearing, Cycloidal and Involute profile, Undercutting and interference, Methods to avoid interference, Condition for minimum number of teeth to avoid interference, Contact ratio, Interference, Simple, Compound and Epicyclic gear trains, Tabular column method for Epicyclic gear trains, Fixing torque.

Gyroscopes: Principles of Gyroscope, Effect of Gyroscopic couple on automobiles, ships and aircrafts.

UNIT-III

Dynamic Analysis: Analysis of single slider crank mechanism for displacement, velocity and acceleration using analytical method, Klein's Construction, Turning moment diagrams, Flywheel.
Mechanical governors:Function of a governor, types of governors: weight and spring loaded, Hunting and Sensitivity, efforts and power of a governor, controlling diagrams.

UNIT - IV

Balancing: Static and Dynamic balancing, balancing of rotating and reciprocating masses, single and multicylinder engines.
Vibrations: Free vibration of a body, single degree of freedom system, Rayleigh method, free vibrations with viscous damping, Logarithmic decrement, Response of damped spring mass system to harmonic forces, Whirling of shafts, Vibration isolation, Transmissibility Ratio.

Textbook(s):

1. S.S. Rattan, "Theory of Machines", Tata McGraw Hill.
2. V.P. Singh, "Theory of Machines", Dhanpat Rai & Co.(P)Ltd.

References:

1. J E Shigley "Theory of Machines", Pearson.
2. Thomas Beven, "The Theory of Machines", CBS Publishers.
3. R.L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill.
4. P.L. Ballaney, "Theory of Machines & Mechanism", Khanna Publishers.

Paper Code(s): MEC-207	L	P	C
Paper: Strength of Materials	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about different types of load conditions and determine the stress, strain and change in geometrical parameters of different types of materials.
2.	To understand the resistance mechanism of beams due to bending and shearing.
3.	To understand the principal stresses, behaviour of torsional members, columns and failure mechanisms in materials.
4.	To understand the difference between thin & thick pressure vessels and the design of springs.

Course Outcomes (CO)

CO 1	Evaluate the stress induced in structural members subjected to tension, compression, tangential and thermal loads.
CO 2	Analyse the performance of the beam for different types of loads and support conditions using SFD and BMD and determine the bending stress, shear stress and deflection induced.
CO 3	Analyse the stress induced in columns and members under torsion.
CO 4	Distinguish between thin and thick pressure vessels and estimate the different stresses induced in pressure vessels and springs.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Simple Stresses & strains: Concept of stress and strain. Hooke's law, Stress-Strain diagram, factor of safety, Elongation of tapering bars of circular and rectangular cross sections, Elongation due to self-weight. Saint Venant's principle, Compound bars, state of simple shear, complementary shear stress, Volumetric stresses and Strains, Elastic constants and their relationship, Thermal stresses, Compound section subjected to thermal stresses, Sudden, gradual & impact load, Strain energy & Proof Resilience, Strain energy under normal and shear stress.

UNIT-II

Shear Force and Bending Moment in Beams: Types of beams, supports and loadings, Definition of bending moment and shear force, Sign conventions, relationship between load intensity, Bending moment and shear force, Shear force and bending moment diagrams for statically determinate beams subjected to points load, Uniformly distributed loads, Uniformly varying loads, Couple and their combinations.

Bending and Shear Stresses in Beams: Introduction, Pure bending theory, Assumptions, Derivation of bending equation, Modulus of rupture, Section modulus, Flexural rigidity, Beam of uniform strength, Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for circular, rectangular, ‘I’, and ‘T’ sections, Castigliano’s theorem, Shear Centre (only concept).

Slope and deflection of Beams: Definition of slope, Deflection and curvature, Sign conventions, Derivation of moment curvature equation, Double integration method, Macaulay’s method and Principle of superposition method, Slope and deflection for standard loading cases and for determinate prismatic beams subjected to point loads, UDL, UVL and couple. [12]

UNIT-III

Columns: Introduction, Short, Medium and Long columns, Slenderness ratio, Euler’s theory; Assumptions, Derivation for Euler’s Buckling load for different end conditions, Limitations of Euler’s theory, Rankine-Gordon’s formula for columns.

Torsion: Stresses and strains in pure torsion of solid circular shafts and hollow circular shafts, Power transmitted by shafts, Shaft in series and parallel, Combined bending and torsion.

Compound stresses and strains: State of stress at a point, General two-dimensional stress system, Principal stresses and strains, Principal planes. Mohr’s circle of stresses, Theories of Failures.

UNIT - IV

Springs: Analysis of Close-coiled helical springs, Springs in series and parallel, Stress in leaf springs.

Pressure vessels: Thin cylindrical and Spherical vessels subjected to internal pressure, Hoop stresses, Longitudinal stress and change in volume, Thick cylinders subjected to internal and external pressure, Lame’s equation, Radial and hoop stress distribution.

Textbook(s):

1. Sadhu Singh, “Strength of Materials”, Khanna Pub.
2. S.S. Bhavikatti, “Strength of Materials”, Vikas Publishers;(2000)
3. R.K. Bansal, “A Textbook of Strength of Materials”, Laxmi Publications; 4th ed.(2010)

References:

1. S.P. Timoshenko and J. Gere, “Elements of Strength of Materials”, East-West affiliated, New Delhi.
2. R.C. Hibbler, “Mechanics of Materials”, Prentice Hall, New Delhi;(1994)
3. L.S. Sri Nath et.al., “Strength of Materials”, McMillan, New Delhi;(2001)
4. Eger P. Popov, “Engg. Mechanics of solids”, Prentice Hall, New Delhi;(1998)
5. Roger T. Fenner, “Mechanics of Solids”, U.K. B.C. Publication, New Delhi;(1990)

Paper Code(s): MEC-209	L	P	C
Paper: Manufacturing Science & Technology - I	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To acquire knowledge in casting processes and develop an understanding of the various variables which control the casting process.
2.	To introduce students to different welding processes, weld testing and advanced processes.
3.	To acquire a fundamental knowledge on metal forming technology.
4.	To make student familiar with the various sheet metal work and powder metallurgy.

Course Outcomes (CO)

CO 1	Understand the working of different manufacturing processes and apply knowledge to use appropriate manufacturing process based on the need.
CO 2	Identify the capabilities of the different manufacturing processes.
CO 3	Analyse the different design aspects of the manufacturing processes
CO 4	Evaluate the effects of process parameters on the performance of Manufacturing processes and prepare a report in a team for different processes.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	-	-	2	-	-	-	-	-	-
CO 2	3	2	2	-	-	2	-	-	-	-	-	-
CO 3	3	3	3	2	-	2	-	-	-	-	-	-
CO 4	3	3	3	3	-	2	-	-	3	3	-	-

UNIT-I

Casting: Introduction to sand moulding, Testing of moulding sand, Moulding and core making machine, Design of metal moulds, Gating system and its design, Riser design and its placement, Mould filling time, Melting, Pouring and Fluidity, Selection of melting furnaces, Control of melt and Cupola charge calculations, Solidification of pure metals and alloys, Solidification time, Fundamentals of Casting of complicated shapes: automotive components, casting of light alloys – Aluminium, Magnesium and Titanium alloys and Other casting processes, like investment, continuous, slush, squeeze casting, stir casting.

UNIT-II

Welding: Types of metal transfer in arc welding, Analysis of Voltage-Arc length Characteristics, Welding processes like GTAW, GMAW and SAW processes and their recent variants, Plasma arc welding process: transferred and non- transferred arc welding and their applications, Plasma cutting, Surfacing and plasma spray forming, Explosive, Ultrasonic, Laser Beam, Electron Beam, Friction Stir, Thermit, Atomic Hydrogen welding, Cold metal transfer Welding, Resistance welding, Soldering and brazing, welding of special materials – Stainless steel, Aluminium etc. weldability of cast iron, steel, stainless steel, aluminium alloys, Soldering, Brazing and their applications, Joint design, welding symbols and Joint evaluation through destructive and non-destructive testing methods, Defects in welding: causes and remedies, Related numerical problems on electric arc welding and resistance welding.

UNIT-III

Forming: Plastic deformation of metals, Elements of theory of plasticity, Flow curve, True stress & true strain, stress-strain relationships, Yield criteria for ductile metals, Von Misses & Teresa yield criteria, combined stress tests, Hot working and Cold working, Friction and lubrication in metal working, Analysis of bulk forming Process: Extrusion: Analysis of extrusion process, extrusion pressure, Rolling: Forces & geometrical relationship in rolling, Rolling load and torque in cold rolling, Von-Karman work equation, Wire and Tube Drawing, Drawing stress, Reduction factor, Unconventional forming processes, Defects in metal forming.

UNIT - IV

Sheet Metal and other Processes: Classification - conventional and HERF processes-presses-types and selection of presses, formability of sheet metals- principle, process parameters, equipment and application of the following processes: deep drawing, spinning, stretch forming. Plate bending, spring back, press brake forming, Introduction to forming, electro hydraulic forming, magnetic pulse forming. Introduction to press work – coining, embossing etc., Design of sheet metal dies. Powder Metallurgy: fabrication routes, powder size determination – micro and nano level, powder consolidation routes, compacting, sintering, hot pressing, sintering, hot isostatic pressing, field assisted sintering technologies.

Textbook(s):

1. Kalpakjian, “Manufacturing Engineering and Technology”, Addison Wesley.
2. A. Ghosh and A.K. Mallik, “Manufacturing Science”, East West Press.

References:

1. M.P. Groover, “Modern Manufacturing Processes”.
2. R. W. Heine, C. R. Loper and P. C. Rosenthal, “Principles of Metal Casting”, Tata-McGraw Hill.
3. G. E. Dieter, “Mechanical Metallurgy (Part IV)”, Tata-McGraw Hill.
4. B. Avitzur, “Metal Forming: Processes and Analysis”.
5. G.W. Rowe, “Industrial Metal Working Processes”.

Paper Code(s): MEC-211	L	P	C
Paper: Thermal Engineering – I	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concepts of laws of thermodynamic and apply them to determine the feasibility of any process.
2.	To understand the principles of pure substance and to be able to determine exergy of any system.
3.	To understand the principle of vapour power cycle and its thermal refinement.
4.	To understand the working of I.C engine and Gas Turbine engine and able to compute its performance parameters.

Course Outcomes (CO)

CO 1	Develop understanding of first and second law of thermodynamics and use it to determine feasibility of a process
CO 2	Evaluate the properties of a pure substance using different property relations and determine entropy changes for different types of processes and the reversibility or irreversibility of such processes.
CO 3	Analyze the performance of simple Rankine cycle and improve its performance with thermal refinement.
CO 4	Examine various gas power cycles and their applications in automotive and aviation sector.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	2	-	-	-	-	2
CO 3	3	3	3	3	-	-	2	-	-	-	-	2
CO 4	3	3	3	3	-	-	2	-	-	-	-	2

UNIT-I

Basic definitions and Laws of Thermodynamics: Thermodynamic systems: Closed, Open and Isolated systems, Microscopic and Macroscopic view, Intensive and Extensive properties, Zeroth law of Thermodynamics, Phase, State, Process, Cycle, Point functions and Path functions, Work and Heat, First Law of Thermodynamics, Internal energy, Non flow processes, Concept of Flow work, Analysis of steady flow and unsteady flow processes and their applications, Limitations of First law, Second Law of Thermodynamics, Reversible and Irreversible processes, Reversed Carnot cycle, Carnot‘s Theorem, Clausius inequality, Entropy, Change in Entropy during various processes.

UNIT-II

Availability and Irreversibility: High grade and low grade energy, Available and unavailable energy, Dead state, Loss of available energy due to Heat transfer through a Finite temperature difference, Availability, Reversible

work and Irreversibility, Availability in non flow systems, Second law efficiency.
Thermodynamic Property Relations: Maxwell Relations, Clapeyron Equation.
Properties of a Pure Substance: Phase equilibrium of a pure substance on T-V diagram, Normal boiling point of Pure substance, Saturation states, Compressed liquid, P-V & P-T diagram of a pure substance, Steam and its different states, Use of Steam tables and Mollier diagram, Different processes of vapour on P-V and T-S diagrams, Measurement of Dryness fraction.

UNIT-III

Vapour Power Cycles: Carnot vapour power cycles, drawbacks as a reference cycle, Simple Rankine cycle, description, T- S diagram, Analysis for performance, comparison of Carnot and Rankine cycles, Effects of pressure and temperature on Rankine cycle performance, Actual vapour power cycles, Ideal and practical regenerative Rankine cycle, open and closed feed water heaters, Reheat Rankine cycle.
Boiler: Classification of Boiler, Boiler mountings and Boiler Accessories, Once through Boiler, Working and construction of Babcock and Wilcox boiler, Lancashire boiler.

UNIT – IV

Gas power cycle: Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, Two stroke and Four stroke Cycles, Working of S.I Engine and C.I Engine, Valve timing diagram of S.I engine and C.I engine.
Gas Turbines: Brayton cycle, Thermal refinements, Performance of Gas turbines, Combined cycle, Principles of Jet Propulsion, Turbojet engines.

Textbook(s):
1. P K Nag Basic and Applied Thermodynamics 5th edition McGraw Hill
2. Mathur & Sharma Internal Combustion Engine, Dhanpat Rai Publication.

References:
1. M.J. Moran & H.N. Shapiro "Fundamentals of Thermal Engineering" John Wiley & sons.
2. S L Somasundaram "Engineering Thermodynamics", New Age International Publishers.
3. R. K. Rajput, "Engineering Thermodynamics", Lakshmi Publications
4. Y. A. Cengel & M. A Boles "Thermodynamics- An Engineering Approach ", 6th edition Tata McGraw Hill
5. Gordon Rosers, & Yon Mahew; Engineering Thermodynamics", Pearson.

Paper Code(s): CEC-205	L	P	C
Paper: Structural Analysis – I	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To know the concept of stress and strain for the calculation of internal forces in the structural member.
2.	To know the concept of shear force and bending moment.
3.	To calculate deflection in beams and column
4.	To familiarize students about the failure modes of materials.

Course Outcomes (CO)

CO 1	Define stress, strain, elastic constants, Hooke’s Law, shear force, bending moment.
CO 2	Construct Mohr circle , shear force diagrams and bending moment diagrams to solve complex problems.
CO 3	Analyze principal stresses and principal strains, load carrying capacity of long columns with different end conditions.
CO 4	Determine bending and shear stress, slope and deflection of beams using various techniques, torsion of shafts.

Course Outcomes (CO) to Programme Outcomes (PO) mapping

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	-	2	-	-	-	-	-	-	-	-	-	-
CO 3	-	3	-	-	-	-	-	-	-	-	-	-
CO 4	-	3	-	-	-	-	-	-	-	-	-	-

UNIT-I

Simple Stresses and Strains
Introduction, Normal and Shear stresses, Stress-Strain Diagrams, Hook’s law, Modulus of elasticity, Elastic Constants, Principle stresses and strains, Mohr’s circle.
One dimensional loading & Torsion
One dimensional loading on members of varying cross-section. Torsion: Introduction, Torsion of shafts of circular section, torque and twist- shear stress due to torque

UNIT-II

Shear Force and Bending Moment
Types of beams, loads and supports, shear force and bending moment diagram, bending stresses and shear stresses in beams.
Deflection of Beams
Deflection due to bending: The moment curvature relation, Macaulay’s method, Moment area and Conjugate

beam method, Deflection of determinate plane frames using strain energy and unit load method, Elastic curve sketch.

UNIT-III

Analysis of determinate structure

Classification of Structures, Stress Resultants, Degree of Freedom per node, Static and Kinematic degrees of indeterminacy. Work and Energy. Strain energy of deformable systems, Betti's theorem of reciprocal work and Maxwell's theorem. Principle of virtual work and complementary virtual work, Principle of total minimum stationary potential energy, Stable and unstable equilibrium, Castigliano's Theorem I and II

UNIT - IV

Columns and Struts

Theory of Columns, long column and short column, Euler's formula, Columns with eccentric axial loads, Rankine's formula, Secant formula, Buckling and stability, slenderness ratio, combined bending and direct stress, effect of end conditions on column buckling.

Textbook(s):

1. A Textbook of Strength of Materials, Prof. R. K Bansal, Laxmi Publications.
2. Strength of Materials, RK Rajput, S Chand
3. Strength of Materials, B.C. Punmia, Laxmi Publications.

References:

1. Strength of Materials, Vol. I: Elementary Theory and Problems Paperback – 2004 ,S. Timoshenko CBS Publishers & Distributors Pvt. Ltd., New Delhi
2. Strength of Materials by Pytel and Singer, Harper Collins.
3. Strength of Materials by Ryder, Macmillan.
4. Strength of Materials by Timoshenko and &Youngs, East West Press.
5. Mechanics of Materials, Popov Nagarjan & Lu, Prentice Hall of India, N. Delhi.

Paper Code(s): CEC-207	**L**	**P**	**C**
Paper: Structural Design - I	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To develop basic understanding of reinforced concrete and steel as a construction material
2.	To develop understanding of various design philosophies and their differences.
3.	To understand mix design and its implementation in structure.
4.	To understand and analyse construction management in structure.

Course Outcomes (CO)

CO 1	Define different types of concrete its characteristic and parameters as per the requirement of the structure.
CO 2	Infer the properties of concrete, the concept of design philosophies, and behavior of load bearing masonry walls and the principles of retaining wall.
CO 3	Identify preliminary data of concrete structure by the code recommendations and concept of limit states.
CO 4	Analyse construction management methods including project scheduling and networking.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	2	-	-							-	-	-
CO 2		2	3	-	-	-	1	-	-			
CO 3	-	-	2	-		2	-	-	-			
CO 4	-	2	-	-			-	-	-	-	3	-

UNIT-I

Construction Materials:Properties of Cement & Aggregate, Bulking of Sand. Hydration of cement, initial and final setting type.

Structural Steel – Composition and its type, material properties and behaviour; stress strain curve, relaxation of steel.

Concrete**:** Mechanical properties of concrete: elastic modules, poisson's ratio, creep, shrinkage and durability of concrete.

UNIT-II

Working stress and Limit state design concepts.

Introduction to Various Design Philosophies including characteristic strength, Partial Safety Factor, Factored Load, Design stress strain curve. Assumptions in Limit State Design Method. Constituents, mix design, short-term and long-term properties**. (IS 456, IS 800, IS 10262)**

UNIT-III

Structural Steel, and its designation as per **IS: 800:2007**, Properties of Structural steel. Basics of types of members (Tension member, Compression member and flexural member)
Connections – Types of connections. Rivet Connections, Bolted Connections and Welded Connections.

UNIT- IV

Project Planning: Project Scheduling, Controlling, Method of Planning.
PERT & CPM: Activity time estimate, Start and finish time of Activities, Critical Path and critical activities. Development of PERT Network. Time estimate using PERT.

Textbook(s):

1. S.K. Duggal, "Building Materials", New Age International Publications.
2. L.S Negi, "Design of Steel Structure", Tata McGraw-Hill.
3. N Subramanyam, "PERT & CPM", Tata McGraw-Hill.

References:

1. Jain A.K., "Limit State Design of Reinforced Concrete Structures"., Nem Chand Publishers, Roorkee.
2. B.C. Purnima , R.C.C. Designs, Laxmi Publication
3. Raju K., "Reinforced Concrete", New Age International (P) Ltd., New Delhi.
4. Unikrishna Pillai S., "Reinforced Concrete Design"., Tata McGraw Hill Publishing Company Ltd., New Delhi.

Paper Code(s): CEC-209	L	P	C
Paper: Fluid Mechanics	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce fundamentals of stagnant fluid.
2.	To elaborate fundamentals of flowing fluid and governing equations
3.	To understand fluid flow through different conduits and measurement techniques for it.
4.	To study the effect of fluid flow using the concepts of dimensional analysis

Course Outcomes (CO)

CO 1	Define the fundamental properties of fluid.
CO 2	Explain pressure forces acting on body(submerged and floating)
CO 3	Solve flow rate problems to determine the flow condition and forces exerted
CO 4	Examine flow around Models or Prototype using Dimensional Analysis approach.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1	-	-	-	-	-	1	-	-
CO 2	3	3	3	2	2	-	-	-	-	1	-	-
CO 3	3	3	2	1	1	-	-	-	-	1	-	-
CO 4	2	3	3	3	1	-	-	-	-	1	-	-

UNIT-I

Introduction: Fluid properties, Ideal and real fluids, Density, Specific weight, specific volume, compressibility, specific gravity, Concept of viscosity, viscometer, cohesion, adhesion, surface tension, Capillarity, Newtonian and Non Newtonian Fluids;
Fluid Statics: Fluid pressure and its measurement, types of manometers, Total pressure and centre of pressure, principles of equilibrium, buoyancy, centre of buoyancy, meta centre, stability conditions of floating and submerged bodies, Evaluation of pressure force on dams, lock gates, curved surfaces, pressure distribution in liquid subjected to constant horizontal/vertical acceleration.

UNIT-II

Fluid Kinematics: Variation of flow parameters in space and time, Lagrangian and Eularian concepts in fluid motion, Types of fluid flow: steady and unsteady, uniform and non-uniform, rotational and irrotational, Laminar and turbulent, one, two and three dimensional flow, control volume, streamline, pathline and streakline, Continuity equation and its applications, Velocity potential and stream function, Cauchy-Riemann equation, flownet.
Types of motion: Linear translation, linear deformation, Angular deformation, Rotation, Vorticity, Free and forced vortex flow

UNIT-III

Fluid Dynamics : Newton's, Reynolds's, Navier-Stokes and Euler's equations of motion, Derivation of Bernoulli's equation from Euler's equation and its limitations, Applications of Bernoulli's equations-Orifice and Mouth piece, Orifice-meter, Venturimeter, Weir and notch, Pitot's tube, Siphon, etc; hydraulic gradient and total energy lines and their Engineering significance. Momentum equation, Moment of momentum equation-Assumptions and limitations, applications, impact of jets and forces in bends.

UNIT - IV

Dimensional and Model Analysis: Dimensional homogeneity, methods of dimensional analysis, Buckingham's π theorem, selection of Repeating variables, Forces acting on moving fluid, Dimensionless numbers and their Engineering significance, Model analysis, Geometric, Kinematic and Dynamic similarity, Model testing of partially submerged bodies, scale ratios for distorted models.

Textbook(s):
1. P. N. Modi and S. M. Seth "Hydraulics and Fluid Mechanics (incl Hydraulic Machines)" Standard Publications
2. Frank White, "Fluid mechanics" Tata McGraw Hill Publications.

References:
1. S. Ramamrutham, Hydraulics Fluid Mechanics and Fluid Machines, Dhanpat Rai Publishing Company
2. Victor Streeter, "Fluid Mechanics", International Edition, Tata McGraw Hill Publications.
3. Hughes and Brighton, "Fluid Mechanics", Tata McGraw Hill.
4. Neville, "Fluid Mechanics", Pearson Education.

Paper Code(s): CEC-211	L	P	C
Paper: Geomatics Engineering	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To know the different methods and techniques used in surveying and the applications.
2.	To apply concepts of tachometry and levelling in surveying difficult and hilly terrains to obtain the topographical map of area.
3.	To use survey instruments in carrying out survey, collect data, write reports and able to perform required calculations.
4.	To build a map or plan of an area using surveying and levelling.

Course Outcomes (CO)

CO 1	Ability to understand the basic principles of surveying.
CO 2	Analyse and explain the various methods used in surveying and levelling.
CO 3	Apply the concepts various types of surveying in computation of distance, direction and elevation.
CO 4	Compare types of errors for different surveying techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	3	-	-	-	-	-	-	-	-	-
CO 2	1	-	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	2	-	2	-	-	-	-	-	-	-
CO 4	-	2	2	-	-	-	-	-	-	-	-	-

UNIT-I

Linear Measurement: Introduction, Principles of chain survey, use and adjustment of various instruments employed in chain survey, chaining on sloping grounds, Offsets and error in offsets, Obstructions in chaining, chaining angles, Errors and sources of error, Introduction to advance linear measuring instruments, Field book.
Compass Survey: Use and adjustment of prismatic and surveyor's compass, Methods of surveying with a compass, Magnetic declination, local attraction, Errors in prismatic survey, plotting of compass survey, distribution of closing error.

UNIT-II

Levelling: definitions of terms used in levelling, different types of levels, parallax, staves, adjustments, bench marks, classification of levelling, booking and reducing the levels, rise and fall method, line of collimation method, errors in levelling, permanent adjustments, Two peg test, reciprocal levelling, Corrections to curvature and refraction, cross sections and longitudinal levelling.

Trigonometric Levelling: Definitions & terms, curvature & refraction Methods: direct & reciprocal, eye and object correction, coefficient of refraction. Contours: Definition, representation of reliefs, horizontal equivalent, contour interval, characteristics of contours, methods of contouring, contour gradient, uses of contour maps.

UNIT-III

Theodolite Traversing: types of theodolities, measurement of angles, temporary and permanent adjustments, closed & open traverse consecutive and independent co-ordinates, advantages & disadvantages of traversing closing error, Bowditch, Transit rules.

Triangulation: Principal, selection of base line and stations, order of triangulation, triangulation figures,scaffold and signals, marking of stations, Intervisibility and heights of stations, satellite stations, base linemeasurement and corrections, Introduction to adjustment of observations.

UNIT - IV

Photogrammetric Survey: Basic principles, elevation of a point, determination of focal length of lens, aerial camera, scale of a vertical photograph, relief displacement of a vertical photograph, height of object from relief displacement.

Curves: Types of curves, Elements of a curve, Simple curves, different methods of setting out, Introduction to compound, reverse, transition and vertical curves. Introduction to modern surveying Instruments /Techniques like Total station; Basics of remote sensing &GPS etc.

Textbook(s):
1 Surveying ,B.C. Punmia Vol - I,/II, Laxmi Publication
3 Surveying Vol -1 by K.R. Arora

References:
1. Plane and Geodetic Surveying by D. Clark
2. Plane and Geodetic Surveying by S. Ramamrutham
2 Surveying Vol.2, Duggal, McGraw Hill Education (I) Pvt.Ltd.
4 Surveying and Levelling by R. Subramanian

Paper Code(s): ECC-217	L	P	C
Paper: Analog and Digital Electronics	**3**	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of different types of Diodes.
2.	To impart the knowledge of Transistors.
3.	To impart the knowledge of logic gates and flip flops.
4.	To impart the knowledge of operational amplifier.

Course Outcomes (CO)

CO 1	Ability to understand working and applications of various Diodes.
CO 2	Ability to understand working of Transistors.
CO 3	Ability to understand function of gates and flip flops.
CO 4	Ability to understand applications of operational amplifier.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT-I

Evaluation of Electronics: Energy Band Structures In Metals, Semiconductors And Insulators, Theory Of Semiconductors: Classification Of Semiconductors, Properties Of Intrinsic And Extrinsic Semiconductors,
Theory of p-n junction Diode: Diode Current Equation, Diode Resistance, Effect of Temperature on p-n Junction Diode, Switching Characteristics, Special Diodes: Zener Diode, Varactor Diode, Tunnel Diode, Photodiode, Light Emitting Diodes, Schottky Barrier Diode, Applications of Diodes: Half-Wave Diode Rectifier, Full-Wave Rectifier, Clippers and Clampers (Elementary treatment only). [T1]

UNIT – II

Bipolar junction transistor: Introduction of transistor, construction, transistor operations, BJT characteristics, load line, operating point, leakage currents, saturation and cut off mode of operations CB, CE, CC configurations, hybrid model for transistor at low frequencies, Introduction to FETs and MOSFETs. [T1]

UNIT – III

Number Systems and Codes:- Decimal, Binary, Octal and Hexadecimal Number systems Conversion between various Codes.

Logic Circuits:- Review of basic gates- Universal gates, Adder, Subtractor , Comparators, - Latches and Flip

Flops- SR, , D, T and MS-JK Flip Flops [T2]

UNIT- IV

Op-Amp and its applications: Inverting and Non-inverting amplifiers, adder, sub-tractor, integrators, differentiator, instrumentation amplifiers, oscillators, multi vibrators, A to D and D to A converter. [T1]

Textbook(s):

1. S. Salivahanan, N. Suresh Kr. & A. Vallavaraj, "Electronic Devices & Circuit", Tata McGraw Hill, 2008
2. R.P. Jain, "Modern Digital Electronics", TMH, 2nd Ed.

Reference Books:

1. Sedra & Smith, "Micro Electronic Circuits" Oxford University Press, 2000.
2. B.Kumar & Shail Bala Jain, "Electronic Devices And Circuits" PHI.
3. Boylestad & Nashelsky, "Electronic Devices & Circuits", Pearson Education, 10TH Edition.
4. Morris Mano, Digital Logic and Computer Design", Pearson.

Paper Code(s): ES-251	**L**	**P**	**C**
Paper: Computational Methods Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Computational Methods) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Implementation to be done in C/C++

1. Program for finding roots of f(x)=0 Newton Raphson method.
2. Program for finding roots of f(x)=0 by bisection method.
3. Program for finding roots of f(x)=0 by secant method.
4. To implement Langrange's Interpolation formula.
5. To implement Newton's Divided Difference formula.
6. Program for solving numerical integration by Trapezoidal rule
7. Program for solving numerical integration by Simpson's 1/3 rule
8. To implement Numerical Integration Simpson 3/8 rule.
9. Inverse of a system of linear equations using Gauss-Jordan method.
10. Find the Eigen values using Power method.
11. Program for solving ordinary differential equation by Runge-Kutta Method.

Paper Code(s): ECC-253	**L**	**P**	**C**
Paper: Digital Logic and Computer Design Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Digital Logic and Computer Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Design and implementation of adders and subtractors using logic gates.
2. Design and implementation of 4-bit binary adder/subtractor.
3. Design and implementation of multiplexer and demultiplexer.
4. Design and implementation of encoder and decoder.
5. Construction and verification of 4-bit ripple counter and Mod-10/Mod-12 ripple counter.
6. Design and implementation of 3-bit synchronous up/down counter.
7. Design and computer architecture: Design a processor with minimum number of instructions, so that it can do the basic arithmetic and logic operations.
8. Write an assembly language code in GNUsim8085 to implement data transfer instruction.
9. Write an assembly language code in GNUsim8085 to store numbers in reverse order in memory location.
10. Write an assembly language code in GNUsim8085 to implement arithmetic instruction.
11. Write an assembly language code in GNUsim8085 to add two 8 bit numbers.
12. Write an assembly language code in GNUsim8085 to find the factorial of a number.
13. Write an assembly language code in GNUsim8085 to implement logical instructions.
14. Write an assembly language code in GNUsim8085 to implement stack and branch instructions.

Paper Code(s): CIC-255	**L**	**P**	**C**
Paper: Data Structures Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Data Structures) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Implement sparse matrix using array. Description of program:
    a. Read a 2D array from the user.
    b. Store it in the sparse matrix form, use array of structures.
    c. Print the final array.
2. Create a linked list with nodes having information about a student and perform
    a. Insert a new node at specified position.
    b. Delete of a node with the roll number of student specified.
    c. Reversal of that linked list.
3. Create doubly linked list with nodes having information about an employee and perform Insertion at front of doubly linked list and perform deletion at end of that doubly linked list.
4. Create circular linked list having information about a college and perform Insertion at front perform Deletion at end.
5. Implement two stacks in a using single array.
6. Create a stack and perform Push, Pop, Peek and Traverse operations on the stack using Linked list.
7. Create a Linear Queue using Linked List and implement different operations such as Insert, Delete, and Display the queue elements.
8. Implement Experiment-2 using liked list.
9. Create a Binary Tree and perform Tree traversals (Preorder, Postorder, Inorder) using the concept of recursion.
10. Implement insertion, deletion and traversals (inorder, preorder and postorder) on binary search tree with the information in the tree about the details of an automobile (type, company, year of make).
11. Implement Selection Sort, Bubble Sort, Insertion sort, Merge sort, Quick sort, and Heap Sort using array as a data structure.
12. Perform Linear Search and Binary Search on an array. Description of programs:
    a. Read an array of type integer.
    b. Input element from user for searching.
    c. Search the element by passing the array to a function and then returning the position of the element from the function else return -1 if the element is not found.
    d. Display the position where the element has been found.
13. Implement the searching using hashing method.
14. Create a graph and perform DFS and BFS traversals.

Paper Code(s): CIC-257	L	P	C
Paper: Object-Oriented Programming Using C++ Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Object-Oriented Programming Using C++) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program for multiplication of two matrices using OOP.
2. Write a program to perform addition of two complex numbers using constructor overloading. The first constructor which takes no argument is used to create objects which are not initialized, second which takes one argument is used to initialize real and imag parts to equal values and third which takes two argument is used to initialized real and imag to two different values.
3. Write a program to find the greatest of two given numbers in two different classes using friend function.
4. Implement a class string containing the following functions:
    a. Overload + operator to carry out the concatenation of strings.
    b. Overload = operator to carry out string copy.
    c. Overload <= operator to carry out the comparison of strings.
    d. Function to display the length of a string.
    e. Function tolower( ) to convert upper case letters to lower case.
    f. Function toupper( ) to convert lower case letters to upper case.
5. Create a class called LIST with two pure virtual function store() and retrieve().To store a value call store and to retrieve call retrieve function. Derive two classes stack and queue from it and override store and retrieve.
6. Write a program to define the function template for calculating the square of given numbers with different data types.
7. Write a program to demonstrate the use of special functions, constructor and destructor in the class template. The program is used to find the bigger of two entered numbers.
8. Write a program to perform the deletion of white spaces such as horizontal tab, vertical tab, space ,line feed ,new line and carriage return from a text file and store the contents of the file without the white spaces on another file.
9. Write a program to read the class object of student info such as name , age ,sex ,height and weight from the keyboard and to store them on a specified file using read() and write() functions. Again the same file is opened for reading and displaying the contents of the file on the screen.
10. Write a program to raise an exception if any attempt is made to refer to an element whose index is beyond the array size.

Paper Code(s): ECC-255	L	P	C
Paper: Analog Communications Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Analog Communications) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Generation of DSB-SC AM signal using balanced modulator.
2. To study amplitude demodulation by linear diode detector
3. Generation of SSB AM signal.
4. To study envelop detector for demodulation of AM signal and observe diagonal peak clipping effect.
5. To generate FM signal using voltage controlled oscillator.
6. To generate a FM Signal using Varactor & reactance modulation.
7. Detection of FM Signal using PLL & foster seelay method.
8. To study Super heterodyne AM receiver and measurement of receiver parameters viz.sensitivity, selectivity & fidelity.
9. To study Pre-emphasis and De-emphasis in FM.
10. Generation of Phase modulated and demodulated signal.

Paper Code(s): ECC-257	L	P	C
Paper: Analog Electronics – I Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Analog Electronics - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To plot V-I characteristics of a semiconductor diode & Calculate Static & Dynamic Resistance.
2. To Study the Reverse characteristics of Zener diode
3. To Study the Rectifier circuit (With and Without Filter).
    a. Half Wave Rectifier
    b. Centre Tapped Rectifier.
    c. Bridge Rectifier.
4. Plotting input and output characteristics and calculation of parameters of a transistor in common emitter configuration.
5. Transistor biasing circuit. Measurement of operating point (Ic and Vce) for a :-
    a. fixed bias circuit
    b. potential divider biasing circuit.
6. Plot the FET characteristics & MOSFET characteristics.
7. To measure the overall gain of two stages at 1 KHz and compare it with gain of Ist stage, Also to observe the loading effect of second stage on the first stage
8. To plot the frequency response curve of two stage amplifier.
9. To study Emitter follower circuit & measurement of voltage gain and plotting of frequency response Curve.
10. Feedback in Amplifier. Single stage amplifier with and without bypass capacitor, measurement of voltage gain and plotting the frequency response in both cases.
11. To determine and plot firing characteristics of SCR by varying anode to cathode voltage, and varying gate current.
12. To note the wave shapes and voltages at various points of a UJT relaxation oscillator circuit.
13. For Transistorized push pull amplifier Measurement of optimum load, maximum undistorted power (by giving maximum allowable signal) Efficiency and percentage distortion factor.
14. To study the characteristics of single tuned & double tuned amplifier.

Paper Code(s): ECC-259	**L**	**P**	**C**
Paper: Signals and Systems Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Signals and Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to MATLAB and its basic commands.
2. Plot unit step, unit impulse, unit ramp, exponential, parabolic functions and sinusoidal signals
3. Plot the linear convolution of two sequences.
4. Plot the correlation of two sequences.
5. Plot the magnitude and phase spectra of a signal using Fourier transforms.
6. Plot the magnitude and phase spectrum of signal using Fourier series.
7. Find out the Z transform of a signal and check the stability using pole zero location.
8. Plot the spectra of ideally sampled signal w.r.t. sampling of Discrete time signals.
9. Verification of few properties of Fourier transform.
10. Evaluate the DTFS coefficients of a signal and plot them.
11. Plot the step response for any impulse response entered by user.

Paper Code(s): EEC-257	**L**	**P**	**C**
Paper: Electrical Machines – I Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Electrical Machines - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the construction and operation of various types of starters available in the laboratory for starting DC motors.
2. To study the magnetization characteristics of a separately excited D.C generator at different speeds and to find the critical field resistance at those speeds.
2. To perform the load test on D.C. shunt motor and to draw the performance characteristics.
3. To control the speed of a DC shunt motor by using
   (a) Field control
   (b) Armature/Rheostatic control
   (c) Supply voltage control
4. To perform the Swinburne’s test on a D.C. shunt Machine and to pre determine its efficiency when running as a motor as well as generator and also draw the characteristic curves.
5. To conduct load test on DC shunt generator and obtain its internal and external characteristics.
6. To perform O.C./S.C. tests on a single phase transformer and determine equivalent circuit parameters.
7. To perform Sumpner’s (back to back) test on two identical single phase transformers and draw the load efficiency graphs.
8. To perform load test on a single-phase transformer and determine the following:
   (a) Voltage ratio of transformer.
   (b) Efficiency at different loads.
   (c) Voltage regulation of the transformer.
9. To perform Polarity test on two single-phase transformers, connect them in parallel and study the load sharing between them.
10. To convert a three-phase supply into two phase supply using Scott-connection between two single phase transformers with suitable tapping. Verify the following:
    (a) Turn ratio between windings of main and teaser transformers.
    (b) Voltage of both phases of two phase supply is equal.
    (c) Whether the phase angle between them is 900.
11. To connect three-phase transformers in Y- Y / Y - Δ, Δ-Δ/Δ- Y connections and study line /phase voltage relationships.

Paper Code(s): EEC-259	L	P	C
Paper: Electrical Engineering Workshop	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions for paper setter
1. The course objectives and course outcomes are given below.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more.

Course Objectives :

1.	To Impart the knowledge components and design of DC power supply.
2.	To Impart the knowledge of components and accessories used in electrical installations.
3.	To Impart the knowledge of various illumination devices.
4.	To Impart the knowledge of fabrication of transformer and its testing.

Course Outcomes (CO)

CO 1	The students are able to understand the symbols, specification and application of components.
CO 2	The students are able to understand the connections/ wiring diagrams used in electrical installations.
CO 3	The students are able to understand the function of illumination devices.
CO 4	The students are able to understand to fabricate the transformer and assembly of domestic appliances.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT 1

Identification of hand tools, their specifications and purpose, safety precautions, first aid for electric shock, identification, specification of various types of resistors, capacitors, inductors, diodes, zener diodes, transistors, thyristors, LDR, VDR, UJT. Soldering and desoldering practice on wire and PCB.
Design and fabricate dc power supply using single diode half wave rectifier, two diodes full wave rectifier, 4 diode bride rectifier, capacitor filter, without and with regulator.

UNIT 2

Introduction to various electrical components and accessories used in wiring installation for example fuse, MCB, ELCB, switches etc. Introduction of different types of electrical wiring and wiring diagrams, selection (gauges, size etc.) and ratings of wires. Introduction to domestic and industrial wiring installations.

UNIT 3

Fabrication of different types of extension board. Study and wiring of a tube light circuit. Connection of fan with regulator circuit. Demonstration of various types of illumination devices like lamp, tube light, CFL and LED lamps. Trouble shooting of various home appliances.

UNIT 4

Study of various components of a small single phase step down transformer & its fabrication and testing. Safety measures regarding electric fire. Introduction to relays, contactors and starters, their specification and applications. Connecting a 3-phase induction motor through (a) D.O.L. starter (b) Star/delta starter, running & reversing the direction of rotation of motor.

Textbook(s):

1. Electrical Workshop: A Textbook Paperback by R. P. Singh, I K International Publishing House Pvt. Ltd; 2nd edition.
2. A Textbook of Electrical Workshop Practices by Umesh Rathore, Naresh Kumar Sharma, S.K. Kataria & Sons.

Paper Code(s): ECC-261	L	P	C
Paper: Electronics – I Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Electronics - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To plot V-I characteristics of a semiconductor diode & calculate static & dynamic resistance.
2. To Study the Reverse characteristics of Zener diode
3. To Study the Rectifier circuit (With and Without Filter).
    a) Half Wave Rectifier
    b) Centre Tapped Rectifier.
    c) Bridge Rectifier.
4. To Plot Input & Output characteristics CB/CE/CC transistor.
5. Realization of basic gates.
6. Implementation of Boolean functions (two or three variables).
7. Realize all gates using NAND & NOR gates
8. Realize Half Adder, Full Adder, Half subtracter, Full subtracter
9. Realize Master-Save J K Flip-Flop, using NAND/NOR gates
10. Realize Universal Shift Register
11. Realize Self-Starting, Self Correcting Ring Counter
12. Realize Multiplexer and De-Multiplexer

Paper Code(s): EEC-253 / EEC-254	**L**	**P**	**C**
Paper: Circuits and Systems Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Circuits and Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to MATLAB and its basic commands.
2. Plot unit step, unit impulse, unit ramp, exponential, parabolic functions and sinusoidal signals
3. Plot the linear convolution of two sequences
4. Study the transient response of series RLC circuit for different types of waveforms on CRO and verify using MATLAB
5. Study the time response of a simulated linear system and verify the unit step and square wave response of first order and second order, type 0,1 system
6. To determine Z and Y parameters of the given two port network.
7. To determine ABCD parameters of the given two port network.
8. To verify various theorems in AC Circuits.
9. To determine Hybrid parameters of the given two port network.
10. To design Cascade Connection and determine ABCD parameters of the given two port network.
11. To design Series-Series Connection and determine Z parameters of the given two port network.
12. To design Parallel-Parallel Connection and determine Y parameters of the given two port network.
13. To design Series-Parallel Connection and determine h parameters of the given two port network.

Paper Code(s): EEC-255	**L**	**P**	**C**
Paper: Electrical Machines Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Electrical Machines) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To obtain magnetization characteristics of DC shunt generator and determine critical field resistance and critical speed.
2. To perform load test on DC shunt generator and determine the characteristics.
3. To perform speed control of DC shunt motor by field and armature control.
4. To perform the load test on D.C. shunt motor and to draw the performance characteristics.
5. To perform the Swinburne's test on a D.C. shunt Machine and to pre determine its efficiency when running as a motor as well as generator and also draw the characteristic curves.
6. To perform Open circuit and short circuit tests on single phase transformer for parameter estimation of the transformer.
7. To obtain star-star, star-delta and delta-delta connections for three phase transformers.
8. To perform parallel operation of two single phase transformers.
9. To perform block rotor test and no load test on induction motor(single phase) for parameter estimation.
10. To perform block rotor test and no load test on induction motor (three phase) for parameter estimation.
11. To perform SCC and OCC of an alternator and calculate voltage regulation at UPF, .8 leading and .8 lagging pf.
12. To perform load test on alternator.

Paper Code(s): ECC-265	L	P	C
Paper: Analog Electronics Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Analog Electronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To plot V-I characteristics of a semiconductor diode & Calculate Static & Dynamic Resistance
2. To Study the Reverse characteristics of Zener diode
3. To Study the Rectifier circuit (With and Without Filter).
   a) Half Wave Rectifier
   b) Centre Tapped Rectifier.
   c) Bridge Rectifier.
4. To Plot Input & Output characteristics CB/CE/CC transistor.
5. Plot the FET characteristics & MOSFET characteristics.
6. Two Stage R.C. Coupled Amplifier.
   a) To measure the overall gain of two stages at 1 KHz and compare it with gain ofIst stage,
   b) To observe the loading effect of second stage on the first stage.
   c) To plot the frequency response curve of two stage amplifier.
7. To study Emitter follower circuit & measurement of voltage gain and plotting of frequency response Curve.
8. Feedback in Amplifier. Single stage amplifier with and without by pass capacitor, measurement of voltage gain and plotting the frequency response in both cases.
9. To study the opamp (IC 741) as inverting and non inverting amplifier and calculate its gain.
10. To study the opamp (IC 741) as adder, sub-tractor and voltage follower, calculate its output voltage.
11. To study RC phase shift/WIEN BRIDGE oscillator
12. To study the waveform of square wave generator using 741 OP-AMP IC.

Paper Code(s): MEC-253	L	P	C
Paper: Theory of Machines Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Theory of Machines) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study and verify the inversions of four bar (4R), single slider (3R-1P) crank and double slider (2R-2P) crank mechanism and also prove Grashof's Law.
2. To find out experimentally the Coriolis component of acceleration and compare with theoretical values
3. To study various types of CAM and follower mechanisms. Also, draw the CAM profile for the given CAM apparatus and determine jumping speed.
4. Draw velocity and acceleration diagram of engine mechanism using Klien's construction
5. To study various types of gear and gear trains and to determine gear ratio of simple, compound and epicyclic gear trains.
6. To calculate the torque on a Planet Carrier and torque on internal gear using epicyclic gear train and holding torque apparatus.
7. To determine the radius of gyration and moment of Inertia of a given rod.
8. To study and verify the motion of any one Governor.
9. To study and verify the gyroscopic law of motion.
10. To study and verify the dynamic balancing of rotating masses.
11. To determine the natural frequency of undamped free vibration of the given spring mass system.
12. To find the moment of inertia of a fly wheel.
13. To determine whirling speed of shaft theoretically and experimentally.

Paper Code(s): MEC-255	**L**	**P**	**C**
Paper: Strength of Materials Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Strength of Materials) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To perform the Hardness Test (Rockwell, Brinell & Vicker's test) and find the Hardness Number of different materials (MS, HSS, Wood, C.I., Al specimens).
2. To perform the Impact Test on a standard notched specimen to evaluate its Impact Number.
3. To perform the Tensile/Compression Test in ductile/brittle materials, draw a stress-strain curve and evaluate various mechanical properties of a given specimen.
4. To perform Shear Test and find maximum (ultimate) shear strength of given test specimen.
5. To perform the Bending /Deflection Test on a beam and evaluate its Young's Modulus.
6. To perform the Torsion Test and find modulus of rigidity, rupture stress (maximum shear stress), shear stress at yield point.
7. To determine Buckling loads of long columns with different end conditions.
8. To measure mechanical strain in a given beam using strain gauges.
9. To determine the different mechanical properties of given material under creep failure.
10. To determine flexural strength (modulus of rupture) of concrete beam.
11. To determine the endurance limit of the given specimen under fatigue or cyclic loading.
12. To find the Shear Modulus of two different materials; Aluminium and Steel using two twist and bent test rigs are used.
13. To determine the different mechanical properties of a given close coiled helical spring.

Paper Code(s): MEC-257	**L**	**P**	**C**
Paper: Thermal Engineering – I Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Thermal Engineering - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To draw the valve timing diagram of a Single Cylinder Four Stroke CI Engine.
2. To draw the valve timing diagram of a Single Cylinder Four Stroke SI Engine.
3. To determine Exergy destruction of Exhaust Gas Calorimeter of Petrol Engine test rig at different load.
4. To determine Exergy destruction of Exhaust Gas Calorimeter of Diesel Engine test rig at different load.
5. To determine the dryness fraction of given steam sample.
6. Visit and understanding of thermal power plant.
7. Thermodynamic analysis of Rankine cycle.
8. Comparative thermodynamic analysis of Otto, diesel and dual for the given condition.
9. Comparative analysis of air standard cycles under stated condition.
10. Study and analysis of Gas-Turbine cycle.
11. To study the working and construction different type of Boilers.

Paper Code(s): MEC-259	L	P	C
Paper: Manufacturing Science and Technology – I Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Manufacturing Science and Technology - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To determine the percentage of clay content in dry sand.
2. To determine the grain fineness number of a given sand specimen.
3. To Determine the moisture content quickly in fresh sand and moulding sand.
4. To determine the compressive strength of moulding sand.
5. To determine the permeability number of moulding sand.
6. Mould preparation and casting of metals after preparation of suitable moulds.
7. Laboratory experiments in fabrication processes using GMAW process.
8. Laboratory experiments in fabrication processes using Plasma Arc welding.
9. Laboratory experiments in fabrication processes using GTAW process.
10. Inspection of weld joints and welding defects.
11. Develop a flat blank layout, transfer the layout to the sheet metal, cut and form to the desired shape.
12. Practicing smithy or forging of carbon steels and testing of its property changes.
13. Form parts from metallic powders, record and plot pressing data, perform destructives tests on sintered powder metal parts.

Paper Code(s): CEC-253	L	P	C
Paper: Civil Engineering Drawing Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions for paper setter

1. The course objectives and course outcomes are given below.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more.

Course Objectives :

1.	To understand the basics of Civil Engineering.
2.	To use software(s) for development of civil engineering drawing.
3.	To calculate item/component quantity using software.
4.	To develop civil engineering drawing.

Course Outcomes (CO)

CO 1	To understand and draw the symbols and conventions in civil engineering drawing.
CO 2	To develop the building drawing for the given line plan and data.
CO 3	To draw the different types of staircases
CO 4	To measure the item quantities from the drawing.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	3	-	-	-	-	2	-	-
CO 2	-	-	-	-	3	-	-	-	-	2	-	-
CO 3	-	-	-	-	3	-	-	-	-	2	-	-
CO 4	-	-	-	-	3	-	-	-	-	-	2	-

UNIT-I

Symbols and conventions of materials: concrete, brickwork, glazing, wood, iron etc.

Symbols and conventions of building components- doors and windows; and fittings used in buildings: electrical, mechanical, plumbing and firefighting, sanitary etc.

UNIT-II

Double line plan, elevation, sectional elevation at different sections for a RCC framed and load bearing/ structure building
Structural detailing – beam, column, slab, foundation,

UNIT-III

Details of various staircases, perspective view of building/structure

UNIT – IV

Measurement of various item/component quantities- excavation, brickwork, concrete, plastering etc.

Text Books

1. Computer Aided design and Manufacture, Grover M.P.Simmers, E.W. Prentice Hall
2. CAD/CAM/CIM, Radhakrishnan & Subramanyam, Willey Eastern Limited Publications (Reprint 2015)

Reference Books

1. A Guide to the Preparation of Civil Engineering Drawings, M. V. Thomas, springer link
2. Civil Engineering Drawing & House Planning, Dr. B.P. Verma, Khanna Publishers

Paper Code(s): CEC-255	**L**	**P**	**C**
Paper: Fluid Mechanics Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Fluid Mechanics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To determine the pressure in a pipe line using various pressure measuring instruments.
2. To determine the metacentric height.
3. To verify the impulse momentum equation [impact of jet].
4. To verify Bernoulli’s theorem using Bernoulli Instrument.
5. To determine cc, cv and cd of an orifice.
6. To calibrate a V- notch rectangular notch.
7. To calibrate a V- notch rectangular notch
8. To calibrate orifice meter.
9. To calibrate venturimeter.
10. To validate type of flow using Reynolds dye experiment.
11. Determination of frictional losses in pipes of different diameters.
12. Determination of minor losses in pipes.

Paper Code(s): CEC-257	L	P	C
Paper: Geomatics Engineering Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Geomatics Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of various instruments used in chain surveying.
2. To conduct the chain survey closed traverse around a building and plot the existing building.
3. To plot the plan of a given area by compass traversing
4. Study of theodolite in detail & measuring of horizontal angles by method of repetition
5. Locating given building by theodolite traversing.
6. Determination of elevation of various points with Auto level by collimation plane method and rise & fall method.
7. Determination of elevation of object if base of object accessible, using the principle of trigonometric levelling.
8. Determination of elevation of object if base of the object inaccessible and instrument stations in the same vertical plane as the elevated object
9. Determination of elevation of object if base of the object inaccessible and instrument stations not in same vertical plane as the elevated object, adopt trigonometrical levelling.
10. To study of various components of total station and measuring horizontal angle, vertical angle, horizontal distance and slope distance

11 To study about the stereoscope and determination of the line of flight on Aerial Photo.

12. Setting out a simple circular curve by different methods

Paper Code(s): ECC-263	**L**	**P**	**C**
Paper: Analog and Digital Electronics Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Analog and Digital Electronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To plot V-I characteristics of a semiconductor diode & Calculate Static & Dynamic Resistance
2. To Study the Reverse characteristics of Zener diode
3. To Study the Rectifier circuit (With and Without Filter).
    a. Half Wave Rectifier
    b. Centre Tapped Rectifier.
    c. Bridge Rectifier.
4. To Plot Input & Output characteristics CB/CE/CC transistor.
5. Realization of basic gates.
6. Implementation of Boolean functions (two or three variables).
7. Realize all gates using NAND & NOR gates
8. Realize Half Adder, Full Adder, Half subtracter, Full subtracter
9. Realize Master-Slave J K Flip-Flop, using NAND/NOR gates..
10. To study the opamp (IC 741) as inverting and non inverting amplifier and calculate its gain.
11. To study the opamp (IC 741) as adder, sub-tractor and voltage follower, calculate its output voltage.

Paper Code(s): BS-202	L	P	C
Paper: Probability, Statistics and Linear Programming	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand probability and probability distributions.
2:	To understand methods of summarization of data.
3:	To understand and use test for hypothesis.
4:	To understand methods for solving linear programming problems.

Course Outcomes (CO):

CO1:	Ability to solve probability problems and describe probability distributions.
CO2:	Ability to describe and summarize data.
CO3:	Ability to use test for hypothesis.
CO4:	Ability to formulate and solve linear programming problems.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	-	3	1	1	1	-	-	-	-	-	1	2
CO2	-	3	1	1	1	-	-	-	-	-	1	2
CO3	-	3	2	2	1	-	-	-	-	-	2	2
CO4	-	3	3	3	1	-	-	-	-	-	2	2

Unit I

Basics: Probability and Statistical models, Sample Spaces and Events, Counting Techniques, Interpretations and Axioms of Probability, Unions of Events and Addition Rules, Conditional Probability, Intersections of Events and Multiplication and Total Probability Rules, Independence, Bayes' Theorem, Random Variables.
Discrete and Continuous Random Variables and Distributions: Probability Distributions and Probability Mass / density Functions, Cumulative Distribution Functions, Mean and Variance of a Random Variable, Discrete and continuous Uniform Distribution, Binomial Distribution, Geometric and Negative Binomial Distributions, Hypergeometric Distribution, Poisson Distribution. Normal Distribution, Normal Approximation to the Binomial, and Poisson Distributions; Exponential Distribution, Erlang and Gamma Distributions, Weibull Distribution, Lognormal Distribution, Beta Distribution.

Unit II

Joint Probability Distributions for Two Random Variables, Conditional Probability Distributions and Independence, Joint Probability Distributions for Two Random Variables, Covariance and Correlation, Common Joint Distributions, Linear Functions of RandomVariables, General Functions of Random Variables, Moment-Generating Functions.
Numerical Summaries of Data, Stem-and-Leaf Diagrams, Frequency Distributions and Histograms, Box Plots, Time Sequence Plots, Scatter Diagrams, Probability Plots. Point Estimation, Sampling Distributions and the

Central Limit Theorem without proof, General Concepts of Point Estimation, Methods of Point Estimation, Statistical Intervals for a Single Sample.

Unit III

Hypotheses Testing for a SingleSample: Tests on the Mean of a Normal Distribution with Variance Known / Unknown, Tests on the Variance and Standard Deviationof a Normal Distribution, Tests on a Population Proportion, Testing for Goodness of Fit, Nonparametric tests (Signed, Wilcoxon), Similarly Statistical Inference forTwo Samples.

Regression and Correlation: Linear Regression, Least Squares Estimators, Hypotheses testing for simple linear regression, Confidence Intervals, Adequacy of model, Correlation, Transformed Variables, Logistic Regression. Similarly, for multiple linear regression including aspects of MLR.

Unit IV

Linear Programming: Introduction, formulation of problem, Graphical method, Canonical and Standard form of LPP, Simplex method, Duality concept, Dual simplex method, Transportation and Assignment problem.

Textbooks:

1. *Applied Statistics and Probability for Engineers* by Douglas G. Montgomery and Runger, Wiley, 2018
2. *Linear Programming* by G. Hadley, Narosa, 2002

References:

1. *Miller and Freund's Probability and Statistics for Engineers* by Richard A. Johnson, Pearson, 10th Ed., 2018.
2. *Probability & Statistics for Engineers & Scientists* by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Pearson, 2016.
3. *Statistics and probability with applications for engineers and scientists using Minitab, R and JMP*, C. Gupta, Irwin Guttman, and Kalanka P. Jayalath, Wiley, 2020.
4. *Probability and Statistics for Engineering and the Sciences*, Jay Devore, Cengage Learning, 2014.
5. *Probability and Statistics in Emgineering*, William W. Hines, Douglas C. Montgomery, David M. Goldman, and Connie M. Borror, Wiley, 2003.
6. *Operations Research: An Introduction* by Hamdy A. Taha, Pearson, 10th Edition, 2016

Paper Code(s): HS-204	L	P	C
Paper: Technical Writing	**2**	**-**	**2**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To improve grammar and sentence structure and build vocabulary.
2:	To understand how to write different types of writings.
3:	To understand how to compose different types of business documents.
4:	To understand business ethics and develop soft skills.

Course Outcomes (CO):

CO1:	Ability to improve grammar and sentence structure and build vocabulary.
CO2:	Ability to write different types of writings with clarity.
CO3:	Ability to write different types of business documents.
CO4:	Ability to apply business ethics and enhance personality.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	1	-	-	-	3	-	-
CO2	-	-	-	-	-	1	-	-	-	3	-	-
CO3	-	-	-	-	-	1	-	-	-	3	-	-
CO4	-	-	-	-	-	1	-	3	-	3	-	-

Unit I

Grammar and Vocabulary--- Types of sentences (simple, complex and compound) and use of connectives in sentences, Subject-verb agreement, Comprehension, Synonyms and Antonyms, Homophones and Homonyms, Word Formation: Prefixes and Suffixes, Indianism, Misappropriation and Redundant Words, Question Tags and Short Responses.

Unit II

Writing Styles -- Expository, Explanatory, Descriptive, Argumentative and Narrative.
Precis writing, Visual Aids in Technical Writing, Plagiarism and Language Sensitivity in Technical Writing, Dialogue Writing, Proposals: Purpose and Types.

Unit III

Letters at the Workplace—letter writing: Request, Sales, Enquiry, Order and Complaint.
Job Application---Resume and Cover letter, Difference between Resume and CV, Preparation for Interview.
Meeting Documentation--- Notice, Memorandum, Circular, Agenda, Office Order and Minutes of meeting, Writing Instructions.

Unit IV

Ethics and Personality Development-----The Role of Ethics in Business Communication—Ethical Principles, Time Management, Self-Analysis through SWOT and JOHARI Window, Emotional Intelligence and Leadership Skills, Team Building, Career Planning, Self Esteem.

Textbook:

1. Meenakshi Raman and Sangeeta Sharma, Technical Communication: Principles and Practice, Oxford University Press, New Delhi (2015).

References:

1. Sanjay Kumar and Pushp Lata, Communication Skills, Oxford University Press, New Delhi (2015).
2. Herta A Murphy, Herbert W Hildebrandt, Jane P Thomas, Effective Business Communication, Tata McGraw-Hill, Hill Publishing Company Limited, Seventh Edition.

Paper Code(s): CIC-206	L	P	C
Paper: Theory of Computation	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand Automata (Deterministic and Non-Deterministic) and Language Theory
2.	To understand Context Free Grammar (CFG), Parse Trees and Push Down Automata
3.	To introduce the concepts of Turing Machines and Computability Theory
4.	To understand Complexity Theory (NP-completess NP-hardness) and Space complexity

Course Outcomes (CO)

CO 1	Ability to understand the design aspects of "abstract models" of computers like finite automata, pushdown automata, and Turing machines.
CO 2	Ability to comprehend the recognizability (decidability) of grammar (language) with specific characteristics through these abstract models.
CO 3	Ability to decide what makes some problems computationally hard and others easy?
CO 4	A ability to deliberate the problems that can be solved by computers and the ones that cannot?

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	1	1	3
CO 2	3	2	2	2	2	-	-	-	2	1	1	3
CO 3	3	2	2	2	2	-	-	-	2	1	1	3
CO 4	3	2	2	2	2	-	-	-	2	1	1	3

UNIT – I

Automata and Language Theory: Chomsky Classification, Finite Automata, Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA), Regular Expressions, Equivalence of DFAs, NFAs and Regular Expressions, Closure properties of Regular grammar, Non-Regular Languages, Pumping Lemma.

UNIT – II

Context Free Languages: Context Free Grammar (CFG), Parse Trees, Push Down Automata (deterministic and non-deterministic) (PDA), Equivalence of CFGs and PDAs, Closure properties of CFLs, Pumping Lemma, Parsing, LL(K) grammar.

UNIT – III

Turing Machines and Computability Theory: Definition, design and extensions of Turing Machine, Equivalence of various Turing Machine Formalisms, Church – Turing Thesis, Decidability, Halting Problem, Reducibility and its use in proving undecidability. Rices theorem. Undecidability of Posts correspondence problem., Recursion

Theorem.

UNIT – IV

Complexity Theory: The class P as consensus class of tractable sets. Classes NP, co-NP. Polynomial time reductions. NP-completess, NP-hardness. Cook- Levin theorem (With proof). Space complexity, PSPACE and NPSPACE complexity classes, Savitch theorem (With proof). Probabilistic computation, BPP class. Interactive proof systems and IP class. relativized computation and oracles.

Textbook(s):

1. Sipser, Michael. Introduction to the Theory of Computation, Cengage Learning, 2012.
2. J. Hopcroft, R. Motwani, and J. Ullman, Introduction to Automata Theory, Language and Computation, Pearson, 2nd Ed, 2006.

References:

1. Peter Linz, An Introduction to Formal Languages and Automata, 6th edition, Viva Books, 2017
1. Maxim Mozgovoy, Algorithms, Languages, Automata, and Compilers, Jones and Bartlett, 2010.
2. D. Cohen, Introduction to Computer Theory, Wiley, N. York, 2nd Ed, 1996.
3. J. C. Martin, Introduction to Languages and the Theory of Computation, TMH, 2nd Ed. 2003.
4. K. L. Mishra and N. Chandrasekharan, Theory of Computer Science: Automata, Languages and Computation, PHI, 2006.
5. Anne Benoit, Yves Robert, Frédéric Vivien, A Guide to Algorithm Design: Paradigms, Methods, and Complexity Analysis, CRC Press, 2013.

Paper Code(s): CIC-210	L	P	C
Paper: Database Management System	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce basic concepts, architecture and characteristics of database systems
2.	To introduce relational model concepts and PL/SQL programming
3.	To introduce relational database design and Normal forms based on functional dependencies
4.	To introduce concepts of object oriented & distributed databases

Course Outcomes (CO) :

CO 1	Ability to understand advantages of database systems
CO 2	Ability to use SQL as DDL, DCL and DML
CO 3	Ability to design database and manage transaction processing
CO 4	Understand object oriented & distributed databases systems and use them

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT – I

Basic concepts: database & database users, characteristics of the database systems, concepts and architecture, date models, schemas & instances, DBMS architecture & data independence, database languages & interfaces, data modelling using the entity-relationship approach. Enhanced ER concepts - Specialization/Generalization, Aggregation, Mapping of ER model to Relational Model.
SQL – DDL, DCL & DML views and indexes in SQL. Basics of SQL, DDL, DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator.

UNIT - II:

Relational model concepts, relational model constraints, relational algebra, relational calculus.
SQL – Functions - aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types. Transaction control commands – Commit, Rollback, Save point.

UNIT - III

Relational data base design: functional dependencies & normalization for relational databases, normal forms based on functional dependencies, (1NF, 2NF, 3NF & BCNF), lossless join and dependency preserving decomposition, normal forms based on multivalued & join dependencies (4NF & 5NF) & domain key normal form

Properties of Transaction, Transaction states, Transaction Schedule, Serializability, Concurrency control techniques, locking techniques, time stamp ordering, Recoverable schedules, granularity of data items, Deadlock detection and Recovery, recovery techniques: recovery concepts, database backup and recovery from catastrophic failures.
Database Programming – control structures, exception handling, stored procedures, Triggers.

UNIT - IV

File Structures and Indexing: Secondary Storage Devices, Operations on Files, Heap Files, Sorted Files, Hashing, Single level indexes, Multi-level indexes, B and B+ tree indexes.
Concepts of Object Oriented Database Management systems & Distributed Database Management Systems

Textbooks:
1. R. Elmsari and S. B. Navathe, "Fundamentals of database systems", Pearson Education, 7th Edition, 2018
2. V. M. Grippa and S. Kumichev, "Learning MySQL", O'Reilly, 2021.
3. SQL/ PL/SQL, The programming language of Oracle, Ivan Bayross, 4th Edition BPB Publications

References:
1. A. Silberschatz, H. F. Korth and S. Sudershan, "Database System Concept", McGraw Hill, 6th Edition,2013.
2. Date, C. J., "An introduction to database systems", 8th Edition, Pearson Education, 2008.
3. P. Rob & C. Coronel, "Database Systems: Design Implementation & Management", Thomson Learning, 6th Edition, 2004
4. Desai, B., "An introduction to database concepts", Galgotia publications, 2010
5. H. Garcia-Molina, J. D. Ullman, J. Widom, "Database System: The Complete Book", PH.
6. Joel Murach, Murach's Mysql"", 3rd Edition-Mike Murach and Associates, Incorporated, 2019.
7. Oracle and MySQL manuals.

Paper Code(s): CIC-212	**L**	**P**	**C**
Paper: Programming in Java	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand and gain knowledge of characteristics of Java, JVM, instruction set, control flow, programming and the sandbox model.
2.	To learn the Java programming, use of exceptional handling and inheritance.
3.	To understand threads, thread synchronization, AWT components and event handling mechanism.
4.	To understand the concepts of I/O streams, JDBC, object serialization, sockets, RMI, JNI, Collection API interfaces, Vector, Stack, Hash table classes, list etc.

Course Outcomes (CO)

CO 1	Ability to understand the compilation process of Java, role of JVM as an emulator and various types of instructions.
CO 2	Ability to learn and apply concepts of Java programming, exceptional handling and inheritance.
CO 3	Ability to understand the use of multi-threading, AWT components and event handling mechanism in Java.
CO 4	Ability to understand the concepts of I/O streams, IDBC, object serialization, sockets, RMI, JNI, Collection API interfaces, Vector, Stack, Hash table classes, list etc.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT - I

Overview and characteristics of Java, Java program Compilation and Execution Process Organization of the Java Virtual Machine, JVM as an interpreter and emulator, Instruction Set, class File Format, Verification, Class Area, Java Stack, Heap, Garbage Collection. Security Promises of the JVM, Security Architecture and Security Policy. Class loaders and security aspects, sandbox model

UNIT - II

Java Fundamentals, Data Types & Literals Variables, Wrapper Classes, Arrays, Arithmetic Operators, Logical Operators, Control of Flow, Classes and Instances, Class Member Modifiers Anonymous Inner Class Interfaces and Abstract Classes, inheritance, throw and throws clauses, user defined Exceptions, The String Buffer Class, tokenizer, applets, Life cycle of applet and Security concerns.

UNIT - III

Threads: Creating Threads, Thread Priority, Blocked States, Extending Thread Class, Runnable Interface, Starting Threads, Thread Synchronization, Synchronize Threads, Sync Code Block, Overriding Synced Methods, Thread Communication, wait, notify and notify all.

AWT Components, Component Class, Container Class, Layout Manager Interface Default Layouts, Insets and Dimensions, Border Layout, Flow Layout, Grid Layout, Card Layout Grid Bag Layout AWT Events, Event Models, Listeners, Class Listener, Adapters, Action Event Methods Focus Event Key Event, Mouse Events, Window Event

UNIT - IV

Input/Output Stream, Stream Filters, Buffered Streams, Data input and Output Stream, Print Stream Random Access File, JDBC (Database connectivity with MS-Access, Oracle, MS-SQL Server), Object serialization, Sockets, development of client Server applications, design of multithreaded server. Remote Method invocation, Java Native interfaces, Development of a JNI based application.

Collection API Interfaces, Vector, stack, Hashtable classes, enumerations, set, List, Map, Iterators.

Textbook(s):

1. Patrick Naughton and Herbertz Schidt, “Java-2 the Complete Reference”,TMH

References:

1. E. Balaguruswamy, “Programming with Java”, TMH
2. Horstmann, “Computing Concepts with Java 2 Essentials”, John Wiley.
3. Decker & Hirshfield, “Programming Java”, Vikas Publication.

Paper Code(s): EEC-206	**L**	**P**	**C**
Paper: Network Analysis and Synthesis	**3**	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To understand the network theorem in AC circuit.
2.	To understand mathematical modelling of circuit.
3.	To understand two port parameter and transfer function.
4.	To understand realization of passive network and filter.

Course Outcome (CO):

CO 1	Ability to apply network theorems in AC circuit.
CO 2	Ability to determine transient respond of circuit.
CO 3	Ability to determine two port parameter of circuit.
CO 4	Ability to realize the circuit from their transfer function.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**

UNIT-I

Application of Mesh current analysis, Node voltage analysis and Network theorems in AC circuits.
Graph theory: concept of tree, tie set matrix, cut set matrix and application to solve electric networks.

UNIT-II

Periodic waveforms and signal synthesis, properties and applications of Laplace transform of complex waveform.
System modeling in terms of differential equations and transient response of R, L, C, series and parallel circuits for impulse, step, ramp, sinusoidal and exponential signals by classical method and using Laplace transform.

UNIT-III

Two port networks – Introduction of two port parameters and their interconversion, interconnection of two 2-port networks, open circuit and short circuit impedances and ABCD constants, relation between image impedances and short circuit and open circuit impedances. Network functions, their properties and concept of transform impedance, Hurwitz polynomial.

UNIT IV

Positive real function and synthesis of LC, RC, RL Networks in Foster's I and II, Cauer's I& II forms, Introduction of passive filter and their classification, frequency response, characteristic impedance of low pass, high pass, Band Pass and Band reject prototype section.

Textbook(s):

1. W H Hayt "Engineering Circuit Analysis" TMH Eighth Edition
2. Kuo, "Network analysis and synthesis" John Weily and Sons, 2nd Edition.

Reference Books:

1. S Salivahanan "Circuit Theory " Vikas Publishing House 1st Edition 2014
2. Van Valkenburg, " Network analysis" PHI, 2000.
3. Bhise, Chadda, Kulshreshtha, " Engineering network analysis and filter design" Umesh publication, 2000.
4. D. R. Choudhary, "Networks and Systems" New Age International, 1999
5. Allan H Robbins, W.C.Miller "Circuit Analysis theory and Practice"Cengage Learning Pub 5th Edition 2013
6. Bell "Electric Circuit" Oxford Publications 7th Edition.

Paper Code(s): ECC-210 / ECC-313	L	P	C
Paper: Microprocessors and Microcontrollers	**3**	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To impart knowledge about architecture and instruction set of 8085 microprocessor so that students can implement 8085 assembly language programs.
2.	To impart knowledge about architecture and instruction set of 8086 microprocessor so that students can implement 8086 assembly language programs.
3.	To impart knowledge about interfacing of 8255, 8254/8253, 8251, 8259 and I/O devices with 8086 microprocessor.
4.	To impart knowledge about architecture and operation of 8051 microcontroller and their interfacing with memory and I/O.

Course Outcome (CO):

CO 1	Ability to understand and distinguish the use of different 8085 instructions, timing diagram, addressing modes, interrupts and apply those instructions for implementing assembly language programs.
CO 2	Ability to analyse the timing diagrams, understand its instruction set, assess its memory organisation and will implement the assembly language programs , interfacing of memory with 8086 successfully
CO 3	Understand and realize the interfacing of 8255 (PPI), 8254/8255 (PIT), 8251 (USART), 8259 (PIC), 8279 (Keyboard and display), Sample and hold circuit, DAC/ADC, LCD & Stepper motor with 8086 microprocessor.
CO 4	Understand the architecture and operation of 8051 microcontroller and ability to use them for designing various applications based on 8051 by implementing the elaborate instruction set.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	1	1	-	-	-	-	1
CO 2	3	3	3	2	3	1	1	-		-		1
CO 3	3	3	3	2	3	1	1	-	1	-	-	1
CO 4	3	3	3	2	3	1	1	-	-	-	-	1

UNIT - I

Introduction to Microprocessor Systems: Architecture and PIN diagram of 8085, Timing Diagram, memory organization, addressing modes, interrupts. Assembly Language Programming.

UNIT – II

8086 Microprocessor: 8086 Architecture, difference between 8085 and 8086 architecture, generation of physical address, PIN diagram of 8086, Minimum Mode and Maximum mode, Bus cycle, Memory Organization, Memory Interfacing, Addressing Modes, Assembler Directives, Instruction set of 8086, Assembly Language Programming, Hardware and Software Interrupts.

UNIT – III

Interfacing of 8086 with 8255, 8254/8253, 8251, 8259: Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI)-Intel 8255, Sample-and-Hold Circuit and Multiplexer, Keyboard and Display Interface, Keyboard and Display Controller (8279), Programmable Interval timers (Intel 8253/8254), USART (8251), PIC (8259), DAC, ADC, LCD, Stepper Motor.

UNIT – IV

Overview of Microcontroller 8051: Introduction to 8051 Micro-controller, Architecture, Memory organization, Special function registers, Port Operation, Memory Interfacing, I/O Interfacing, Programming 8051 resources, interrupts, Programmer's model of 8051, Operand types, Operand addressing, Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions, Timer & Counter Programming, Interrupt Programming.

Textbook(s):

1. Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", Pearson, 2006
2. Douglas V Hall, "Microprocessors and Interfacing, Programming and Hardware" Tata McGraw Hill, 2006.
3. Ramesh Gaonkar, "MicroProcessor Architecture, Programming and Applications with the 8085", PHI

References:

1. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. MCKinlay "The 8051 Microcontroller and Embedded Systems",2nd Edition, Pearson Education 2008.
2. Kenneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing The PC", Delmar Publishers, 2007.
3. A K Ray, K M Bhurchandi, "Advanced Microprocessors and Peripherals", Tata McGraw Hill, 2007.
4. Vaneet Singh, Gurmeet Singh, "Microprocessor and Interfacing", Satya Prakashan, 2007.

Paper Code(s): ECC-212	L	P	C
Paper: Digital Communications	**3**	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To understand importance of information theory in digital communication and various PCM modulation.
2.	To understand the various basic concepts of digital communication.
3.	To understand the various digital Modulation-demodulation techniques
4.	To understand various coding in digital communications.

Course Outcome (CO):

CO 1	Ability to understand the need of digital communication and conversion of analog to digital signals.
CO 2	Ability to understand the effect of additive white Gaussian Noise on digital communication modulation techniques.
CO 3	Ability to analyse the effect of inter symbol interference as the source of channel impairment and the effect of multipath phenomenon.
CO 4	Ability to use and design communication systems for reliable communication

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Review of probability theory and Stochastic processes, Poisson and Gaussian Process, Noise, Narrowband Noise, Sinewave plus Narrowband Noise. Sampling Theory, PAM, Quantization characteristics, PCM, DPCM, Delta Modulation, Adaptive Delta Modulation, Line Codes.

UNIT II

AWGN Channel Signalling: Geometric Representation of Signals, Conversion of Continuous AWGN Channel to a vector channel: ASK, QASK, FSK, M-array FSK, BPSK, DPSK, DEPSK, QPSK, M-array PSK, QAM, MSK, GMSK, Coherent and non-coherent detection and other keying techniques.

UNIT III

Band Limited Channels: Error rate due to channel noise in a matched filer receiver, Intersymbol Interference, Signal Design for Zero ISI, Raised cosine and square root raised cosine spectrum, Eye pattern, Adaptive equalization, signalling over multiple baseband channel, Fading Channels: Propagation effects, Jakes Model, Statistical Characteristics of wideband wireless channel, Diversity techniques, MIMO, MIMO Capacity for channel known at receiver, OFDM, Spread-spectrum signals.

UNIT IV

Information Theory: Entropy, Source Coding Theorem, Lossless data compression, Discrete Memoryless channel, Mutual Information, Channel Capacity, Channel Coding Theorem, Differential Entropy and Mutual Information for Continuous Random Ensembles, Information Capacity Law. Error Control Coding: Introduction, Error Control using forward correction, Linear Block Code, Cyclic Codes, Convolutional Codes.

Textbook(s):

1. Simon Haykins, “Digital Communication Systems” John Wiley, 2014

References:

1. Simon Haykins and Michael Moher, “Communication Systems” John Wiley &sons Inc, 5th edition, 2009.
2. B P Lathi and Zhi Ding, “Modern Digital and Analog Communication Systems”, OUP, 5th edition, 2019
3. H P Hsu, Schaum Outline Series, Analog and Digital Communications, TMH 2006
4. J.G Proakis, Digital Communication, 4th Edition, Tata Mc Graw Hill Company, 2001.

Paper Code(s): ECC-214	L	P	C
Paper: Analog Electronics – II	**3**	**-**	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To understand Basic building block and characteristic of Op-Amp
2.	To understand the frequency response and Configurations of Op-Amp
3.	To analyze and design linear, nonlinear and Oscillators circuits using Op-Amp
4.	To analyze and design active filters and to understand function of Op-Amp based special ICs

Course Outcome (CO):

CO 1	Ability to understand and use Op-Amps to design open-loop and closed loop configuration.
CO 2	Ability to analyse frequency response of and Op-Amp circuit.
CO 3	Ability to use Op-Amp in linear and non-linear applications.
CO 4	Ability to design Active Filters

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT – I

The Operational Amplifiers: Block diagram representation of OP-AMP; Evolution of IC and types, Power supply for Op-Amp; The Ideal Op-Amp: schematic, characteristics, equivalent circuit, Ideal voltage transfer curve, typical IC 741 characteristics
Open Loop Op-Amp configurations: The differential amplifier, inverting amplifier, non-inverting amplifier
Closed loop Op-Amp configurations: inverting and non-inverting amplifiers, voltage followers, differential amplifiers, closed loop frequency response & circuit stability, single supply operation of OP-AMP, Inverting and Non-Inverting op-amp.

UNIT – II

The Practical Op-Amp: Input offset voltage, input bias current, input offset current, Total output offset voltage, thermal drift, error voltage, Supply voltage rejection ration (SVRR), CMRR
Frequency Response of An Op-Amp: Frequency response compensator networks, High frequency OP-AMP equivalent circuit, open loop voltage gain as a function of frequency, Slew rate, causes of slew rates and its effects in application.

UNIT – III

Linear applications of Op-Amps: Summing, scaling and averaging amplifier (inverting, non-inverting & differential configuration), voltage to current & current to voltage converters, Integrator, Differentiator,
Non-Linear applications of IC op-amps: Comparator, Zero crossing detector, Schmitt Trigger, Clipping & Clamping Circuits, Precision Rectifiers, sample and hold circuit
Oscillators: Principles & Types; Phase shift, Wein-bridge & quadrature. Square wave, triangular wave and saw tooth wave generators, voltage-controlled oscillator

UNIT – IV

Active Filters: Classification and frequency response of filters, response Advantages of active filters, characteristics of butter worth, chebyshev, first order and second order butter worth filters- low pass and high pass types. Band pass & band reject filters.
Specialised IC- The 555 Timer: functional diagram, Monostable and Astable multivibrators; PLL: Basic PLL principle, monolithic 565 PLL; Voltage Regulators, Three terminal IC voltage regulators(LM 317

Textbook(s):

1. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2001.
2. D. Roy Choudhary & S. B Jain, “Linear Integrated Circuit”, 2nd ed. New age publication.2018.

References:

1. Adel S. Sedra and Kenneth C. Smith, “Micro Electronic Circuits Theory and Applications,” 5th Edition , OUP, 2004.
2. David A. Bell, “Op-amp & Linear ICs”, Oxford, 2013.
3. James M. Fiore, “Op Amps & Linear Integrated Circuits Concepts & Applications”, Cengage, 2010.
4. J. Michel Jacob, “Applications and Design with Analog Integrated Circuits”, PHI, 2004.
5. R. L. Boylestad and N. Nashlesky, “Electronic Devices and Circuit Theory”, Pearson Education, 11th Ed., 2014
6. J. Millman, C. Halkias, and C. D. Parikh, “Millman’s Integrated Electronics: Analog and Digital circuits and system”, McGraw Hill Education, 2018.

Paper Code(s): EEC-210	**L**	**P**	**C**
Paper: Electrical Machines – II	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concept of synchronous generator.
2.	To understand the concept of three phase induction motor.
3.	To understand the concept of synchronous motor.
4.	To understand the concept of single phase motor.

Course Outcomes (CO)

CO 1	Ability to analyse the synchronous generator.
CO 2	Ability to analyse ofthree phase induction motor
CO 3	Ability to analyse ofsynchronous motor.
CO 4	Ability to analyse ofsingle phase motor.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	2	2	1	2	1	-	2	2	-	3
CO 2	3	3	2	2	1	2	1	-	2	2	-	2
CO 3	2	2	1	2	1	2	1	-	2	2	-	2
CO 4	2	2	2	2	1	2	1	-	2	2	-	2

Unit I

Synchronous Alternators Constructional features, armature windings, E.M.F. equation, winding coefficients, harmonics in the induced E.M.F., armature reaction, O.C. and S.C. tests, voltage regulation-Synchronous impedance method, MMF Method, Potier's triangle method parallel operation, operation on infinite bus, cooling. Two reaction theory, power expressions for cylindrical and salient pole machines, performance characteristics. [T1,T2]

Unit II

Poly phase Induction Machines Constructional features, production of rotating magnetic field, working of 3-phase Induction motor, phasor diagram, equivalent circuit, power and torque relations, torque and slip relations, no load and blocked rotor tests and efficiency. speed control by rotor resistance, injected e.m.f, frequency variation and pole changing, DOL, Y-Δ and autotransformer starters, deep bar and double cage rotor motors, cogging and crawling, operation of Induction machine as generator and phasor diagram. [T1,T2]

Unit III

Synchronous Motors – Principle of operation, starting methods, phasor diagram torque-angle characteristics, V-curves hunting and damping, synchronous condenser, introduction to single phase synchronous motors: Reluctance and Hysteresis motors. [T1,T2]

Unit IV

Fractional Horse Power Motors Single Phase Induction Motor: Double revolving field theory, equivalent circuit, no load and blocked rotor tests, starting methods, split phase Induction motor- capacitor start, two value capacitor motor.
Introduction and applications of single phase AC series motor, universal motor, AC servo motor, stepper motor, permanent magnet AC motors. [T1,T2]

Textbook(s):

1. A Fitzgeral, Charles Kingsley, Stephen Umans, "Electric Machinery", Tata McGraw Hill Education, 6th Edition, 2002
2. I J Nagrath D P Kothari, "Electric Machines", McGraw-Hill Education, 3rd edition, 2011.

Reference Books:

1. The Performance and Design of Alternating Current Machines, M.G. Say, CBS Publishers, 2005
2. Oblems in Electrical Engineering: Power engineering and electronics with answers Partly Solved in I. Units: Parker Smith , CBS Publishers, 9th edition, 2003
3. Electric Machines, I J Nagrath D P Kothari, Mc Graw-Hill Education, 3rd edition, 2011
4. Samarjit Ghosh, "Electrical Machines", Pearson

Paper Code(s): EEC-212	**L**	**P**	**C**
Paper: Power Systems – I	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of transmission line parameter.
2.	To impart the knowledge of transmission line.
3.	To impart the knowledge of cables.
4.	To impart the knowledge of load flow studies.

Course Outcomes (CO)

CO 1	Ability to calculate the transmission line parameters.
CO 2	Ability to analyse performance of transmission line.
CO 3	Ability to understand working of cables.
CO 4	Ability to solve load flow in power system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	2	2	1	2	1	-	2	2	-	3
CO 2	3	3	2	2	1	2	1	-	2	2	-	2
CO 3	2	2	1	2	1	2	1	-	2	2	-	2
CO 4	2	2	2	2	1	2	1	-	2	2	-	2

UNIT I

Power System Components: Block diagram of electric power system, Single line diagram of power system, brief description of power system elements such as, synchronous machine, transformer, transmission line, bus bar and circuit breaker.
Transmission line: Configurations, type of conductors, Mechanical Design of Transmission Line: catenary curve, calculation of sag and tension, effects of wind and ice loadings on sag, sag template, vibration dampers. Overhead Lines Insulators: Types of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential. [T1,T2]

UNIT II

Overhead Transmission Lines: Corona and Interference: Phenomenon of corona, corona loss, factors affecting corona, methods of reducing corona, bundle conductors and interference.
Calculation of resistance (skin & proximity effects), inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines. Modeling and performance analysis of short, medium and long transmission line. Ferranti effect, Transposition of transmission conductors, surge impedance loading. Introduction and analysis of travelling wave use of Bewley Diagram. [T1,T2]

UNIT III

Insulated Cables: Types of cables, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables.
Fault Analysis: Per unit system, symmetrical component, calculation of symmetrical and unsymmetrical fault, use of current limiting reactors. [T1,T2]

UNIT IV

Power Flow Analysis: Formulation of Y-bus Matrix, Power flow equations, Classification of buses, Data for load flow, Gauss-Seidal Method, acceleration factor of convergence; Newton Raphson Method Fast Decoupled load flow; Comparison of power Flow Methods. [T1,T2]

Textbook(s):

1. C.L.Wadhava, “Electrical Power Systems”, New Age International, 2004
2. Hadi Saddat, “Electric power systems”, Tata McGraw Hill. 2014.

Reference Books:

1. S. L. Uppal, “Electrical Power”, Khanna Publishers, 13th edition 2003
2. W. H. Stevension, ”Elements of Power System Analysis”, McGraw Hill, 1982
3. Ashfaq Hussain, “Electrical Power System” CBS Publishers and Distributors.

Paper Code(s): ECC-218	L	P	C
Paper: Electronics – II	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the working of amplifier circuits.
2.	To understand the working of multi-stage, feedback and power amplifier.
3.	To understand working of operational amplifier and linear applications.
4.	To understand the function of waveform generators.

Course Outcomes (CO)

CO 1	Ability to solve problems related to amplifier circuits.
CO 2	Ability to apply the amplifiers circuits in real world.
CO 3	Ability to analyse various operational amplifier circuits.
CO 4	Ability to understand the function of various waveform generators.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**

UNIT – I

BJT, FET MOSFET Bias stabilization: Need for stabilization, fixed Bias, emitter bias, self-bias, bias stability with respect to variations in ICO, Small signal amplifiers:, hybrid model for transistor at low frequencies, RC coupled amplifiers, mid band model, gain & impedance, comparisons of different configurations, Emitter follower, Darlington pair(derive voltage gain, current gain, input and output impedance). [T1]

UNIT – II

Multistage Amplifiers
Feedback Amplifiers: Feedback concept, Classification of Feedback amplifiers, Properties of negative Feedback amplifiers, Impedance considerations in different Configurations,
Power Amplifiers: Power dissipations in transistors, Amplifiers Classification, (Class-A, Class-B, Class-C, Class-AB) Efficiency analysis, Push-pull and complementary Push-pull amplifiers. [T1]

UNIT – III

Linear & Non Linear Wave shaping: , Inverting and non-inverting amplifiers, voltage follower, difference amp, adders, Voltage to current with floating & grounded load, current to voltage converter, practical integrator & differentiator, Clipping & Clamping circuits, Comparators, log/antilog circuits using Op-Amps, precision

rectifiers(half & full wave),peak detector, Inverting & non inverting Schmitt trigger circuit.
Waveform generations: Sine wave generator (Phase shift, Wein bridge, Hartley & Colpitts), Barkhausen criteria of oscillations, conditions for oscillation, crystal oscillator. [T2]

UNIT IV

Waveform generators: Square and triangular waveform generators (determine period and frequency), saw tooth wave generator, Astable multi-vibrator, Monostable and Bistable Multivibrator.
Active RC Filters: Idealistic & Realistic response of filters (LPF, BPF, HPF, BRF), Butter worth & Chebyshev approximation filter functions All pass, Notch Filter. [T2]

Textbook(s):

1. Salivahanan , Suresh Kumar, Vallavaraj, "Electronic Devices and Circuits" TMH, 1999
2. D. Roy Choudhary, Shail B Jain, "Linear Integrated Circuits" New Age Publisher, 1999.

Reference Books:

1. B. Kumar ,Shail Bala Jain, "Electronic Devices and Circuits" PHI.
2. M.Rashid , "Microelectronic Circuit", Cengage Learning Publication.
3. Sedra & Smith, "Micro Electronic Circuits" Oxford University Press, 2000
4. David A Bell, "Operational Amplifiers and Linear IC's", PHI.

Paper Code(s): ECC-206	**L**	**P**	**C**
Paper: Communication Systems	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand working of general instrument system, types of error, methods of measurement etc.
2.	To give an overview of test and measuring instruments.
3.	To expose the students to the design of bridges for the measurement of resistance, capacitance and inductance.
4.	Understand the principle and working of various electrical and electronic measuring instruments

Course Outcomes (CO)

CO 1	Ability to understand principal and working of electric and electronic measuring instruments
CO 2	Ability to analyse various errors in measurement
CO 3	Ability to evaluate the unknown quantities using measuring instruments
CO 4	Ability to design bridge circuits for measurement of resistance, capacitance and inductance

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	2	2	1	2	1	-	2	2	-	3
CO 2	3	3	2	2	1	2	1	-	2	2	-	2
CO 3	2	2	1	2	1	2	1	-	2	2	-	2
CO 4	2	2	2	2	1	2	1	-	2	2	-	2

UNIT I

Introduction: Overview of Communication system, Communication channels, Mathematical Models for Communication Channels
Introduction of random Variables: Definition of random variables, PDF, CDF and its properties, joint PDF, CDF, Marginalized PDF, CDF, WSS wide stationery, strict sense stationery, non-stationery signals, UDF, GDF, RDF, Binomial distribution, White process, Poisson process, Wiener process. [T1, T2]

UNIT II

Analog Modulation: Modulation- Need for Modulation, Amplitude Modulation theory: DSB-SC, SSB, VSB. Modulators and Demodulators. Angle Modulation, Relation between FM and PM Wave. Generation of FM wave- Direct and Indirect Methods. Bandwidth of FM (NBFM, WBFM)
Pulse Analog Modulation: Sampling-Natural and Flat top. reconstruction, TDM-Pulse Amplitude Modulation (TDM-PAM), Pulse Width Modulation (PWM), Pulse Position Modulation(PPM), Generation and Recovery.
Pulse Digital Modulation: Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), ADPCM. [T1, T2]

UNIT III

Digital Modulation and Transmission: Advantages of digital communication. Modulation schemes: ASK, PSK, FSK. Spectral Analysis. Comparison. Digital Signaling Formats-Line coding.
Information and Coding Theory: Entropy, Information, Channel Capacity. Source Coding Theorem: Shannon Fano Coding, Huffman Coding. [T1, T2]

UNIT IV

Fiber Optical System: Basic Optical Communication System. Optical fibers versus metallic cables, Light propagation through optical fibers. Acceptance angle and acceptance cone, Fiber configurations. Losses in optical fibers. Introduction to Lasers and light detectors. Applications: Military, Civil and Industrial applications.
Advanced Communication Systems: Introduction to cellular radio telephones. Introduction to satellite Communication. [T1, T2]

Textbook(s):
1. George Kennedy, "Electronics Communication System", TMH 1993.
2. B.P. Lathi, "Analog& Digital Communication", Oxford University Press 1999.

Reference Books:
1. Simon Haykin, "Introduction to Analog & Digital Communication", Wiley, 2000
2. Tannenbaum, "Computer networks", Pearson, 5th Edition.
3. K. Sam Shanmugam, "Digital & Analog Communication system", John Wiley & Sons 1998

Paper Code(s): ECC-208	**L**	**P**	**C**
Paper: Digital Electronics	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of codes and switching functions in digital electronics.
2.	To understand working of combinational logic circuits.
3.	To impart the knowledge of sequential logic circuits.
4.	To understand the applications of 555 timer and A to D and D to A converters.

Course Outcomes (CO)

CO 1	Ability to understand conversion of codes and switching operations.
CO 2	Ability to design combinational logic circuits using gates.
CO 3	Ability to analyse sequential logic circuits.
CO 4	Ability to understand applications of 555 timer and A to D and D to A converters.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Number Systems and Codes:- Decimal, Binary, Octal and Hexadecimal Number systems, Codes- BCD, Gray Code, Excess-3 Code, ASCII, EBCDIC, Conversion between various Codes.
Switching Theory: - Boolean Algebra- Postulates and Theorems, De' Morgan's Theorem, Switching Functions- Canonical Forms- Simplification of Switching Functions- Karnaugh Map and Quine Mc-Clusky Methods. .

[T1,T2]

UNIT II

Combinational Logic Circuits:- Review of basic gates- Universal gates, Adder, Subtractor ,Serial Adder, Parallel Adder- Carry Propagate Adder, Carry Look-ahead Adder, Carry Save Adder, Comparators, Parity Generators, Decoder and Encoder, Multiplexer and De-multiplexer, ALU, PLA and PAL.
Integrated circuits: - TTL and CMOS logic families and their characteristics. Brief introduction to RAM and ROM.

[T1,T2]

UNIT III

Sequential Logic Circuits: - Latches and Flip Flops- SR, , D, T and MS-JK Flip Flops, Asynchronous Inputs.
Counters and Shift Registers:- Design of Synchronous and Asynchronous Counters:- Binary, BCD, Decade and Up/Down Counters , Shift Registers, Types of Shift Registers, Counters using Shift Registers- Ring Counter and

Johnson Counter, Sample and Hold Circuit. [T1,T2]

UNIT IV

Introduction to 555 Timer IC: Functional and block diagram of 555 timer, Application of 555 timer as astable and monostable multivibrator.
Analog-to-digital (successive approximation, integrating, flash and sigma-delta) and digital-to-analog converters (weighted R, R-2R ladder and current steering logic). Characteristics of ADC and DAC (resolution, quantization, significant bits, conversion/settling time). [T1,T2]

Textbook(s):

1. Zyi Kohavi, “Switching & Finite Automata Theory”, TMH, 2nd Edition
2. Morris Mano, Digital Logic and Computer Design”, Pearson

Reference Books:

1. A Anand Kumar, “Fundamentals of Digital Logic Circuits”, PHI
2. Taub ,Helbert and Schilling, “Digital Integrated Electronics”, TMH

Paper Code(s): ICC-210	L	P	C
Paper: Sensors and Transducers	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide an understanding about the concepts of measurement system its static and dynamic characteristics.
2.	To expose the students to various sensors and transducers for measuring mechanical quantities and their applications.
3.	To teach the basic conditioning circuits for various sensors and transducers.
4.	To introduce about advancements in sensor technology and smart sensors.

Course Outcomes (CO)

CO 1	Ability to define, understand various Sensors, their need and properties of sensors.
CO 2	Ability to apply knowledge of various types of transducers in domestic and industrial applications
CO 3	Ability to analyse various types of sensors for particular application.
CO 4	Ability to design signal conditioning circuit for various sensors and transducers.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT I

[Introduction to sensors and Transducers] General concepts and terminology of measurement systems and its functional elements, transducer classification, static and dynamic characteristics of a measurement system, criteria for transducer selection.
Resistive Transducers: Principles of operation, construction, theory, signal conditioning circuits and applications of resistance potentiometers, strain gauges (metallic and semi-conductor type), resistance thermometer, thermistors, photo transistors. [T1,T2]

UNIT II

[Displacement Sensors and Transducers] Capacitive Transducers: Types of capacitive transducer, Principles of operation, construction, theory, signal conditioning circuits and applications of capacitive transducers
Inductive Transducers: Types of Inductive transducer, Principles of operation, construction, signal conditioning circuits and applications of various variable inductive transducers, LVDT , RVDT Eddy current sensors, Synchros. [T1,T2]

UNIT III

[Temperature and Radiation Sensors] Active Transducers: Principle of operation, construction, theory, signal conditioning and applications of Piezo-electric transducer, Magneto-strictive transducer, Hall effect transducer, Photo-voltaic transducer and Thermocouple
Optical transducers: photo-emissive, photo-conductive and Photovoltaic cells, photomultipliers
Digital Transducers: Optical encoders translational and rotary encoders (absolute position and incremental position encoders) and magnetic pickups. [T1,T2]

UNIT IV

[Smart Sensors] Other transducers: Ultrasonic sensors, Vibration pickups and accelerometers and its dynamic response, stroboscope, sound and humidity sensors Microelectromechanical. system (MEMS), Biosensors: Glucometer, Oxymeter, Nanosensors and its application, Smart sensor system. [T1,T2]

Textbook(s):

1. D. Patranabis, ―Sensors and Transducers‖, PHI Learning Pvt. Ltd., 2nd edition.
2. D V S Murty, ―Transducers and Instrumentation‖, PHI Learning Pvt. Ltd.

Reference Books:

1. E.O. Doebelin,Dhanesh N Manik, ―Measurement Systems‖,6th Edition, McGraw Hill Edu.
2. John P. Bentely, ―Principles of Measurement System‖, 4th Edition, Pearson Prentice Hal .

Paper Code(s): EEC-214	**L**	**P**	**C**
Paper: Electrical and Electronics Measurements	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand working of general instrument system, types of error, methods of measurement.
2.	To give an overview of test and measuring instruments.
3.	To expose the students to the design of bridges for the measurement of resistance, capacitance and inductance.
4.	Understand the principle and working of various electrical and electronic measuring instruments

Course Outcomes (CO)

CO 1	Ability to understand principal and working of electric and electronic measuring instruments
CO 2	Ability to analyse various errors in measurement
CO 3	Ability to evaluate the unknown quantities using measuring instruments
CO 4	Ability to design bridge circuits for measurement of resistance, capacitance and inductance

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	-	-	-	-	-	-	-	-	3
CO 2	3	3	-	-	-	-	-	-	-	-	-	3
CO 3	3	3	2	3	-	-	-	-	-	2	-	3
CO 4	3	3	3	3	-	2	2	-	2	2	-	3

UNIT I

Basics of Measurement: Measurement & its significance, Direct & Indirect methods of measurement, classification of measurement
Characteristics of Measurement: Static and dynamic characteristics
Units & Standards: SI units, standards of Measurement (R, L, C, Voltage, current & frequency)
Errors in Measurement: types of errors in measurement system, Error and Uncertainty analysis, Propagation of errors, Linear and weighted regression. [T1,T2]

UNIT II

AC Bridges: Wheatstone bridge, kelvin double bridge, Maxwell bridge, Megohm bridge, Anderson bridge, Schering and Wein's bridge for measurement of R, L, C and frequency respectively. Q meter, Shielding and grounding. [T1,T2]

UNIT III

AC Instruments: Measurement of voltage, current and power in single phase and three phase circuits, ac and dc current probes, true rms meter, voltage and current scaling.

Instrument Transformers: Construction, operation & ratio and phase errors in current and potential transformers, compensation technique for error in current and potential transformers. [T1,T2]

UNIT IV

Electronic Measuring Instruments: General purpose cathode ray oscilloscope (CRO); Construction & working & principleTimer/counter, Measurement of time, phase& frequency, digital voltmeter, digital multimeter. [T1,T2]

Textbook(s):

1. Albert D.Helfrick, William D.Cooper, ―Modern Electronic Instrumentation and Measurement Techniques‖, PHI India.
2. Electronic Instrumentation by HS Kalsi, Tata McGraw- Hill.

Reference Books:

1. A.K. Sawhney, Puneet Sawhney – A course in Electrical and Electronic Measurements and Instrumentation.
2. J.B GUPTA – A courseinElectrical and Electronic Measurements and Instrumentation.
3. B. C. Nakra., K. K. Chaudhry, ―Instrumentation, Measurement and Analysis, 4th Edition, McGraw Hill Education.
4. Electrical Measurements & Measuring Instruments by Golding & Widdis, Wheeler's.

Paper Code(s): MEC-206	L	P	C
Paper: Manufacturing Science & Technology - II	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concepts of metal cutting and tool materials.
2.	To develop an understanding of the various machine tools.
3.	To introduce students to different gear forming methods and jigs & fixtures
4.	To acquire a fundamental knowledge on non-traditional machining processes.

Course Outcomes (CO)

CO 1	Understand and apply concepts of cutting tool geometry, materials, mechanism of chip formation and mechanics of metal cutting
CO 2	Illustrate and identify the various constructional features and operations performed on machine tools.
CO 3	Analyse the kinematic motions and associated mathematical relationships in a machine tool.
CO 4	Select a machine tool, cutting tool and holding devices as per the requirement of metal cutting and submit report in a team.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	3	-	2	-	-	-	-	-	-
CO 2	3	-	2	-	-	2	-	-	-	-	-	-
CO 3	3	3	2	2	-	2	-	-	-	-	-	-
CO 4	3	2	2	3	-	2	-	-	3	3	-	-

UNIT-I

Theory of Metal Cutting: Single point cutting tool nomenclature, geometry. Mechanics of Chip Formation, Types of Chips. Merchants circle diagram and analysis, Ernst Merchant’s solution, shear angle relationship, problems of Merchant’s analysis. Tool Wear and Tool failure, tool life. Effects of cutting parameters on tool life. Tool Failure Criteria, Taylor’s Tool Life equation. Problems on tool life evaluation.

Cutting Tool Materials: Desired properties and types of cutting tool materials, Cutting fluids and its desired properties, types and selection. Heat generation in metal cutting, factors affecting heat generation. Heat distribution in tool, work piece and chip. Measurement of tool tip temperature.

UNIT-II

Lathe, Shaper, Planer and Slotter: Classification, constructional features, work and tool holding devices for General lathe, Turret and Capstan Lathe. Tool Layout, shaping Machine, Planing Machine, Driving mechanisms of lathe, shaping and planing machine tools, Different operations on lathe, shaping machine, planing, slotting machine tools. Problems on machining time calculations, thread cutting.

Drilling: Classification, constructional features, drilling & related operations. Types of drill & drill bit nomenclature, Basic principle of design of drill bits, drill materials, related problems.

UNIT-III

Milling and Grinding: Classification, constructional features, milling cutters nomenclature, milling operations, up milling and down milling concepts. Various milling operations. Indexing Methods: Simple and compound. Problems on indexing and machining time calculation. Grinding: Selection of grinding wheel, Classification, constructional features of grinding machines (Centerless, cylindrical and surface grinding), Dressing and truing of grinding wheels.

Broaching process: Principle of broaching, Applications, advantages and limitations. Finishing and other Processes Lapping and Honing operations – Principles, arrangement of set up and application. Super finishing process, polishing, buffing operation and application.

Gear Manufacturing: Gear forming, gear generation, gear shaping and gear hobbing.

UNIT - IV

Jigs & Fixtures: Important considerations in jigs and fixture design. Main principles of designing of jigs & fixtures, elements of Jigs and fixtures. Different devices and methods of locations. Different types of clamps used in jigs & fixtures.

Introduction to CNC machines- Principles of operation. Basics of Manual part programming methods.

Non- Traditional Machining: Need and classification of non-traditional machining, Principle, equipment & operation of Electric discharge machining, Laser Beam Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining.

Textbook(s):
1. B.L. Juneja, G. S. Sekhon, Nitin Seth, “Fundamental of Metal Cutting and Machine Tools”, New Age International; 2nded.
2. A. Ghosh and A.K. Mallik, “Manufacturing Science”, East West Press.
3. P. H. Joshi, “Jigs and Fixtures”, Tata McGraw Hill;2nd ed.

References:
1. G. Boothroyd, “Fundamentals of Metal Machining and Machine Tools”, Taylor and Francis; 3rd ed.
2. M. C. Shaw, “Metal Cutting Principles”, Oxford University Press.
3. J.A. McGeough, “Advanced Methods of Machining”, Springer International Edition.
4. P.C. Sharma, “A Text Book of Production Engineering”, S. Chand, New Delhi;(2004)
5. H. S. Bawa, “Workshop Technology”, Vol.2, Tata McGraw Hill;(2004)
6. G.K. Lal, “Introduction to Machining Science”, New age International.
7. A. Bhattacharya,Metal cutting Theory and Practice- New Central Book Agency.

Paper Code(s): MEC-208	L	P	C
Paper: Material Science and Metallurgy	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To develop the knowledge of lattice structure and their defects.
2.	To develop the relation between structural and mechanical properties of metals for the selection of product design.
3.	Identify the microstructure and properties of Iron-Iron carbide Phase diagram.
4.	To develop the knowledge of various composite materials and their applications.

Course Outcomes (CO)

After completion of the course, the students will be able to:

CO 1	Summarize the properties of crystal structures of metallic elements and understand the mechanism of diffusion and deformation.
CO 2	To relate the material behaviour under environmental conditions and interpret the characteristics of steel through iron- iron carbide and TTT diagram.
CO 3	Relate the properties of steel with heat treatment processes and study the effect of alloying elements in steel.
CO 4	Classify types of corrosion and composites.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (Scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	3	2	-	-	-	-	-	-	3	3
CO 2	3	2	3	2	-	-	-	-	-	-	3	3
CO 3	3	2	3	2	-	-	-	-	-	-	3	3
CO 4	3	-	-	2	-	3	3	-	-	-	3	3

UNIT – I

Structure of metal: Crystal structure (BCC, FCC and HCP), Packing factor and density calculation, miller indices, imperfections in solids.

Diffusion: Diffusion mechanisms, steady state and non-steady state diffusion, factors affecting diffusion.

Deformation: Slip, twinning, critical resolved shear stress, effect of cold working and hot working on mechanical properties, principles of recovery, re-crystallization and gain growth.

UNIT – II

Fracture: Types of fracture- ductile and brittle, ductile to brittle transition temperature (DBTT), Fatigue-Endurance limit, S-N Curve, factors affecting fatigue.

Creep: Mechanism of creep, creep curve, basic consideration in the selection of material for high temperature service.

Equilibrium diagram: solids solutions and alloys, Gibbs phase rule, unary and binary eutectic phase diagram, lever rule, Iron- Iron carbide Phase diagram, TTT-diagram, Effect of alloying elements on TTT diagram.

UNIT–III

Heat Treatment: Principles and purpose of heat treatment of plain carbon steels, annealing, normalizing, hardening, tempering, quenching, austempering, martempering, case hardening processes – carburizing, nitriding, cyaniding, induction and flame hardening, Hardenability: determination of hardenability, Jominy end quench test.

Materials: Types of Plain carbon steels, effect of alloying elements on steel, Cast iron-white, grey, malleable and nodular cast iron, properties and application of cast iron, properties and uses of high speed steel, stainless steel, spring steel, Non-ferrous materials.

UNIT– IV

Corrosion: Types of corrosion, mechanism of corrosion, preventions against corrosion.

Introduction to composite materials- Classification, Properties and applications of composite materials.
Surface Coatings: Introduction to metallic coating and coating methods.

Text Books (s):
1. W. D. Callister, David G. Rethwisch, “Materials Science and Engineering: An Introduction”, Wiley & Sons; 9thed. (2013).
2. K. I. Parashivamurthy, “Material Science and Metallurgy”, Pearson.
3. Sidney H. Avner, “Introduction to Physical Metallurgy”, Tata McGraw-Hill, New Delhi; (1997).

Reference Books:
1. L. Krishna Reddi, “Principles of Engineering Metallurgy”, New Age Publication, New Delhi; (2001)
2. Buduisky et. al., “Engineering Materials & Properties”, Prentice Hall India, New Delhi; (2004)
3. Peter Haasten, “Physical Metallurgy”, Cambridge Univ. Press; (1996)
4. Raymond A. Higgin., “Engineering Metallurgy Part 1”, Prentice Hall India, New Delhi; (1998)

Paper Code(s): MEC-210	L	P	C
Paper: Thermal Engineering – II	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the working of steam nozzle at design condition and off design condition. To differentiate clearly between impulse and impulse-reaction turbine.
2.	To understand the working of reciprocating compressor & refrigeration cycle.
3.	To understand the combustion in I.C engine and appreciate the concept of knocking.
4.	To be able to compute performance parameters of an I.C engine and to determine components of heat balance of given i.C engine.

Course Outcomes (CO)

CO 1	To determine the mass flow rate through steam nozzle and to be able to determine blade efficiency and stage efficiency of steam turbine blading.
CO 2	To determine work requirement of a reciprocating compressor and to analyze refrigeration system based on vapour compression refrigeration system.
CO 3	Explain the combustion in I.C engine and enumerate the factors responsible for knocking.
CO 4	Evaluate performance parameter of I.C engine and draw heat balance sheet of specified engine.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	2	-	-	-	-	2
CO 3	3	3	3	3	-	-	2	-	-	-	-	2
CO 4	3	3	3	3	-	-	2	-	-	-	-	2

UNIT-I

Steam Nozzle: Types of nozzles, flow of steam through nozzles, condition for maximum discharge through nozzle, nozzle efficiency, effect of friction and off design condition of convergent nozzle and convergent-divergent nozzle.

Steam Turbine: Working principle and types of steam turbines, velocity diagrams for impulse and reaction turbines, compounding of impulse turbines, optimum velocity ratio and maximum efficiency, comparison of impulse and reaction turbines, reheat factor.

UNIT-II

Air Compressors: Steady flow analysis, isothermal, adiabatic and polytropic compression, single- and multi-stage compression, ideal intermediate pressure, compressor clearance, volumetric and isothermal efficiency, minimum work requirement of a compressor.

Refrigeration Cycle: Vapour compression refrigeration cycle, description, analysis, refrigerating effect, power required, unit of refrigeration, COP, Refrigerants and its desirable properties. Vapor absorption refrigeration system.

UNIT-III

Internal Combustion Engine: Combustion in S.I. engine, Combustion in C.I. engine and its stages, Knocking in S.I. and C.I. engine and its detrimental effect, Factors affecting knocking in S.I. and C.I. engine.

UNIT – IV

I.C. Engine performance: Measurement of performance parameters of an engine, different methods to determine Indicated power and friction power of an engine, components of heat balance sheet of a given Engine, Ignition system, Fuel injection system, Lubrication system.

Textbook(s):
1. S. Domkundwar, Thermal Engineering, Dhanpat Rai & Co (p) Ltd.
2. P.K Nag, Applied Thermodynamics, Tata McGraw Hill (p) Limited.
3. Mathur & Sharma, Internal Combustion Engine, Dhanpat Rai Publication.

References:
1. Onkar Singh, Applied Thermodynamics, New Age International (p) Limited.
2. Cohen & Rogers, Gas Turbines, Pearson Prentice Hall, ISBN- 9780582236325.
3. R. K. Rajput, “Engineering Thermodynamics”, Lakshmi Publications.
4. V.Ganesan, “Internal Combustion Engine “, Tata McGraw Hill Publishing Co., New Delhi.
5. Gordon Rosers, & Yon Mahew; Engineering Thermodynamics”, Pearson.

Paper Code(s): MEC-212	**L**	**P**	**C**
Paper: Machine Design – I	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand ab-initio design concepts under various constraints, stress concentration and dynamic loading. Also analyse the design of static joints and pipes.
2.	To conceptualise joints for power transmission in rotating parts, suspension parts and in leverage.
3.	To analyse bolted & screwed fastenings and structural plates joining for complex engineering applications under myriad of loads.
4.	To thoroughly understand the design procedure for speed variation effects in toothed elements and power screws.

Course Outcomes (CO)

CO 1	Grasp the systematic design procedure & design principles considering constraints of various methods of manufacture and effect of static & dynamic forces on joints for rods.
CO 2	Synthesis of keyed-coupled shafts and stress analysis of flexible elements & levers.
CO 3	Design analysis of fastening threads and various temporary & permanent joints for plates.
CO 4	Analyse the effect of changing speeds on designed toothed elements and efficient power transmitting devices.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	3	2	2	2	1	1	2	3
CO 2	3	3	3	3	3	2	2	2	1	1	2	3
CO 3	3	3	3	3	3	2	2	2	1	1	2	3
CO 4	3	3	3	3	3	2	2	2	1	1	2	3

UNIT-I

Introduction: Systematic Design Process (SDP), Basic principles for mechanical design, Use of standards. Manufacturing consideration in design of casting & machining parts.

Dynamic and fluctuating stresses, fatigue failure and endurance limit, design under combined direct & varying stresses. Stress concentration, causes and remedies in design.

Factor of safety and it's affecting factors, Tolerances and fits as per BIS, Materials selection, Designation of steels.

Detailed design procedure of Spigot & Socket Cotter joint, Knuckle joint, Pipe joint. Numerical Design Problems.

UNIT-II

Shafts, keys and couplings: Transmission Shafts, materials, design of shafts on strength & rigidity basis and under combined torsional and bending loads as per ASME code. Keys, types and applications. Design of rigid and pin bushed flexible couplings.

Levers, types, Design of Bell crank lever.
Springs and their applications, design of close coiled helical springs. Numerical Design Problems.

UNIT-III

Riveted & Welded Joints: Types of riveted joints, Failure modes, strength equations, joint efficiency, Riveted joint for boiler shells, Riveted joints under direct and eccentric loads. Welded joints, strength of parallel, transverse & combined filled welded joints, axially loaded unsymmetrical welded joint, eccentrically loaded welded joints, welded joints subjected to bending moment and torsional moment.
Threaded Joints: Types of screwed fastenings, Initial tightening loads in bolts, Torque requirement, Uniform strength bolt, Direct & eccentrically loaded bolted joints. Numerical Design Problems.

UNIT - IV

Power Screws: Types of threads of power screws - Square, trapezoidal & Acme threads, Torque requirement, efficiency, irreversibility & self-locking, Complete analysis of design of screw jack.
Spur Gear: Classification of Gears, spur gear terminology, Gear tooth failure, Lewis equation for beam strength of tooth, dynamic and wear loads. Numerical Design Problems.

Textbook(s):
1. V.B. Bhandari, “Design of Machine elements”, Tata McGraw Hill Education Private Ltd. Third Edition (2012)
2. Maleeve Hartman and O.P. Grover, “Machine Design”, CBS Publishers& Distributors Pvt. Ltd. Sixth Edition (2015)

References:
1. K. Mahadevan, “Design Data Book”, CBS Publishers & Distributors.
2. J.E. Shigley & C.R. Mischke, "Mechanical Engineering Design”, Tata McGraw Hill Co. Inc.
3. P.C. Sharma and D.K Aggarwal., “Machine Design”, S.K. Kataria & Sons.
4. R.C. Juvinal andK.M. Marshek, “Fundamentals of Machine component Design”, Wiley India .
5. R.I. Norton, “Machine Design” Pearson.

Paper Code(s): CEC-206	L	P	C
Paper: Soil Mechanics	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To explain the methods of classifying the soils
2.	To analyse the flow of water through soils and to estimate the stress distribution in the soil mass
3.	To interpret the compaction characteristics, compressibility characteristics, settlements
4.	To assess the shear strength of the soils.

Course Outcomes (CO)

CO 1	Classify the soil and determine its Index properties.
CO 2	Evaluate the permeability, seepage and compaction characteristics of soil.
CO 3	Apply the knowledge of effective stress and consolidation to determine settlement of soil.
CO 4	Analyse the shear strength parameters of various types of soil.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	2	3	-	-	2	-	-	-	1	-
CO 2	3	2	2	3	2	1	1	-	1	1	1	2
CO 3	3	3	2	3	2	1	-	-	-	1	1	1
CO 4	2	2	3	2	2	1	2	-	1	1	1	1

UNIT-I

Introduction & Basic Properties of Soil: Scope of Soil Mechanics, Soil formation, Soil as a three-phase system, Definitions of various parameters and their Interrelationships, Index properties-water content, specific gravity, particle size distribution, sieve analysis, hydrometer method, consistency of soils, activity, sensitivity, thixotropic.

Soil Classification & Clay Mineralogy: Unified and Indian standard soil classification system, Soil structure, Clay Minerals.

UNIT-II

Soil Hydraulics: Stress conditions in soil–total, effective and neutral stresses and relationships. Permeability–Darcy's Law, Hydraulic conductivity, Equivalent hydraulic conductivity in stratified soil, Seepage through soils, Flow nets, Seepage calculation from a flow net, Flow nets in anisotropic soils, Uplift pressure, Piping, Capillarity, Seepage force, Quicksand condition, Seepage through earth dam, Phreatic line of an earth dam.

Stress Distribution in Soil: Boussinesq equations, Vertical stress distribution diagrams, Vertical stress beneath loaded areas, Westergaard's equation, Contact pressure.

UNIT-III

Soil Compaction: Laboratory tests: Standard proctor test, modified proctor test, OMC, Factors affecting compaction, Compaction specifications and field control.

Consolidation: Primary and secondary consolidation, Normal and Over Consolidated soils, Over Consolidation Ratio, Spring analogy for primary consolidation, Terzaghi's one dimensional consolidation theory and equation, Solutions of Terzaghi’s equation, Determination of coefficient of consolidation, Determination of primary consolidation settlement, Secondary consolidation.

UNIT–IV

Shear Strength of soil: Introduction, Mohr’s circle of stress, Mohr-Coulomb failure criterion, shear parameters, Various Laboratory tests for measurement of shear strength, UU, CU and CD tests and their relevance to field problems, unconfined compression test, Pore pressure parameters, Shear characteristics of sand, liquefaction.

Textbook(s):
1. Gopal Ranjan and ASR Rao, “Basic and Applied Soil Mechanics”, New Age International Publishers, 4th Edition (2-22).
2. Dr B.C. Punmia, Er. AK Jain, & Dr. AK Jain, “Soil Mechanics and Foundations”, Laxmi Publications, 17th Edition (2021).

Reference Books:
1. Dr KR Arora, “Soil Mechanics and Foundation Engineering”, Standard Publishers Distributors (2-2-).
2. JE Bowles, Foundation Analysis and Design, McGraw-Hill, New Delhi (1996).
3. Venkataramaiah, “Geotechnical Engineering”, New Age International Publishers.
4. VNS Murthy, “Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering” (2-16).
5. P. Purushothama Raj, “Soil Mechanics and Foundation Engineering”, Pearson Education India (2-13).
6. DP Coduto, MR Yeung, WA Kitch, “Geotechnical Engineering: Principles and Practices”, Pearson Education, Singapore, 2nd Edition (2-17).
7. K Terzaghi, R B Peck, G Mesri, “Soil Mechanics in Engineering Practice”, John Wiley and Sons, New Jersey (1996).

Paper Code(s): CEC-208	L	P	C
Paper: Hydraulics and Hydrology	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To study different types of flow and forces exerted by flow on the boundary of conduit.
2.	To explain forces on submerged bodies, flow through pipes and principles of turbines.
3.	To assess the storage capacity of the reservoir and the process of mitigating floods.
4.	To determine runoff characteristics.

Course Outcomes (CO)

CO 1	Able To Define different types of flow, and hydraulic machines
CO 2	Able To Determine Various Components Of The hydrologic cycle affecting movement of water in the earth and various Stream flow measurements technique
CO 3	Able to analyse complex flow problems on boundary layers, pipe network and hydraulic turbines & pumps.
CO 4	Able to determine and analyse ground water hydraulics.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	-	-	-	-	-	-	-	1	-	-
CO 2	2	3	2	1	-	-	-	-	-	1	-	-
CO 3	2	3	2	1	-	-	-	-	-	-	1	-
CO 4	3	2	3	2	1	-	-	-	-	-	-	-

UNIT-I

Laminar Flow : Flow through circular pipe and parallel plates, Kinetic energy correction factor, Momentum correction factor; Loss of head due to friction; determination of coefficient of viscosity.
Boundary Layer: Concept and development of boundary layer, Laminar and turbulent boundary layers and their analysis, boundary layer thickness; Critical Reynolds number; Boundary layer separation and control.
Forces on submerged bodies: Forces exerted by flowing fluid, Concept and expression for Drag and lift; Pressure drag and friction drag; Stream line and bluff body; Drag on sphere and cylinder, Terminal velocity of a body, Lift on a circular cylinder, Drag force acting on a rotating cylinder, Development of lift on Airfoil.

UNIT-II

Flow through pipes: Loss of head / energy in pipes - Major losses-friction loss by Darcy Weisbach formula, Chezy’s formula; Types of minor losses; Hydraulic gradient and total energy line, Flow through siphon, Pipes in series, concept of equivalent pipe, flow through parallel and branched pipes; Water hammer in pipes, sudden and gradual closure of valve; Analysis of Pipe network using Hardy Cross method.
Hydraulic machines: General layout of hydroelectric power plant, classification of hydraulic turbines, Pelton turbine and its main parts, Analysis and design of Pelton turbine for jet diameter, wheel diameter, width, depth

and number of buckets; Hydraulic, mechanical and overall efficiencies of turbine, Introduction to other turbines like Francis and Kaplan turbines, Specific speed and its significance.

Pumps: Centrifugal Pump, Introduction, Main parts; Head, efficiencies, specific speed, Cavitations in turbines and centrifugal pumps and their effects and precautions, Main parts of Reciprocating Pump.

UNIT-III

Hydrology: Hydrologic Cycle. Water Budget Equation, Precipitation: Types, measurements and analysis, error in estimation, missing data, consistency of rainfall records, Intensity during frequency (IDF) and probabilistic maximum Precipitation (PMP) curves. Evaporation and consumptive use: Process affecting factors, estimation, and measurement techniques. Infiltration: Process affecting factors, measurement and estimation, Infiltration Indices.

Surface Runoff: Components and factors affecting runoff, methods of estimation of runoff volume and peak runoff, rating curve, Rainfall – runoff relationships.

Hydrograph analysis: components, factors affecting hydrographs, base flow separation, Direct Runoff Hydrograph, Unit Hydrograph: Theory and assumptions. Derivation of Unit Hydrograph, Synthetic Unit Hydrograph.

UNIT – IV

Ground Water Hydrology: Zones of underground water, Aquifers and their types, important terms, Determination of discharge through unconfined and confined aquifers with steady flow conditions, Interference among wells, determination of aquifer constants, Well loss and specific capacity, efficiency of a well, types of water wells, bored and open wells, specific yield of a well, type of tube wells, well shrouding and well development, Suitable site selection for tube well, Types of open wells, Methods of lifting water. Infiltration galleries and Infiltration well.

Textbook(s):

1. P.N. Modi & S.M. Seth, Hydraulics and Fluid Mechanics including Hydraulics Machine Standard Book House, New Delhi.
2. Subramanya,K.,Engineering Hydrology,Tata McGraw Hill, New Delhi
3. Ramamrutham S., Hydraulics Fluid Mechanics and Fluid Machines, Dhanpat Rai Publicating Company, Delhi.
4. Fluid Mechanics: Including Hydraulic Machines by A.K. Jain.

References:

1. Modi,P.N.,IrrigationWaterResources,andWaterPowerEngineering,StandardBookHouse,NewDelhi.
2. Todd,D.K.,GroundwaterHydrology,1993JohnWiley&Sons.
3. Raghunath, H.M, Hydrology–Principles,AnalysisandDesign,1986,Wiley
4. Dr. P. Jaya Rami Reddy, A Textbook of Hydrology, University Science Press.
5. Garg S.K., Hydrology and Water Resources Engineering

Paper Code(s): CEC-210	**L**	**P**	**C**
Paper: Environmental Engineering - I	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To analyse water quality and its quantity requirements for given uses.
2.	To understand the distribution system and assess the capacity of reservoir.
3.	To design water treatment plant based upon quality of raw water and desired quality of treated water.
4.	To explain different air pollutants, their effects and control strategies

Course Outcomes (CO)

CO 1	Analyze water quality and its quantity requirements for given uses.
CO 2	Understand the distribution system and assess the capacity of reservoir.
CO 3	Design water treatment plant based upon quality of raw water and desired quality of treated water.
CO 4	Explain different air pollutants, their effects and control strategies

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	2	1	2	1	-	-	2	-	-	-	1	-
CO 2	3	2	2	2	1	1	1	-	-	-	1	2
CO 3	3	3	2	1	1	1	-	-	-	1	-	1
CO 4	2	2	2	-	1	1	2	-	1	1	1	1

UNIT-I

Water Demand: Various types of Water demands, factors affecting per capita demand, variations in demand, population forecasting by various methods, design life and design discharge of different units in water scheme
Sources of Water: Ground water development, types of geological formations, different forms of extraction of ground water, yield of open well and tube well.
Water Quality Parameters (WQP): physical WQP–Suspended solids, turbidity, colour, taste & odour, Temperature; Chemical WQP–Total dissolved solids, alkalinity, pH, hardness, chloride & nitrogen content, fluorides, metals and gases; Biological WQP–Membrane filter technique, most probable number test.

UNIT-II

Transmission of Water: Various types of conduits, capacity and sizes including economical sizes of rising main, structural requirements, laying and testing of water supply pipelines, pipe materials, joints, appurtenances and valves, leakages and control.
Storage and Distribution System: Methods of distribution, pressure and gravity distribution systems, Concept of service and balancing reservoirs, Capacity of distribution reservoirs–general design guidelines for distribution system.

UNIT-III

Treatment of water: Objectives of water treatment, process details and design considerations of treatment units such as screening, aeration, sedimentation, coagulation, flocculation, theory of filtration, hydraulics of filtration, slow sand, rapid sand and pressure filters, backwashing, design of slow and rapid sand filters, operational troubles in rapid sand filter, different methods of disinfection, requirements of an ideal disinfectant, chlorination and practices of chlorination, water softening and ion-exchange process, Minor methods of treatments such as treatment with activated carbon, copper sulphate, deferrization, fluoridation, de-fluoridation, desalination and reverse osmosis.

UNIT – IV

Air Pollution and Control: Introduction, primary and secondary air pollutants, their sources and effects, super adiabatic, sub adiabatic, and neutral environment, inversion, types of plumes, Control of gaseous and particulate air pollutants.
Noise Pollution: Introduction, level of noise, rating of noise.

Text Books:
1. Garg, S.K.: Water Supply Engineering (Environmental Engineering Vol. – I & II)
2. Peavy, Howard S., Rowe, Donald R and Tchobanoglous, George, “Environmental Engineering” McGraw Hill Education (India) Pvt. Ltd., New Delhi.

References:
1. Manual on Water Supply and Treatment, C. P. H. E. E. O.,Ministry of Urban Development, Government of India, New Delhi
2. Punmia: Water Supply and Wastewater Engineering Vol. I and II
3. Ramalho: Introduction to Wastewater Treatment Processes
4. Davis Mackenzie L., Cornwell, David A., “Introduction to Environmental Engineering” McGraw Hill Education (India) Pvt. Ltd., New Delhi.

Paper Code(s): CEC-212	**L**	**P**	**C**
Paper: Transportation Engineering	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To explain the basic modes of transportation and their importance in selecting the effective transportation mode.
2.	To analyse the various parameters including surveys for planning of new transportation systems.
3.	To design the layout of terminal facilities like railway stations, yards for railways, docks & harbours for waterways and airport for airways.
4.	To identify the forces and stresses to be considered while designing various transportation structures like railway track, harbour components, runways, and tunnels.

Course Outcomes (CO)

CO 1	Explain the basic modes of transportation and their importance in selecting the effective transportation mode considering the socio-economical and geographical aspects.
CO 2	Analyse the various parameters including surveys for planning of new transportation systems (Highways, Railways, Waterways and Airways).
CO 3	Design the layout of terminal facilities like railway stations, yards for railways, docks and harbours for waterways and airport for airways.
CO 4	Identify the forces and stresses to be considered while designing various transportation structures like railway track, harbour components, runway, and tunnels.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	-	2	-	1	-	3	3	-	-	-	-	2
CO 2	1	3	3	2	-	1	2	-	2	1	2	1
CO 3	3	-	3	3	3	1	3	-	3	1	3	2
CO 4	2	3	3	2	1	1	-	-	1	-	-	-

UNIT-I

Introduction to Transportation Systems: Modes of transportation, introduction to road, rail, air and water transportation, Comparison of various modes of transportation.
Highway Development and Planning: History of road development, Highway development in India, Classification of roads, Road patterns, Saturation system, Engineering surveys for highway alignment.
Introduction to Rail Transportation: Types of surveys, Permanent way–its various components and functions of rails, sleepers, ballast, etc., Requirements of an ideal permanent way, Defects in rails, Gauges in railway track, Coning of wheels, Tilting of rails, Rail joints, Rail fastenings, Sleeper density, Creep of rail.

UNIT-II

Geometric Design of Railway Track: Gradient and grade compensation, Superelevation, concepts of cant excess and deficiency, Negative superelevation, Safe permissible speed, transition curves, Widening of gauge on curves.
Railway Operation and Control: Points and crossings, Types of turnouts, Design of turnouts, Types of switches, Types of track junctions, Different types of stations and yards, Equipment in station yards, Signalling and Control systems–Classification of Signals, Absolute block system, Centralized traffic control system, Interlocking of signals.
Railway Construction and Maintenance: Construction of railway track–earthwork, plate laying and laying of ballast, Maintenance of railway tracks, Modern methods of track maintenance, Concept of high-speed trains.

UNIT-III

Water Transportation: Classification of Harbour, Harbour planning, Sounding methods, Classification of Ports, tide, wind and wave, Shore protection work, Littoral drift, Types of breakwaters, Classification and shape of Docks and basins, Jetties and wharves.
Tunnel Engineering: Necessity of tunnels, Classification of tunnels, Shape of tunnels, Shafts in tunnels, Methods of Tunnelling in rocks and in soft ground, Shield method, Compressed air method, Ventilation, drainage and lighting for tunnels.

UNIT – IV

Airport Planning and Design: Aircraft characteristics affecting airport, Airport planning, Surveys for site selection, Wind rose diagram and its utility, Concept of airport runway length, calculations and corrections, taxiway, Apron, Hanger, Radar, Air traffic control, and service equipment.

Text Books
1. S.C. Saxena & S.P. Arora, “A Textbook of Railway Engineering”, Dhanpat Rai Publications, 7th Edition (2018).
2. S.K. Khanna, M.G. Arora & S.S. Jain, “Airport Planning and Design”, Nem Chand & Bros., 6th Edition (2012).

Reference Books
1. S.K. Khanna, C.E.G. Justo, A. Veeraragavan, “Highway Engineering”, Nem Chand & Bros., 10th Edition (2021).
2. V.N. Vazirani & S.P. Chandola, “Transportation Engineering–Vol. II”, Khanna Publishers (2012).
3. Satish Chandra & M.M. Agarwal, “Railway Engineering”, Oxford University Press, 2nd Edition (2013).
4. R. Srinivasan, “Harbour, Dock and Tunnel Engineering”, Charotar Publishing House, 30th Edition (2022).
5. S.C. Rangwala, “Railway Engineering”, Charotar Publishing House, 27th Edition (2017).

Paper Code(s): MAC-210	**L**	**P**	**C**
Paper: Database Management Systems	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the basic concept of Database management system and Client Server Architecture
2.	To understand the concepts of the ER model and Relation model
3.	To introduce basics of relational database design, PL SQL and NO SQL
4.	To introduce concept of transaction, security and learn basics of DBMS for CAD/CAM

Course Outcomes (CO) :

CO 1	To understand basics of database management system and SQL
CO 2	To learn the concepts of the ER model and Relation model
CO 3	To understand benefits of relational database design, PL SQL and NO SQL
CO 4	To understand properties of transaction, security and relationship of CAD/CAM with DBMS

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	1	1	3	-	-	-	2	2	2	3
CO 2	3	3	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	2	2	3	-	-	-	2	2	2	3
CO 4	3	2	1	1	2	-	-	-	2	2	2	3

UNIT – I

Basic concepts: Advantages of a DBMS over file processing system, Data Abstraction, Database Languages, Data Independence. , Components of a DBMS and overall structure of a DBMS, Three views of Data (External View, Conceptual View, Internal View), Three level architecture of DBMS, Data Independence, Client Server Architecture

SQL: Data definition language, Data manipulation language, SQL, Object naming conventions, Object naming guidelines, Data types, Tables (Creating , Inserting, Updating and deleting tables and using constraints), Views, Indexes, SQL Command :- DESCRIBE, SELECT, WHERE CLAUSE, DISTINCT CLAUSE, ORDER BY,HAVING, LOGICAL OPERATIONS, SQL OPERATORS, JOIN Aggregate functions, String functions and date time functions, Null values

UNIT - II

ER Model : Entity sets and relationship sets- Attributes - Keys in entity and relationship sets : (a) Super Key (b) Candidate Key (c) Primary Key (e) Unique Key - Mapping constraints, Participation Constraint, E-R diagram, Notations. Strong Entity Set and Weak Entity Set

Relation Model: Advantages, Disadvantages, Codd's 12 rules, Definition of Relations, Schema, Sub schema. Relational Model Constraints (Domain, Tuple Uniqueness, Key Constraints, Integrity Constraints, Entity constraints). Relations algebra (Basic operation: Union intersection difference and Cartesian product), Additional Relational Algebraic Operations (Projection, Selection rows, Division, rename and join) , Converting ER Model to Relational Model

UNIT – III

Relational Database Design: Purpose of Normalization, Data redundancy and updating anomalies, Functional Dependencies and Decomposition, Process of Normalization using 1NF, 2NF, 3NF, multivalued dependencies and BCNF, Forth Normal Form, Fifth Normal Form

Database Programming: User defined function, Control of flow statement, Procedures/Stored procedures, triggers, granting and revoking.

NO-SQL: Introduction, Usages and Application.

UNIT - IV

Properties of Transaction, Transaction states, Transaction Schedule, Serializability, Concurrency control techniques, locking techniques, time stamp ordering, Recoverable schedules, granularity of data items, Deadlock detection and Recovery, recovery techniques: recovery concepts, database backup and recovery from catastrophic failures.

Security: Authorization and View- Security constraints - Integrity Constraints- Encryption

CAD/CAM and database management: The need for CAD/CAM Database management system, CAD/CAM applications using DBMS

Textbooks:

1. Date, C. J., “An introduction to database systems”, 8th Edition, Pearson Education, 2008.
2. R. Elmsari and S. B. Navathe, “Fundamentals of database systems”, Pearson Education, 7th Edition, 2018
3. SQL/ PL/SQL, The programming language of Oracle, Ivan Bayross, 4th Edition BPB Publications
4. V. M. Grippa and S. Kumichev, “Learning MySQL”, O’Reilly, 2021.

References:

1. A. Silberschatz, H. F. Korth and S. Sudershan, “Database System Concept”, McGraw Hill, 6th Edition,2013.
2. P. Rob & C. Coronel, “Database Systems: Design Implementation & Management”, Thomson Learning, 6th Edition, 2004
3. Joel Murach, “Murach's Mysql”, 3rd Edition-Mike Murach and Associates, Incorporated, 2019.
4. Desai, B., “An introduction to database concepts”, Galgotia publications, 2010
5. H. Garcia-Molina, J. D. Ullman, J. Widom, “Database System: The Complete Book”, PH.
6. Kenndy E Lee. CAD: Drawing design, Data Management, Watson-Guptill, 1986
7. Oracle and MySQL manuals.

Paper Code(s): MAC-212	L	P	C
Paper: Thermodynamics and Applications	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concepts of phase change and to be able to determine entropy change for a process.
2.	To understand the working of Vapor power & refrigeration cycle.
3.	To understand the working of Internal combustion engine and to be able to compare the performance of Air standard cycle under stated condition.
4.	To be able to compute performance parameters of an I.C engine and to determine components of heat balance of given I.C. engine.

Course Outcomes (CO)

CO 1	Evaluate the properties of a pure substance and determine entropy changes for different types of processes
CO 2	Analyze the performance of vapor power & refrigeration cycle.
CO 3	Examine various gas power cycles and compare their performance under specified conditions
CO 4	Evaluate performance parameter of I.C engine and draw heat balance sheet of specified engine.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	2	-	-	-	-	2
CO 3	3	3	3	3	-	-	2	-	-	-	-	2
CO 4	3	3	3	3	-	-	2	-	-	-	-	2

UNIT-I

Basic definitions and Laws of Thermodynamics: Revision of concept of heat and work transfer for different processes, First law analysis of open system, Steady flow energy equation and its application for nozzle, diffuser, heat exchangers, Turbine and Compressors and throttling device, Second law of thermodynamics and its significance, Concept of entropy, entropy property of system, entropy change of various reversible processes, Entropy generation and its significance.

Steam: Generation of steam at constant pressure, difference between saturated liquid, wet steam, dry saturated steam, superheated steam and compressed liquid and their properties determination by using Pressure base steam table and temperature base steam table, Use of Moiller chart to determine properties of steam at a state and for a process.

UNIT-II

Vapour Power Cycle: Carnot Cycle and why it is impracticable, Basic Rankine Cycle and its thermal analysis, Concept of mean temperature of heat addition, Comparison of Carnot cycle and Rankine cycle, Performance

parameter of Rankine cycle.
Refrigeration Cycle: Vapour compression refrigeration cycle; description, analysis, refrigerating effect, power required, unit of refrigeration, COP, Refrigerants and its desirable properties, Vapor absorption refrigeration system.

UNIT-III

Gas power cycle: Air Standard Power Cycle, Otto, diesel and dual cycles, Representation on P-V and T-S diagram, Thermal efficiency and Mean effective pressure of Otto, Diesel and Dual cycle, Comparison of air standard cycle based on same maximum pressure, same compression ratio.
Internal Combustion Engine: Combustion in S.I. engine, Combustion in C.I. engine and its stages, Knocking in S.I. and C.I. engine and its detrimental effect, Factors affecting knocking in S.I. and C.I. engine.

UNIT – IV

I.C. Engine performance: Two stroke and four stroke cycle, Measurement of performance parameters of engine i.e., B.P, I.P., F.P, SFC, thermal efficiency, mechanical efficiency and volumetric efficiency of engine, Different methods to determine Indicated power of an engine, components of heat balance sheet of a given engine.

Textbook(s):
1. P K Nag, “Basic and Applied Thermodynamics” 5th edition McGraw Hill.
2. Y. A. Cengel & M. A Boles “Thermodynamics- An Engineering Approach”, 6th edition Tata McGraw Hill.
3. M.L. Mathur and R.P. Sharma Internal Combustion Engine, Dhanpat Rai Publication

References:
1. M.J. Moran & H.N. Shapiro “Fundamentals of Thermal Engineering” John Wiley & son.
2. S L Somasundaram “Engineering Thermodynamics”, New Age International Publishers.
3. R. K. Rajput, “Engineering Thermodynamics”, Lakshmi Publications.
4. Gordon Rosers, & Yon Mahew; Engineering Thermodynamics”, Pearson

Paper Code(s): BS-252	**L**	**P**	**C**
Paper: Probability, Statistics and Linear Programming Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Probability, Statistics and Linear Programming) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Implementation to be done in MATLAB or in equivalent software.

1. Installation of Scilab and demonstration of simple programming concepts like marix multiplication (scalar and vector), loop, conditional statements and plotting.

2. Program for demonstration of theoretical probability limits.

3. Program to plot normal distributions and exponential distributions for various parametric values.

4. Fitting of binomial distributions for given n and p.

5. Fitting of binomial distributions after computing mean and variance.

6. Fitting of Poisson distributions for given value of lambda.

7. Fitting of Poisson distributions after computing mean.

8. Fitting of normal distribution when parameters are given.

9. Fitting of linear regression line through given data set and testing of goodness of fit using mean error.

10. Fitting of Multiple Linear Regression (MLR) curve through given data set and testing of goodness of fit using mean error.

11. Solve a LPP of three variable using Simplex Method.

12. Solve a Transportation problem of three variables.

13. Solve an Assignment problem of three variables.

Paper Code(s): CIC-256	**L**	**P**	**C**
Paper: Database Management System Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Database Management System) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Experiments based on DDL commands – CREATE, ALTER, DROP and TRUNCATE.
2. Apply the integrity constraints like Primary Key, Foreign key, Check, NOT NULL, etc. to the tables.
3. Experiments based on basic DML commands – SELECT, INSERT, UPDATE and DELETE.
4. Write the queries for implementing Built-in functions, GROUP BY, HAVING and ORDER BY.
5. Write the queries to implement the joins.
6. Write the queries to implement the subqueries.
7. Write the queries to implement the set operations.
8. Write the queries to create the views and queries based on views.
9. Demonstrate the concept of Control Structures.
10. Demonstrate the concept of Exception Handling.
11. Demonstrate the concept of Functions and Procedures.
12. Demonstrate the concept of Triggers.

Paper Code(s): CIC-258	L	P	C
Paper: Programming in Java Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Programming in Java) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a java program to implement stack and queue concept.
2. Write a java program to produce the tokens from given long string.
3. Write a java package to show dynamic polymorphism and interfaces.
4. Write a java program to show multithreaded producer and consumer application.
5. Create a customized exception and also make use of all the 5 exception keywords.
6. Convert the content of a given file into the uppercase content of the same file.
7. Write a program in java to sort the content of a given text file.
8. Develop an analog clock using applet.
9. Develop a scientific calculator using swings.
10. Create an editor like MS-word using swings.
11. Create a servlet that uses Cookies to store the number of times a user has visited your servlet.
12. Create a simple java bean having bound and constrained properties.

Paper Code(s): ECC-256 / ECC-363	**L**	**P**	**C**
Paper: Microprocessors and Microcontrollers Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Microprocessors and Microcontrollers) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to add and subtract two 16-bit numbers with/ without carry using 8086.

2. Write a program to multiply two 8 bit numbers by repetitive addition method using 8086.

3. Write a Program to generate Fibonacci series.

4. Write a Program to generate Factorial of a number.

5. Write a Program to read 16-bit Data from a port and display the same in another port.

6. Write a Program to generate a square wave using 8254.

7. Write a Program to generate a square wave of 10 kHz using Timer 1 in mode 1(using 8051).

8. Write a Program to transfer data from external ROM to internal (using 8051).

9. Design a Minor project using 8086 Microprocessor (Ex: Traffic light controller/temperature controller etc)

10. Design a Minor project using 8051 Micro controller

Paper Code(s): ECC-258	**L**	**P**	**C**
Paper: Digital Communications Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Digital Communications) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To Study Sampling Theorem.
2. To Study Pulse Code Modulation.
3. To Study Differential Pulse Code Modulation.
4. To Study Delta Modulation.
5. To Study Adaptive Delta Modulation.
6. To Study Amplitude Shift Keying (ASK) and calculate its S/N ratio and Probability of error.
7. To Study Phase Shift Keying (PSK) and calculate its S/N ratio and Probability of error.
8. To Study frequency Shift Keying (FSK) and calculate its S/N ratio and Probability of error.
9. To Study Differential Phase Shift Keying Modulation (DPSK) and calculate its S/N ratio and Probability of error.
10. To Study Quadrature Phase Shift Keying Modulation (QPSK) and calculate its S/N ratio and Probability of error.
11. To Study Quadrature Amplitude Modulation (QAM) and calculate its S/N ratio and Probability of error.

Paper Code(s): ECC-260	**L**	**P**	**C**
Paper: Analog Electronics – II Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Analog Electronics - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the op-amp (IC 741) as inverting and non-inverting amplifier and calculate its gain.
2. Observe and plot the output Wave shape of Op-Amp R-C differentiating circuits, R-C integrating circuits for square wave input
3. To study the op-amp (IC 741) as adder, subtractor and voltage follower, calculate its output voltage..
4. Construct biased and unbiased series and shunt clipping circuits & combinational clipper circuit for positive and negative peak clipping of a sine wave.
5. To study RC phase shift/Wien Bridge oscillator measurement of frequency and amplitude of oscillations using Op-Amp.
6. To study the waveform of square wave generator using 741 Op-Amp IC.
7. To study the waveform of Schmitt Trigger circuit & Precision Rectifier using 741 OP-AMP IC.
8. To make and test the operations of Monostable Multivibrator circuits using 555 timer.
9. To make and test the operations of Astable Multivibrator circuits using 555 timer.
10. To study the Sallen Key Voltage controlled voltage source active filters.

Paper Code(s): EEC-262	**L**	**P**	**C**
Paper: Network Analysis and Synthesis Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Network Analysis and Synthesis) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to MATLAB and its basic commands.
2. Plot unit step, unit impulse, unit ramp, exponential, parabolic functions and sinusoidal signals
3. Study the transient response of series RLC circuit for different types of waveforms on CRO and verify using MATLAB
4. Study the time response of a simulated linear system and verify the unit step and square wave response of first order and second order, type 0,1 system
5. Using MATLAB determine current in various resistors connected in network using mesh current and node voltage analysis.
6. To determine Z and Y parameters of the given two port network.
7. To determine ABCD parameters of the given two port network.
8. To verify Reciprocity Theorem for the given two port network.
9. To determine Hybrid parameters of the given two port network.
10. To design Cascade Connection and determine ABCD parameters of the given two port network.
11. To design Series-Series Connection and determine Z parameters of the given two port network.
12. To design Parallel-Parallel Connection and determine Y parameters of the given two port network.
13. To design Series-Parallel Connection and determine h parameters of the given two port network
14. Study the frequency response of different filter circuits.

Paper Code(s): EEC-256	L	P	C
Paper: Electrical Machines – II Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Electrical Machines - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To conduct no-load and blocked rotor test on three phase squirrel cage Induction motor and draw the equivalent circuit.
2. To conduct the load test on three phase squirrel cage Induction motor
   (a) Compute torque, output power, efficiency, input power factor and slip for various load settings.
   (b) To plot the following curves on the same graph sheet from the data obtained in part
      (1) Efficiency vs. output power.
      (2) Torque vs. output power.
      (3) Line current vs. output power.
      (4) Power factor vs. output power.
      (5) Slip vs. output power.
   (c) Also plot Torque-slip characteristic.
3. To conduct the load test on three phase slip ring Induction motor
   (a) Compute torque, output power, efficiency, input power factor and slip for various load settings.
   (b) To plot the following curves on the same graph sheet from the data obtained in part
      (1) Efficiency vs. output power.
      (2) Torque vs. output power.
      (3) Line current vs. output power.
      (4) Power factor vs. output power.
      (5) Slip vs. output power.
   (c) Also plot Torque-slip characteristic.
4. To study the different methods available in laboratory for of starting three-phase Induction motor and compare them.
5. To find the effect of the variation of supply voltage on the performance of three-phase Induction motor at 120%, 100%, 80%, 60%, and 50% of rated voltage and plot the variation of power factor, speed, current and input power for different voltages.
6. a) Perform no load and short circuit test on a three-phase synchronous generator.
   b) Measure the resistance of the stator windings
   c) Find the voltage regulation at full load at
      (i) Unity power factor
      (ii) 0.85 power factor leading
      (iii) 0.85 power factor lagging by synchronous impendence method.
7. To synchronize a three-phase synchronous generator with the infinite bus bar. (main supply)
8. To start a synchronous motor and study the effect of variation of field current upon the stator current and power factor, hence draw V and inverted V curves of the motor for ½ load, ¾th load and full load. Also draw the unity power factor curve.
9. To perform slip test on a 3 phase synchronous machine and find direct axix and quadrature axix synchronous reactances (Xd, Xq).
10. To study voltage build up in isolated Induction generator and find its load characteristics using suitable terminal capacitor.
11. To conduct no-load and blocked rotor test on single phase squirrel cage Induction motor and draw the equivalent circuit.

Paper Code(s): EEC-260	L	P	C
Paper: Power Systems – I Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Power Systems - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of constructional features, applications, power rating of LT and HT cables
2. Measurement of Inductance, Capacitance, Resistance and Insulation Resistance of multi-core cables.
3. Study of different types of distribution systems by physical inspection of these systems.
4. Study and calculation of ABCD parameters for a Transmission Line.
5. Study of Ferranti Effect for Transmission Line.
6. Study of different types of insulators with rating. Enumerate the different application of the different types of insulators, with their properties.
7. Calculate the resistance of earth using earth electrodes and Megger.
8. Calculate the dielectric strength of the transformer oil.
9. Enumerate the different applications involved in the power generating station. Write a report on visit of Thermal/Hydro/Nuclear power station.
10. Estimation and Costing of overhead lines/distribution lines of specified voltage level and length.
11. Estimation and Costing of service mains for single face, three face domestic/industrial consumers.
12. Estimation and Costing of pole mounted sub-station /indoor outdoor sub-station.
13. To locate fault in a cable by Murray loop test.

Paper Code(s): ECC-264	**L**	**P**	**C**
Paper: Electronics – II Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Electronics - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Plotting input and output characteristics and calculation of parameters of a transistor in common emittr configuration.
2. Transistor biasing circuit. Measurement of operating point (Ic and Vce) for a :-
   a) fixed bias circuit
   b) Potential divider biasing circuit.
3. Plot the FET characteristics & MOSFET characteristics.
4. Two Stage R.C. Coupled Amplifier.
   a) To measure the overall gain of two stages at 1 KHz and compare it with gain of Ist stage,
   b) To observe the loading effect of second stage on the first stage.
   c) To plot the frequency response curve of two stage amplifier.
5. To study Emitter follower circuit & measurement of voltage gain and plotting of frequency response Curve.
6. Feedback in Amplifier. Single stage amplifier with and without bypass capacitor,measurement of voltage gain and plotting the frequency response in both cases.
7. To study the opamp (IC 741) as inverting and non-inverting amplifier and calculate its gain.
8. To study the opamp (IC 741) as adder, sub-tractor and voltage follower, calculate its output voltage.
9. Construct biased and unbiased series and shunt clipping circuits & combinational clipper circuit for positive and negative peak clipping of a sine wave.
10. To study RC phase shift/WIEN BRIDGE oscillator
11. To study the waveform of square wave generator using 741 OP-AMP IC.

Paper Code(s): ECC-254	**L**	**P**	**C**
Paper: Digital Electronics Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Digital Electronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Realize all gates using NAND & NOR gates
2. Realize Half Adder, Full Adder, Half subtracter, Full subtracter
3. Realize a BCD adder
4. Realize a Serial Adder
5. Realize a four bit ALU
6. Realize Master-Save J K Flip-Flop, using NAND/NOR gates
7. Realize Universal Shift Register
8. Realize Self-Starting, Self Correcting Ring Counter
9. Realize Multiplexer and De-Multiplexer
10. Realize Carry Look ahead Adder / Priority Encoder
11. To make and test the operations of Monostable Multivibrator circuits using 555 timer.
12. To make and test the operations of Astable Multivibrator circuits using 555 timer.
13. To be familiar with Digital to Analog converters.
14. To be familiar with Analog to Digital converters.

Paper Code(s): ICC-256	**L**	**P**	**C**
Paper: Sensors and Transducers Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Sensors and Transducers) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of static and dynamic characteristics of sensors.
2. Measurement of displacement using LVDT
3. Measurement of strain using strain gauge transducer.
4. Measurement of displacement using potentiometer.
5. Measurement of temperature using RTD and plot the characteristics of RTD.
6. Measurement of temperature using thermister.
7. Measurement of pressure using Load cell.
8. Measurement of speed using magnetic sensor.
9. Measurement of speed using photoelectric sensors.
10. Measurement of pressure using pressure transducer.
11. Measurement of liquid level using capacitive sensor.

Paper Code(s): EEC-258	**L**	**P**	**C**
Paper: Electrical and Electronics Measurements Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Electrical and Electronics Measurement) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To measure inductance using Maxwell bridge.
2. To measure inductance using Anderson’s bridge.
3. To measure capacitance using Schering bridge.
4. To measure low resistance using kelvin double bridge.
5. To measure Time, phase and frequency using CRO.
6. Testing of ratio error and phase error using Current Transformer.
7. Measurement of power line parameters (V, I, W, F, VAR, KWH etc.) using series R, RL & RLC Load.
8. Measurement of power in 3-phase circuit.
9. To study Instrumentation amplifier.
10. To measure unknown voltage using potentiometer.

Paper Code(s): MEC-254	**L**	**P**	**C**
Paper: Manufacturing Science and Technology – II Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Manufacturing Science and Technology - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Generation of different angles of a single point cutting tool on a sample workpiece.
2. Perform various machining operations on lathe machine tool.
3. To evaluate shear angle as a function of the rake angle of the tool.
4. Measurement and analysis of cutting forces in orthogonal turning for different materials at different speeds, feed and depth of cut.
5. Measurement of temperature at tool chip interface.
6. A study of chips formed at different speed, feed, depth of cut, for different materials
7. Flank wear – time characteristics for single point cutting tools for different materials at different speeds, feed and depth of cut.
8. To study the characteristic features of milling machine and to machine the hexagonal head of a workpiece.
9. To study the characteristic features of Shaper and to machine a V-block out of the workpiece provided.
10. To study the characteristic features of a Drilling machine and to drill, ream and tap holes on the given workpiece.
11. To study the characteristics of CNC Lathe and CNC milling machines.
12. To study the characteristic features of Electric Discharge Machining processes.

Paper Code(s): MEC-256	**L**	**P**	**C**
Paper: Thermal Engineering – II Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Thermal Engineering - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To conduct the performance test on the Diesel engine test rig.
2. To conduct the performance test on the Petrol engine test rig
3. To prepare heat balance sheet of single cylinder four stroke diesel engine.
4. To prepare heat balance sheet of single cylinder four stroke Petrol engine.
5. To determine COP of refrigeration system based on vapor compression Cycle.
6. Study the working of different types of Compressors.
7. Visit to the refrigeration plant.
8. Determine the effect of load on the components of Heat balance of an I.C engine.
9. Determine the composition of exhaust gas by Orsat Apparatus.
10. Study the working of Vapor Absorption Refrigeration System.

Paper Code(s): MEC-258	**L**	**P**	**C**
Paper: Machine Design – I Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Machine Design - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To design and draw a Spigot and Socket Cotter Joint for a given load under the allowable stress properties of the material.
2. To design and draw a Knuckle Joint for a given load under the material properties constraints.
3. To design and draw a pipe joint carrying pressured fluid within safe stress capabilities of the givens material.
4. To design and draw a protected type Rigid Flanged Coupling for connecting two power transmitting perfect coaxial shafts.
5. To design and draw a bushed pin type Flexible Coupling (Ajax) for connecting two slightly misaligned shafts.
6. To design a quadruple riveted double strap butt joint for the longitudinal seam and circumferential seam of a boiler shell.
7. To design and find the size of an eccentrically loaded Welded Joint.
8. To design and draw a Screw Jack for lifting a given load.
9. To design a pair of Spur Gear Reducer for transmitting a given power between two shafts.
10. To design a Bell Crank Lever for moving a given load with a given mechanical advantage.
11. To design a closed coiled helical spring for the valve mechanism of an engine.

Note: The drawing/drafting of the designed parts based on the actual calculations must be done on any suitable available drafting software.

Paper Code(s): CEC-254	L	P	C
Paper: Soil Mechanics Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Soil Mechanics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Determination of Water content by oven drying method.
2. Determination of Water content by pycnometer.
3. Determination of Water content by rapid moisture meter method.
4. Determination of Specific Gravity by:
    a) Density bottle.
    b) Pycnometer.
5. Determination of Particle size distribution by sieving.
6. Determination of Particle size distribution by hydrometer.
7. Determination of liquid Limit of soil.
8. Determination of Plastic Limit of soil.
9. Determination of Shrinkage limit, shrinkage ratio, and volumetric shrinkage of soil.
10. Determination of In-situ (Field density) by core cutter method.
11. Determination of In-situ (Field density) by sand replacement method.

Paper Code(s): CEC-256	**L**	**P**	**C**
Paper: Hydraulics Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Hydraulics and Hydrology) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study and compare the losses due to flow in smooth and rough pipes.
2. To draw the performance characteristics of variable speed centrifugal pump and single stage reciprocating pump.
3. To determine operating characteristics of pelton wheel turbine.
4. To determine operating characteristics of Francis turbine.
5. To determine operating characteristics of Kaplan turbine.
6. Reynolds dye experiment for flow characterization.
7. To determine the lift and drag force on different airfoils.
8. Measurement of Rainfall by non –recording rain gauge.
9. Measurement of rainfall by recording rain gauge.
10. To determine mean rainfall of an area by Thiessen mean Polygon method and isohyetal method.
11. To determine the velocity of a running of a stream in a canal by current meter and calculate the approximate discharge of the canal.
12. To design a regime channel by Lacey’s theory for a given pattern of crops and area to be irrigated.

Paper Code(s): CEC-258	L	P	C
Paper: Transportation Engineering Lab	-	2	1

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Transportation Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Aggregate crushing strength test.
2. Los Angeles Abrasion test.
3. Aggregate impact test.
4. Flakiness index and elongation index test.
5. Penetration test
6. Ductility test
7. Viscosity test.
8. Softening point test.
9. Flash and fire point test.
10. Determination of bitumen content by centrifuge extractor
11. Determination of marshal stability value.
12. Determination of rebound deflection of pavement by Benkelman beam.

Paper Code(s): MAC-256	L	P	C
Paper: Database Management Systems Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Database Management System) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Experiments based on DDL commands – CREATE, ALTER, DROP and TRUNCATE.
2. Apply the integrity constraints like Primary Key, Foreign key, Check, NOT NULL, etc. to the tables.
3. Experiments based on basic DML commands – SELECT, INSERT, UPDATE and DELETE.
4. Write the queries for implementing Built-in functions, GROUP BY, HAVING and ORDER BY.
5. Write the queries to implement the joins.
6. Write the queries to implement the subqueries.
7. Write the queries to implement the set operations.
8. Write the queries to create the views and queries based on views.
9. Demonstrate the concept of Control Structures.
10. Demonstrate the concept of Exception Handling.
11. Demonstrate the concept of Functions and Procedures.
12. Demonstrate the concept of Triggers.

Paper Code(s): MAC-258	**L**	**P**	**C**
Paper: Thermodynamics and Applications Lab	**-**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Thermodynamics and Applications) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To draw the valve timing diagram of a Single Cylinder Four Stroke CI Engine.
2. To draw the valve timing diagram of a Single Cylinder Four Stroke SI Engine.
3. To conduct the performance test on the Diesel engine test rig.
4. To conduct the performance test on the Petrol engine test rig
5. To prepare heat balance sheet of single cylinder four stroke diesel engine.
6. To prepare heat balance sheet of single cylinder four stroke Petrol engine.
7. To determine Exergy destruction of Exhaust Gas Calorimeter of Petrol Engine test rig at different load.
8. To determine Exergy destruction of Exhaust Gas Calorimeter of Diesel Engine test rig at different load.
9. To determine COP of refrigeration system based on vapor compression Cycle.
10. Visit to the thermal power plant/refrigeration plant.
11. Thermodynamic analysis of Rankine cycle.
12. Comparative thermodynamic analysis of Otto, Diesel and Dual for the given condition.

Syllabus of 3rd Year and 4th Year Papers (in Alphabetical Order of Paper Name)

Ad hoc and Sensor Networks	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-4	ECE-413T
EAE	7	WMC-EAE	WMC-EAE-3A	WMC-453T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To know the issues in Ad Hoc wireless networks and designing a MAC Protocol for the same and summarize and compare various types of MAC protocols.
2.	To analyze and explain issues in designing, goals and classification of Routing algorithm
3.	To know the sensor network architecture, data dissemination, data gathering, MAC protocols for sensor networks.
4.	To know the basics of wireless geolocation architecture with technologies.

Course Outcomes (CO)

CO 1	Identify the issues in Ad Hoc wireless networks and designing a MAC Protocol for the same and summarize and compare various types of MAC protocols
CO 2	Analyze and explain issues in designing, goals and classification of Routing algorithm.
CO 3	Develop an understanding of sensor network architecture and explain data dissemination, data gathering, MAC protocols for sensor networks.
CO 4	Develop the knowledge about the basics of wireless geolocation architecture with technologies.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	2	2	3	2	2	-	2	2	3	3
CO 2	3	1	2	2	2	2	3	-	3	2	2	3
CO 3	3	2	1	2	3	2	3	-	2	2	3	2
CO 4	3	1	2	3	3	3	2	-	2	3	3	2

UNIT I

Ad Hoc Wireless Networks: Introduction. Issues in Ad Hoc Wireless Networks. Ad Hoc Wireless Internet.
MAC Protocols for Ad Hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks. Design Goals of a MAC Protocol for Ad Hoc Wireless Networks. Classifications of MAC Protocols. Contention-Based Protocols. Contention-Based Protocols with Reservation Mechanisms. Different digital topology. MAC Protocols in Directional Antennas.

UNIT II

Routing Protocols for Ad Hoc Wireless Networks: Introduction to Routing algorithm, Issues in Designing a

Routing Protocol for Ad Hoc Wireless Networks. Classifications of Routing Protocols. Table-Driven Routing Protocols. On-Demand Routing Protocol, Routing Protocols with Efficient Flooding Mechanisms. Hierarchical Routing Protocols.

Transport Layer and Security Protocols for Ad Hoc Wireless Networks: Introduction. Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks. Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks. Classification of Transport Layer Solutions. TCP Over Ad Hoc Wireless Networks. Security in Ad Hoc Wireless Networks. Network Security Requirements. Issues and Challenges in Security Provisioning. Network Security Attacks. Key Management. Secure Routing in Ad Hoc Wireless Networks.

UNIT III

Wireless Sensor Networks: Introduction. Sensor Network Architecture. Data Dissemination. Data Gathering. MAC Protocols for Sensor Networks. Location Discovery. Quality of a Sensor Network. Evolving Standards. Other Issues.

Hybrid wireless Networks: Introduction. Next-Generation Hybrid Wireless Architectures. Routing in Hybrid Wireless Networks. Pricing in Multi-Hop Wireless Networks. Power Control Schemes in Hybrid Wireless Networks. Load Balancing in Hybrid Wireless Networks.

UNIT IV

Wireless Geolocation Systems: Introduction. What is wireless Geolocation? Wireless Geolocation System Architecture. Technologies for Wireless Geolocation. Geolocation Standards for E-911 Services. Performance Measures for Geolocation Systems.

Recent Advances in Wireless Networks: Introduction. Ultra-Wide-Band Radio Communication. Wireless Fidelity Systems. Optical Wireless Networks. The Meghadoot Architecture, introduction to vehicular sensor networks.

Text Books:

1. Siva Ram Murthy, C. and Manoj,B. S., Adhoc Wireless Networks Architectures and Protocols, Prentice Hall, PTR, (2004) 2nd ed.
2. Perkins, Charles E., Ad hoc Networking, Addison Wesley, (2000) 3rd ed.

Reference Books:

1. Toh, C. K., Ad hoc Mobile Wireless Networks Protocols and Systems, Prentice Hall, PTR, (2001) 3rd Edition.
2. Pahlavan, Kaveh, Krishnamoorthy, Prashant, Principles of Wireless Networks, - A united approach, Pearson, (2002) 2nd ed.
3. Wang X. and Poor H.V., Wireless Communication Systems, Pearson education, (2004) 3rd ed.
4. Schiller Jochen, Mobile Communications, Person Education – 2003, 2nd ed.
5. Carlos De Morais Cordeiro and Dharam P Agrawal, “Adhoc and Sensor Networks- Theory & Applications”, 2nd Ed, Cambridge Univ Press India Ltd.

Ad hoc and Sensor Networks Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-4	ECE-413P
EAE	7	WMC-EAE	WMC-EAE-3A	WMC-453P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Ad hoc and Sensor Networks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Create a sample wireless topology using Simulation Tool.
2. Create a mobile Ad-hoc networks using Simulation Tool.
3. Implement an Ad-hoc On-demand Distance Vector protocol using Simulation Tool.
4. Implement a Transmission Control Protocol using Simulation Tool.
5. Implement an User Datagram Protocol using Simulation Tool.
6. Implement a Low Energy Adaptive Hierarchy protocol using Simulation Tool.
7. Implement a Power Efficient Gathering in Sensor Information System using Simulation Tool.
8. Implement a Sensor Protocol for Information via Negotiation (SPIN) using Simulation Tool.
9. Implement a Proactive and Reactive based MAC protocol using Simulation Tool.
10. Implement a Scheduling based protocol for WSNs using Simulation Tool.
11. Implement a Predictive Wake-up MAC protocol using Simulation Tool.

Additive Manufacturing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	7	OAE-MAE	OAE-1	MAO-411T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the working principles and process parameters of additive manufacturing processes.
2.	Explore different additive manufacturing processes and suggest suitable methods for building a particular component
3.	Perform suitable post processing operation based on product repair requirement.
4.	Design and develop a working model using additive manufacturing Processes.

Course Outcomes (CO)

CO 1	Identify, Explain, and solve problems related to additive manufacturing.
CO 2	Select suitable additive manufacturing process as per the requirement.
CO 3	Select suitable additive manufacturing material as per the requirement.
CO 4	Design and develop a working model using additive manufacturing Processes.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	2	3	3	2	2
CO 2	3	3	3	3	3	3	3	2	3	2	2	2
CO 3	3	3	3	3	3	3	3	2	3	2	2	2
CO 4	3	3	3	3	3	3	3	2	3	3	3	2

UNIT-I

Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM. Additive Manufacturing Data Formats and Pre-processing.

UNIT-II

Additive Manufacturing Methods-Vat Photopolymerization: Stereolithography (SL), Materials, Process Modelling, Process Benefits and Drawbacks, Applications.
Material Jetting AM Processes: Materials, Process Benefits and Drawbacks, Applications.
Binder Jetting AM Processes: Materials, Process Benefits and Drawbacks, Applications

UNIT-III

Extrusion-Based AM Processes: Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Process Benefits and Drawbacks, Applications.
Sheet Lamination AM Processes: Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications
Powder Bed Fusion AM Processes: Selective laser Sintering (SLS), Materials, Powder fusion mechanism and powder handling, Process Modelling, SLS Metal and ceramic part creation. Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes,

UNIT – IV

Additive Manufacturing Materials: Multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure, microstructure studies, Structure property relationship.
Post Processing of Additive Manufacturing Parts: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques.

Textbook(s):

1. C.P Paul, A.N Junoop, “Additive Manufacturing: Principles, Technologies and Applications”, McGrawHill, 2021.
2. Ian Gibson, David W Rosen, Brent Stucker, “Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital manufacturing” , Springer, 2015, 2nd Edition.

References:

1. Patri K. Venuvinod and WeiyinMa, “Rapid Prototyping: Laser-based and Other Technologies”, Springer, 2004.
2. D.T. Pham, S.S. Dimov, “Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling”, Springer 2001.
3. Rafiq Noorani, “Rapid Prototyping: Principles and Applications in Manufacturing” , John Wiley & Sons, 2006.
4. Amit Bandyopadhyay Susmita Bose, “Additive Manufacturing, Second Edition”, CRC Press Taylor & Francis Group, 2020.

Additive Manufacturing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	7	OAE-MAE	OAE-1	MAO-411P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Additive Manufacturing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To Study the working of Stereolithography (SL) additive manufacturing machine.
2. To Study the working of Material Jetting additive manufacturing machine.
3. To Study the working of Binder Jetting additive manufacturing machine.
4. To Study the working of Fused Deposition Modelling (FDM) additive manufacturing machine.
5. To Study the working of Sheet Lamination additive manufacturing machine.
6. To Study the working of Selective laser Sintering (SLS) additive manufacturing machine.
7. To Study the working of Electron Beam melting (EBM) additive manufacturing machine.
8. To Study the working of Electron Beam melting (EBM) additive manufacturing machine.
9. Manufacture the part by any of additive manufacturing process without Support Material.
10. Manufacture the part by any of additive manufacturing process with Support Material.
11. Prepare the 3D-CAD model in STL format of single point cutting tool.
12. Prepare the 3D-CAD model in STL format of multi point cutting tool.
13. Improve the accuracy of part manufacture by any AM process by post process technique.
14. Manufacture the hollow part by any of additive manufacturing process.
15. Reconstruction the 3D-CAD model of part using reverse engineering and manufacture the part by any AM process.

Advance Manufacturing Process	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	DMS-EAE	DMS-EAE-4	DMS-421T
EAE	7	DT-EAE	DT-EAE-3	DMS-421T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Understand the classifications of non-traditional machining processes based on industrial applications.
2.	To describe the working of modern machining methods based on mechanical, chemical, thermal and thermo-electric energy.
3.	To explain, how to investigate the of process parameters of advanced machining methods on its characteristics.
4.	To Understand the classifications of non-traditional machining processes based on industrial applications.

Course Outcomes (CO)

CO 1	Explain Categories of non- traditional machining processes based on industrial applications.
CO 2	Analyse the working principle of modern machining methods based on mechanical, chemical, thermal and thermo-electric energy.
CO 3	Carryout the investigation of process parameters of advanced machining methods on its characteristics.
CO 4	Evaluating the effects of process parameters (numerically) on the output parameters of Non-traditional methods.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT I

Introduction: An overview of Modern Manufacturing Methods (MMM) - Classification, their comparative study, Need of MMM.
Process Selection: Physical Parameters, Shape applications, Material applications, Process capability, Effects on equipment and Tooling, Process economy.
Electric Discharge Machining: Working Principle, Mechanism of metal removal, Basic EDM circuits, selection of tool material and dielectrics, Flushing, Advantages, Disadvantages and Applications

UNIT II

Ultrasonic Machining: Construction and working Principle, Elements of Process, Effect of process parameters, Applications and limitations.
Abrasive Jet Machining: Working Principle, equipment used, Variables in AJM, Advantages, Disadvantages, Application.
Water Jet Machining: Working Principle, equipment used, process parameter, Advantages, Disadvantages, Application.
Abrasive Flow Machining: Working Principle, equipment used, process parameter, Advantages, Disadvantages, Application.

UNIT III

Chemical Machining: Working Principle, equipment used, process parameter, Advantages, Disadvantages, Application.
Electro Chemical Machining (ECM): Principle, Elements of ECM process, Electrochemistry of ECM, selection of electrolytes and analysis of ECM, Advantages, Limitations, Applications.
Electro Chemical Grinding (ECG): Process: Working principle, equipment used.
Rapid Prototyping Introduction Stereo Lithography Systems Introduction: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems. Stereo Lithography Systems: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application.

UNIT IV

Laser Beam Machining: Working principle, equipment, Process parameters, Advantages, Disadvantages and Application.
Plasma Arc Machining: Working Principle, Parameters, Safety precautions, Applications.
Electron Beam Machining: Principle, beam control techniques, Process capabilities, Comparison of thermal and non-thermal processes, Advantages and limitations.

Text Books:

1. P.C. Pandey & H.S. Shan, “Modern Machining Process”, Tata McGraw Hills, 2006.
2. Amitabh Gosh and A.K. Mallik, “Manufacturing Science”, Affiliated East-West Press Pvt. Ltd., 1985.

Reference books:

1. Vijay K Jain, “Advance Machining Processes”, Allied Publishers Pvt. Ltd., New Delhi, 2002.
2. P K Mishra, “Nonconventional Machining”, Narosa Publication, 1997.
3. McGeough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998.

Advance Manufacturing Process Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	DMS-EAE	DMS-EAE-4	DMS-421P
EAE	7	DT-EAE	DT-EAE-3	DMS-421P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Advance Manufacturing Process) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of electric discharge machining process.
2. Determination of material removal rate on electric discharge machine (EDM).
3. Determination of surface roughness on EDM.
4. Study of electrochemical machining process.
5. Determination of material removal rate on electro chemical machine (ECM).
6. Determination of surface roughness on ECM.
7. Study of Flexible manufacturing system.
8. Case study of Rapid Prototyping
9. Study the effect of current on material removal rate in EDM.
10. Determine the effect of different tool material on material removal rate in EDM.
11. Determine the effect of current on surface finish rate in EDM.
12. Determine the effect of different tool surface finish on surface finish in EDM.

Advance Material Science and Metallurgy	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-3	MEE-330T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To study and understand about ultra-light materials and metallic foams.
2.	To study bio-Materials, its classifications and applications.
3.	To study the composites materials, its classifications and applications in industries.
4.	To study about coating and high temperature materials for MSME application.

Course Outcomes (CO)

CO 1	To understand about ultra-light materials and metallic foams.
CO 2	To analyse bio-Materials, its classifications and applications.
CO 3	To composites materials, its classifications and applications in industries.
CO 4	To study about coating and high temperature materials for MSME application.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Ultra-light Materials and Metallic Foams -Material Definition and Processing Characterization of cellular metals Material properties.

UNIT-II

Bio-Materials-Classes of materials used in medicine Application of materials in medicine and dentistry various materials and coatings for implants.

UNIT-III

Composite material definition and classifications composite material properties and applications, piezoelectric ceramics, magnetostrictive materials, electro-rheological fluids.

UNIT – IV

Coatings and High- Temperature Materials Thin Film Shape Memory Alloys for MEMS application. Introduction to Nano-engineered materials.

Textbook(s):

1. Handbook of Cellular metals, Production, Processing, Application, Edited by Hans Peter Degischer and Brigitte Kriszt, Wiley - VCH, 2002.
2. Materials Science and Engineering, An Introduction, 5th Edition, William D. Callister, Jr., John Wiley & Sons, Inc., New York, 1999, with CD-ROM.

References Books:

1. Mikell P. Grover, "Fundamentals of Modern Manufacturing, Materials, Processing, and Systems", 2nd
2. Edition, John Wiley & Sons, inc.
3. L.J. Gibson, and M.F. Ashby, "Cellular Solids, Structure and Properties", 2nd Edition, Cambridge University Press, 1999.
4. Ashby, M. F., Evans, A., Fleck, N. A., Gibson, L. J., Hutchinson, J. W., & Wadley, H. N. G., Metal Foams: Design Guide, Butterworth-Heinmann, Massachusetts; 2000.
5. Milton Ohring, "Materials Science of Thin Films", 2 nd Edition, Academic Press, 2002.
6. C.T. Herakovich, "Mechanics of Fibrous Composites", John Wiley & Sons, Inc., New York, 1998.
7. Biomaterials Science, An Introduction to Materials in Medicine, Edited by B.D. Ratner, A.S. Hoffman, F.J. Sckoen, and J.E.L Emons, Academic Press, second edition, 2004.

Advance Material Science and Metallurgy Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-3	MEE-330P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Advanced Material Science and Metallurgy) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Making a plastic mould for small metallic specimen.
2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
3. Grain Size determination of a given specimen.
4. Comparative study of microstructures of different given specimens (mild steel, a. Gray C.I., brass, copper etc.)
5. Effect of annealing, normalizing and hardening on hardness of the specimen.
6. Effect of annealing, normalizing and hardening on toughness of the specimen.
7. Effect of case hardening on the hardness of the specimen.
8. Material identification of, say, 50 common items kept in a box.
9. Faradays law of electrolysis experiment.
10. Study of corrosion and its effects.
11. Study of microstructure of welded component and HAZ Macro & Micro Examination.
12. Suitable experiment on Magnetic/ Electrical/Electronic materials.

Advance Metal Cutting and Tool Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-5	MEE-419T
MAE	7	OAE-MAE	OAE-1	MAO-413T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the principles of mechanics to metal cutting process and develop analytical relation between input and output process parameters.
2.	Understand the models of the machining economics and optimization, tool wear and its measurement.
3.	Understand the concept of tool design.
4.	Understand the working principle of advance metal cutting process.

Course Outcomes (CO)

CO 1	Identify, Explain, and solve problems related to metal cutting.
CO 2	Explain, and solve the problems related to economics and optimization, tool wear.
CO 3	Analysis and solve the problems related to tool design.
CO 4	Identify, Explain and select the advance metal cutting process as per requirement.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	2	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	3	3	-	-	--	-	-	2

UNIT-I

Theory of Metal Cutting: Orthogonal and oblique cutting, tool geometry, types of chips, cutting forces in orthogonal cutting and their measurement, Merchant circle and derivation of relationships between the cutting forces, chip thickness ratio. Ernst Merchant Theory, its assumptions and modifications. Relationship between cutting velocity, shear velocity and chip flow velocity. Lee & Shafer Theory – slip line method, determination of shear angle by Mohrs circle.

UNIT-II

Machinability: Machinability and its criteria, forms of tool-wear in metal cutting, tool-life and its criteria, effect of different cutting parameters on tool-life. Economics of machining and numerical. Cutting fluids, their physical action, and applications.

Heat Generation in Metal Cutting: Heat generation and temperature distribution in metal cutting. Calculation of temperature in primary and secondary deformation zones and their measuring methods.

UNIT-III

Cutting Tool Design: General considerations, study of angle for single point cutting and drill. Principles of different cutting tool materials and their important characteristics. Basic principles of design of a single point and multiple point tools i.e. broaches and twist drill.

Jigs & Fixtures: Important considerations in jigs and fixture design. Main principles of designing of jigs & fixtures, elements of Jigs and fixtures. Different devices and methods of locations. Different types of clamps used in jigs & fixtures.

UNIT - IV

Ultrasonic Machining: Construction and working Principle, Elements of Process, Effect of process parameters, Applications and limitations.

Electric Discharge Machining: Working Principle, Mechanism of metal removal, Basic EDM circuits, selection of tool material and dielectrics, Flushing, Advantages, Disadvantages and Applications.

Electro Chemical Machining (ECM): Principle, Elements of ECM process, Electrochemistry of ECM, selection of electrolytes and analysis of ECM, Advantages, Limitations, Applications.

Textbook(s):

1. Geoffrey Boothroyd, “Fundamentals of Metal Machining & Machine Tools”, TMH.
2. P.C. Pandey & H.S. Shan, “Modern Machining Process”, Tata McGraw Hills, 2006.

References:

1. P.N. Rao, “Manufacturing Technology”, Tata McGraw Hill Publication Ltd.
2. B.J. Ranganath, “Metal Cutting & Tool Design” Vikas Publishing House Pvt. Ltd.
3. Amitabh Gosh and A.K. Mallik, “Manufacturing Science”, Affiliated East-West Press Pvt. Ltd., 1985.
4. Vijay K Jain, “Advance Machining Processes”, Allied Publishers Pvt. Ltd., New Delhi, 2002.
5. P. H. Joshi” Jigs and Fixtures”, 2nd Edition TMH.

Advance Metal Cutting and Tool Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-5	MEE-419P
MAE	7	OAE-MAE	OAE-1	MAO-413P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Advance Metal Cutting and Tool Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. A study of chips formed at different speed, feed, depth of cut, for different materials.
2. Measurement and analysis of cutting forces in orthogonal turning for different materials at different speeds.
3. Measurement and analysis of cutting forces in orthogonal turning for different materials at different feed and depth of cut.
4. Flank wear – time characteristics for single point cutting tools for different materials at different speeds.
5. Flank wear – time characteristics for single point cutting tools for different materials at different feed and depth of cut.
6. Find temperature at tool chip interface.
7. Study of electric discharge machining process (EDM).
8. Determination of material removal rate on electric discharge machine (EDM).
9. Determination of material removal rate on electro chemical machine (ECM).
10. Study of Ultrasonic Machining process.
11. Determination of material removal rate on Ultrasonic Machining process.
12. Study the effect of current on surface finish rate in EDM.
13. Study of the effect of different tool surface finish on surface finish in EDM.

Advance Structural Analysis	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	6	PCE	PCE-1	CEE-306

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To discuss concept of arches and its ILDs, curved beams.
2.	To find behaviour of cables, structure by plastic theory.
3.	To explain basics of matrix methods and its use in flexibility matrix method.
4.	To use stiffness matrix method, direct stiffness methods for analysis of structures.

Course Outcomes (CO)

CO 1	Explain reactions and forces in arches, curved beam.
CO 2	Evaluate structural response of cables, plastic theory.
CO 3	Determine relation between stiffness and flexibility matrix, unknowns in indeterminate structures by flexibility matrix method.
CO 4	Analyse indeterminate structures by stiffness methods

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	3	-	-	-	-	-	-	-	-	-
CO 2	2	3	1	-	-	-	-	-	-	-	-	-
CO 3	1	3	-	-	2	-	-	-	-	-	-	-
CO 4	1	3	-	-	2	-	-	-	-	-	-	-

UNIT-I

Arches: Theory of arches, Eddy’s theorem, Circular, parabolic and geometric arches, Linear arch, concept of radial shear force and axial thrust, analysis of three hinged and two hinged arches with various loads, Effect of yielding of supports, rib shortening and temperature changes, tied arches, ILD for two hinged arches, ILD for three-hinged arches.

Curved beam: Introduction, forces on curved beams, analysis of circular arch cantilever beam.

UNIT-II

Cables: Introduction, components and functions, Equilibrium of cable, Cables subjected to concentrated load and uniformly distributed load, length of cable, effect of change in temperature in suspension cables.

Plastic Analysis of structures: Introduction, Plastic bending of beams, shape factors, Plastic hinges, Types of Mechanisms, Load Factors, Numerical- beams and frames

UNIT-III

Matrix Analysis of structure: Introduction, Force and displacement methods of analysis, flexibility influence coefficients and stiffness influence coefficients, Relation between flexibility matrix and stiffness matrix.
Flexibility matrix method: Development of flexibility matrices by physical approach, Flexibility matrices for truss and frame elements, load transformation matrix, development of total flexibility matrix of the structure, analysis of simple structures, plane truss and plane frame, nodal loads and element loads, lack of fit and temperature effects.

UNIT – IV

Stiffness matrix method: Development of stiffness matrices by physical approach, stiffness matrices for truss and frame elements, displacement transformation matrix, development of total stiffness matrix, analysis of simple structures, plane truss and plane frame, nodal loads and element loads, lack of fit and temperature effects.
Direct stiffness method: Introduction, element stiffness matrix, rotation transformation matrix, transformation of displacement and load vectors and stiffness matrix, Introduction to finite element method.

Textbook(s):
1. S S Bhavikatti, "Structural Analysis (Vol.I and II)", Vikas Publication, Fourth Edition (2011)
2. S. Ramamrutham, R. Narayan, "Theory of Structures", Dhanpat Rai Publishing Company, (2017)

References:
1. C.S. Reddy, "Basic Structural Analysis", Tata McGraw Hill (2017)
2. Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House (2015)
3. R.C. Hibbler, "Structural Analysis", Pearson Education
4. C.K. Wang, "Matrix methods of structural analysis", International Textbook Company

Advanced Computer Architecture	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	6	PCE	PCE-1	CIE-314
ECE	6	PCE	PCE-2	ECE-328

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand different parallel computer models and analyze different network properties.
2.	To compute and analyze efficiency of various pipelining.
3.	To understand and perform binary arithmetic operations.
4.	To analyze the need of memory hierarchy.

Course Outcomes (CO)

CO 1	Able to understand different parallel computer models and analyze different network properties.
CO 2	Able to compute and analyze efficiency of various pipelining.
CO 3	Able to understand and perform binary arithmetic operations.
CO 4	Able to analyze the need of memory hierarchy.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	3	2	1	2	1	-	-	1	1	1
CO 2	2	2	3	2	1	2	1	-	-	1	1	1
CO 3	2	2	3	2	1	2	1	-	-	1	1	1
CO 4	2	2	3	2	1	2	1	-	-	1	1	1

UNIT-I

Parallel Computer Models: The state of computing, Classification of parallel computers, Multiprocessors and multicomputers, Multivector and SIMD computers.
Program and Network Properties: Conditions of parallelism, Data and resource Dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain Size and latency, Program flow mechanisms, Control flow versus data flow, Data flow Architecture, Demand driven mechanisms, Comparisons of flow mechanisms

UNIT-II

Pipelining: Linear pipeline processor, nonlinear pipeline processor, Instruction pipeline Design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch Handling techniques, branch prediction, Arithmetic Pipeline Design, Computer arithmetic principles, Static Arithmetic pipeline, Multifunctional arithmetic pipelines

UNIT-III

Arithmetic for Computers: Signed and unsigned Numbers, Addition and Subtraction, Multiplication, Division, Floating Point.
CPU Performance and Its factors, Evaluating performance of CPU.

UNIT-IV

Memory Hierarchy: Introduction, The basics of Cache, Measuring and Improving of Cache Performance, Virtual Memory, Common framework for memory hierarchies
Case study of PIV and AMD opteron memory hierarchies

Text Books:

1. Kai Hwang, “Advanced computer architecture”; TMH. 2000
2. D. A. Patterson and J. L. Hennessey, “Computer organization and design”, Morgan Kaufmann, 2nd Ed. 2002

Reference Books:

1. J.P.Hayes, “computer Architecture and organization”; MGH. 1998
2. Harvey G.Cragon,”Memory System and Pipelined processors”; Narosa Publication. 1998
3. V.Rajaranam & C.S.R.Murthy, “Parallel computer”; PHI. 2002
4. R.K.Ghose, Rajan Moona & Phalguni Gupta, “Foundation of Parallel Processing”, Narosa Publications, 2003
5. Kai Hwang and Zu, “Scalable Parallel Computers Architecture”, MGH. 2001
6. Stalling W, “Computer Organisation & Architecture”, PHI. 2000
7. D.Sima, T.Fountain, P.Kasuk, “Advanced Computer Architecture-A Design space Approach” Addison Wesley, 1997.
8. M.J Flynn, “Computer Architecture, Pipelined and Parallel Processor Design”; Narosa Publishing. 1998
9. D.A.Patterson, J.L.Hennessy, “Computer Architecture: A quantitative approach”; Morgan Kauffmann feb, 2002.
10. Hwan and Briggs, “Computer Architecture and Parallel Processing”; MGH. 1999

Advanced Computer Networks and Administration	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-NET	6	PC	PC	NET-344T
EAE	6	NET-EAE	NET-EAE-1	NET-344T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Demonstrate proficiency in configuring and managing routing protocols.
2.	Evaluate and implement multicast technologies in IP environments.
3.	Explore the concepts and architecture of Highspeed network technologies.
4.	Understand network administration process.

Course Outcomes (CO)

CO 1	Analyze TCP/IP variants, network Algorithm's, Protocols and their functionalities.
CO 2	Evaluate the appropriate network protocols in real network environment.
CO 3	Recognize issues/complexities encountered in a computer network.
CO 4	Understand and perform network administration.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	-	1	1	1	2	-	3
CO 2	3	2	3	2	2	-	1	1	1	2	-	3
CO 3	3	2	3	2	2	-	1	1	1	2	-	3
CO 4	3	3	3	2	2	-	1	1	1	2	1	3

UNIT-I

Network Layer: ARP, RARP, ICMP, IPv4 Routing Principles, Routing and overview, DVR and LSR, the IGRP and EIGRP, BGP, Routing Information Protocol (RIP), OSPF (IPv4 / IPv6).
Multicasting in IP Environments-Broadcasting, Multicasting, IGMP and Multicast Listener Discovery (MLD). The Distance Vector Multicast Routing Protocol (DVMRP), Multicast OSPF (MOSPF), Protocol Independent Multicast (PIM).

UNIT-II

Transport Layer: Transport layer overview, UDP, TCP (Flow Control, Error Control, and Connection Establishment), TCP Protocol: TCP Tahoe, TCP Reno.

UNIT-III

Optical Networking: Introduction to Optical networking, its benefits and drawbacks, SONET layered architecture, frame format, SONET network configuration, its advantages and benefits.
TCP/IP Applications: VoIP, NFS, Telnet ,FTP, SMTP, SNMP, Finger, Whois and WWW, IP v6 and Next Generation Networks, xAAS (PAAS, SAAS, HAAS) and Cloud Computing, Big data, Elements of Social Network.

UNIT-IV

Administration: Introduction to Server Hardware, alternative network options such as peer to peer and server-based networks, Design and configure a domain environment, Connect clients to a network, Introduce the concepts involved with accessing and administrating data.

Text Books:
1. Douglas E. Comer, "Internet networking with TCP/IP", Pearson. TCP/IP, Vol. 2
2. B. A. Forouzan, "TCP/IP Protocol Suite", TMH, 2nd Ed., 2004.
3. Mark Minasi, “Mastering Windows 2000 Server”, Sybex, ISBN: 0-7821-2774-6

Reference Books:
1. TCP/IP Illustrated, Volume 1 (The Protocols) by W. Richard Stevens, Pearson Education.
2. U. Black, "Computer Networks-Protocols, Standards and Interfaces", PHI, 1996.
3. W. Stallings, "Computer Communication Networks", PHI, 1999.

Advanced Computer Networks and Administration Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-NET	6	PC	PC	NET-344P
EAE	6	NET-EAE	NET-EAE-1	NET-344P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Advanced Computer Networks and Administration) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Configuration and logging to a CISCO Router and introduction to the basic user Interfaces. Introduction to the basic router configuration and basic commands.
2. Configuration of IP addressing for a given scenario for a given set of topologies.
3. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.
4. Configure, implement and debug the following: Use open source tools for debugging and diagnostics.
   a. ARP/RARP protocols
   b. RIP routing protocols
   c. BGP routing
   d. OSPF routing protocols
   e. Static routes (check using netstat)
5. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS and forward DNS, using TCP dump/Wireshark characterise traffic when the DNS server is up and when it is down.
6. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterise file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat the experiment.
7. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.
8. Implement Open NMS+ SNMPD for checking Device status of devices in community MIB of a linux PC.
9. Using yellow pages and NIS/NFS protocols implement Network Attached Storage Controller (NAS).
10. Extend this to serve a windows client using SMB. Characterise the NAS traffic using wireshark.

Advanced Construction Materials and Practices	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	CTM-EAE	CTM-EAE-2	CEC-310

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn about the different type of advanced material like timber, plastic, sound insulated material.
2.	To understand the technique used in tunnelling and formwork
3.	To know about the concept of Low cost housing and pre-fabricated structure.
4.	To learn the applications of Ferro cement in construction industry.

Course Outcomes (CO)

CO 1	Characterise and specify advanced construction materials for thermal and sound insulation, smart materials and plastic and timber products.
CO 2	Identify and Specify construction techniques for earthwork, tunnelling and formwork.
CO 3	Know how to Design Low Cost Housing and cost analysis of In- Situ Pre-Cast, Prefabricated and Modular construction.
CO 4	Identify and Specify construction technique for application of Ferro cement

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	2	-	3	-	-	-	-	-	-	-
CO 2	3	1	-	2	3	2	-	-	-	-	-	-
CO 3	-	1	2	2	3	2	-	-	-	-	-	-
CO 4	3	1	2	2	3	-	-	-	-	-	-	-

UNIT-I

Advanced Construction Materials: Plastics, Timber products and Preservation, materials for thermal insulation, materials for sound insulation. Smart Materials and their applications. Special Concretes: Light Weight Concrete, Vacuum Concrete, Waste Material Based.

Advance Concreting: Concrete, Fibre reinforced concrete, Polymer Concrete Composites, Ferro cement, concreting at High and Low Temperatures, Self- Compacting Concrete (SCC), Ready Mixed Concrete (RMC) and its characteristics and advantages, Shotcrete and concreting in tunnels.

UNIT-II

Techniques for Tunnelling and Formwork: Earthwork including cut and cover method, TBM, EBM and trenchless technology, Slip Form Shuttering, Latest type of Formwork, e.g. DOKA.

High Rise Structures: Construction techniques for high rise buildings, chimneys, dams. Special problems of high-rise construction & optimization of space.

UNIT-III

Fire Resistance in Structures: Fire Protection - Fire Alarm & Detection Systems, Fire Extinguishers, Fire hazards in buildings and preventive measures. Fixed Installations– Fire doors, Smoke Ceiling, compartmentation, pressurisation, etc., Fire Safety Practice, Fire Safety Management
Low Cost Housing: Definition and Types of low cost housing, Design process of low cost housing and advantages and disadvantages, Special Constructions.
Precast and Prefabricated Construction and Modular Construction: production and utilisation in various types of structures, Environmental and Economic Benefits.

UNIT - IV

Ferro cement : Definition of Ferro cement, applications of Ferro cement, materials used in Ferro cement, parameters and properties of materials used in Ferro cement, cement mortar mix, skeletal steel, steel mesh reinforcement, fibre reinforced polymeric meshes, advantages of FRP, disadvantages of FRP, behaviour of Ferro cement in tension, advantages of Ferro cement, difference between Ferro cement and reinforced cement concrete: Physical and Mechanical properties, Concrete and other cementitious composite materials

Textbook(s):
1. M.L. Gambhir , Neha Jamwal, Building Materials, Products, properties and systems, Mc Graw Hill(2011)
2. M.L. Gambhir, Concrete Technology, Mc Graw Hill(2013)

References:
1. Low Cost Houses, Publications by HUDCO, India Habitat Centre, Lodhi Road, New Delhi(1982)
2. F. Glower, Structural Pre-cast Concrete, Oxford Publishers.(1974)
3. Shetty, M.S., “Concrete Technology”, SCC Ltd., New Delhi
4. Neville, A.M., “Properties of Concrete”, Longman, India

Advanced Control Systems for Instrumentation	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-1	ICE-314T
EAE	7	CI-EAE	CI-EAE-3	CI-407T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the mathematical modelling of physical systems using state space.
2.	To do the discrete-time mathematical modelling of physical system in both Time domain and frequency domain.
3.	To evaluate the non-linear system behaviour in phase plane and its stability.
4.	To assessdistinct systems stability using Lyapunov stability criterion.

Course Outcomes (CO)

CO 1	Understand and derive discrete-time mathematical model in both time domain and frequency domain
CO 2	Apply and formulate mathematical model and state space model of physical systems.
CO 3	Evaluate nonlinear system behaviour by phase plane and describing function methods and analyse its stability.
CO 4	Design and assess different systems stability using Lyapunov stability analysis.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	2	3	-	-	-	-	-	-	3
CO 2	3	3	1	3	3	-	-	-	-	-	-	3
CO 3	3	3	3	3	3	-	2	-	1	-	-	3
CO 4	3	3	2	3	3	2	-	-	-	-	-	3

Unit I

State Space Analysis: Introduction, state space representation of continuous LTI systems, transfer function and state variables, transfermatrix, EIGEN values and EIGEN vectors, Solution of State equations, controllability and observability,canonical forms (CCF, OCF, DCF, JCF).

Unit II

Discrete System**:** Introduction to discrete time systems, sampling process, Z-transform and inverse Z-transforms and hold circuits,presentation by difference equation and its solution, pulse transfer function, transient and steady state responses,Dead beat response, steady state error, Representation of discrete systems in state variable form and its solution,stability of digital control system, digital equivalent of conventional controller/compensator.

Unit III

Non-Linear System**:** Introduction, Non-linear system behaviour and different types of non-linearities, Describing function analysis,assumptions and definitions, DF of common non-linearities, Phase Plane Analysis, singular points, constructionof phase portrait, phase plane analysis of linear/non-linear systems, existence of limit cycles, jump phenomenon,stability analysis.

Unit IV

Lyapunov Theory and Adaptive Control**:** Lyapunov direct method, positive definite functions and Lyapunov functions, existence of Lyapunov functions,Lyapunov analysis of LTI systems, variable gradient method, performance analysis, Popov'sstability criteria.Introduction to basic approaches to adaptive control - Model reference adaptive control systems, self -tuningregulators, Applications of adaptive control.

Textbooks:

1. Dorf-State Space Analysis, Modern Control System, Pearson 4th edition, 2002
2. M. Gopal-Digital Control and State Variable Methods, TMH 4th Edition.

References:

1. K. Ogata, "Discrete Time Control System", Prentice Hall International.
2. J. J. Stoline, Nonlinear Control System.
3. B. C. Kuo, "Digital Control Systems", Oxford, 2007.
4. Kirk, Donald E. Optimal control theory: an introduction. Courier Corporation, 2004.
5. Brian D.O.Adnerson & John B. Moore, Optimal Control.

Advanced Control Systems for Instrumentation Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-1	ICE-314P
EAE	7	CI-EAE	CI-EAE-3	CI-407P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Advanced Control Systems for Instrumentation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of open loop and closed loop time/ frequency responses of first/second order LTI system.
2. Conversion of transfer functions to state model of LTI system and vice versa.
3. Determine State Space Model of a given system and determine its controllability and observability.
4. Analysis of Zero order hold and first order hold circuits.
5. Conversion of transfer functions to state model of discrete time system.
6. To determine state transition matrix of a given system.
7. Study of saturation and dead zone non-linearity using describing function technique of a relay controlsystem.
8. To draw phase trajectory of a given non-linear system.
9. Experiments based on PLC applications e.g., Lift control models, pick and place module etc.
10. Study of operation of a stepper motor interface with microprocessor.

Advanced DBMS	L	P	C
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CST/ITE	6	PCE	PCE-1	CIE-310T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To do database programming.
2.	To learn various advance concepts of relational model.
3.	To learn the need and concepts of object relational model.
4.	To know about emerging databases.

Course Outcomes (CO)

CO 1	Able to perform database programming.
CO 2	Able to understand the various advance concepts of databases such as transaction processing
CO 3	Able to differentiate between relational model and object relational model.
CO 4	Able to identify the emerging developments in the field of database technologies

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT-I

Concept of advanced database techniques, Impact of emerging database standards, Study of DDBMS architecture, New developments in database technology

Database Programming: Introduction, Database Objects, Procedures, Functions, Packages, Triggers, Programmatic SQL, Embedded SQL, Dynamic SQL, and ODBC Standard. Parallel Database Architecture, Data base System Structure, Storage Manager, Query Processor.

UNIT-II

Introduction to the Relational Model, Advanced Transaction Processing, Relational model conformity and Integrity, Data Replication, Security considerations, Querying relational data and relational Algebra, Query processing & optimization, Integrity Constraints.

UNIT-III

Object Oriented database concepts, Object relational database concepts, Temporal database concepts, Mobile Databases, Object based databases Complex data types, structured types and inheritance in SQL, object identity and reference types in SQL

UNIT - IV

Structure of XML, Document Schema, Querying and Transformation, API in XML, XML applications. Postgre SQL, Oracle, SQL standards, SQL1999, SQL: 2003, Standards for interoperability and integration, XML related specifications, X-Query, X-Path, Web Services, SOAP

Textbook(s):

1. Elmasri, Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education, India.
2. Data base System Concepts, Silberschatz, Korth, McGraw hill, V edition.

References:

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw- Hill
2. Fundamentals of Database Systems, Elmasri Navrate Pearson Education
3. S.R. Prabhu, “Object-Oriented Database Systems: Approaches and Architectures”, Prentice-Hall of India, Pvt. Ltd., Second edition, 2005.
4. SQL/ PL/SQL, The programming language of Oracle, Ivan Bayross, 4th Edition BPB Publications.
5. Rajesh Narang, “Object Oriented Interfaces and Databases”, Prentice-Hall of India, Pvt. Ltd., 2004.

Advanced DBMS Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CST/ITE	6	PCE	PCE-1	CIE-310P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Advanced DBMS) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Creation of tables using all types of constraints.
2. Queries based on join of more than two tables with respect of vertical fragmentats of table.
3. Queries based on set operators with respect to horizonal fragmentation of table.
4. Queries based on nested subqueries.
5. Queries based on corelated subqueries.
6. Creation of views based on multiple tables.
7. Queries based on views.
8. Creation of procedures using cursor with exception handling.
9. Creation of triggers on tables.
10. Creation of triggers on views.

Advanced Environmental Engineering and Design	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	IE-EAE	IE-EAE-2	IE-324

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the concepts and understand the importance of designing water supply structures.
2.	To study and gain knowledge about the water treatment process and design.
3.	To Know the facts and information about the various process involved in treatment of wastewater
4.	To Realise the potential of application of software in designing water distribution networks.

Course Outcomes (CO)

CO 1	Understand the concept and need of environmental engineering design work.
CO 2	Learn about the design stages and process.
CO 3	Analyse the process involved and their feasibility.
CO 4	Understand the mechanism and processes of designing water distribution network

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	1	-	2	1	-	-	1	3	2	1
CO 2	-	3	1	1	1	-	1	-	2	-	1	1
CO 3	2	-	3	2	-	2	-	-	-	3	-	1
CO 4	2	-	-	1	1	-	2	-	-	1	2	1

UNIT-I

Design of Intake structures. Site investigations for subsurface water sources and design of Infiltration wells, Infiltration galleries. Concept and design of Ranney wells.

Size and Cost Optimization of Rising main. Introduction to Linear Programming, dynamic programming, and Nonlinear Programming. Their application to optimization problems in design of Environmental Engineering Work.

UNIT-II

Detailed design of Water treatment that include Screens, Plain sedimentation, Mixing, Flocculators, Clarifiers, Filtration units and Disinfector units Nano-filtration softening and Desalination. Design of different types of Aerators, filters, Coagulation and flocculation,Rapid mix, Clari-flocculators, Flocculation basin,Softeners, Sludge processing units etc.

UNIT-III

Detailed Design and arrangement of Sewage Treatment Plant: Preliminary/ Primary treatment - Screens, Grit chamber, skimming tank, Primary sedimentation etc; Physico- chemical & Chemical treatment systems; Biological treatment systems- Activated Sludge process, Fixed Film (Trickling Filter), Oxidation Ditch, Oxidation Pond, UASB; Disposal/ treatment of sludge-Anaerobic digestion, sludge drying beds.

UNIT – IV

Water treatment Plant using CPHEEO Manual on Water Supply & treatment Design and arrangement of Sewage Treatment Plant units using CPHEEO Manual on Sewerage and Sewage treatment. Design of Water distribution network. Use of EPA NET & WATER GEMS in distribution network design. Planning and Design of storm and sanitary sewers. Computation - flow, cross section size and grade. Hydraulic modelling and design using SEWER GEMS, / CAD, STORM CAD/ CIVIL STORM.

Textbook(s):

1. Garg, S.K, “Water Supply Engineering, Vol 1”, Khanna Publishers, New Delhi. (ISBN 0- 07-6080479-3).
2. Garg, S.K, “Sewage Disposal and Air Pollution Engineering, Vol 2”, Khanna Publishers, New Delhi (ISBN 0-74-7458244-7)

References:

1. Qasim, SR; Motley, EM and Zhu, G. “Water Works Engineering.: Planning, design and operation, Prentice Hall NJ, USA ISBN 0-72-579462-7) 2000
2. Metcalf & Eddy. “Waste Water Engineering: Treatment and reuse, TMH, 2003
3. CPHEEO Manual on Water Supply & treatment, Min of Urban GOI 1999
4. CPHEEO Manual on Sewerage and Sewage treatment, Min of Urban GOI 2013
5. Arceewala SJ, Waste water treatment for Pollution control, TMH, New Delhi
6. Reynolds, T.D., Richards, P.A., Unit Operations and Processes in Environmental Engineering, PWS Publishing Company, Boston, 1996.

Advanced IC Engines	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	TES-EAE	TES-EAE-5	TES-451T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To make the students familiar with the engine fuel and air supply systems, electronic injection systems used in modern automotive engines.
2.	To make the students understand about the combustion in SI and CI engines.
3.	To teach the students about the production and utilization of solid, liquid and gaseous fuels.
4.	To make students learn about pollutants and advancements in IC engines.

Course Outcomes (CO)

CO 1	To learn the components and techniques of an IC engine.
CO 2	To understand concepts of combustion in IC engines.
CO 3	To understand fundamentals and type of fuels.
CO 4	To analyse emissions, emission control and modern trends in IC engines.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2	2	2	-	-	-	2	2	3	3
CO 2	3	2	2	2	2	-	-	-	2	2	3	3
CO 3	3	3	2	2	3	-	1	-	2	2	3	3
CO 4	3	2	3	2	3	1	2	-	2	2	3	3

UNIT – I

Fuel supply systems in SI Engine, introduction-carburetion, mixture requirements, simple carburettor, compensation devices.
Lubrication systems, high altitude fuel supply device, Electronic injection system, CI engine- Injection systems.

UNIT – II

Combustion in SI and CI engines, Ignition - Stages of combustion, Normal and abnormal combustion, Factors affecting knock, Combustion chambers, Fuel spray behaviour, spray structure, spray penetration-and evaporation, air motion, stages of combustion, Factors affecting combustion, Direct and indirect injection systems, Combustion chambers.

UNIT - III

Required properties of Fuels for IC engine, Introduction to alternate fuels-biofuels, thermochemical and biochemical conversion, Vegetable oils and Biodiesel, Ethanol, LPG, Natural gas, Hydrogen-Production and Utilization perspective.

Rating of fuels, High and low tension ignition systems. Ignition timing.

UNIT - IV

Introduction to Turbo charging and supercharging, Exhaust emission from SI and Cl engines, control of emissions.

Modern trends in I.C. engines- Free piston engines, lean burning engines-rotary engines, modification in I.C engines to use CNG/Biofuels, HCCI and GDI concepts.

Textbooks:

1. M.L. Mathur and R.P. Sharma, Internal combustion engine, Dhanpat Rai Publications.
2. V. Ganesan, Internal combustion engines, 2nd Edition, TMH Education, 2002.

References:

1. Heinz Heisler, Advanced Engine Technology, Trafalgar Square, 1997.
2. Ferguson & Kirkpatrick, Internal Combustion Engines – Applied Thermosciences, 3rd Edition, Wiley.
3. K.K. Ramalingam, Internal Combustion Engine Fundamentals, Scitech Publications.
4. D. Smith, Auto fuel Systems, The Good Heart Willox Company, Inc.
5. V. Ganesan, Computer simulation of spark ignition process: University process, Hyderabad 1993.
6. V. Ganesan, Computer simulation of compression ignition engine. Orient Long man.
7. P K Nag, Basic and Applied Thermodynamics, McGraw - Hill Education.
8. G. D. Rai, Non conventional energy sources, Khanna Publishers, New Delhi.

Advanced IC Engines Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	TES-EAE	TES-EAE-5	TES-451P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Advanced IC Engines) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study the comparison between the Spark Ignition engine and Compression Ignition Engine.
2. Study of different types of carburettor in S.I. Engine.
3. Study Ignition Systems in I.C. Engine.
4. Study Fuel Injection Systems in C.I. Engine.
5. Prepare the heat balance sheet of a multi cylinder petrol engine at different load.
6. Prepare the heat balance sheet of a single cylinder 4 stroke diesel engine at different load.
7. Determine the indicated power of a petrol engine by Morse test apparatus.
8. Conduct exergy analysis of exhaust gas calorimeter at different load.
9. Carry out the analysis of an engine performance of a S.I. Engine.
10. Carry out the analysis of an engine performance of a C.I. Engine.
11. Determine the impact of various parameters on the knocking tendency of a S.I. Engine.
12. Determine the impact of various parameters on the knocking tendency of a C.I. Engine.
13. Visit to Automobile Research Lab facility.

Advanced Java Programming	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-1	CIE-306T
EAE	6	FSD-EAE	FSD-EAE-1	FSD-318T
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OSD-453T
OAE	7	SD-OAE	SD-OAE-5A	OSD-453T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn the ability to design console based, GUI based and web based applications
2.	To learn how to create dynamic web pages, using Servlets and JSP.
3.	To learn Designing applications using pre-built framework.
4.	To learn how to do distributed programming in Java using RMI, CORBA.

Course Outcomes (CO)

CO 1	Able to Understand advanced programming concepts.
CO 2	Able to Develop server side programs using JSP and Servlets
CO 3	Able to Develop component-based java software using java beans.
CO 4	Able to develop advanced projects based on java.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	3	2	-	-	-	3	2	2	3
CO 2	3	2	2	3	2	-	-	-	3	2	2	3
CO 3	3	2	2	3	2	-	-	-	3	2	2	3
CO 4	3	2	2	3	2	-	-	-	3	2	2	3

UNIT-I

Introduction to Java, Inheritance, Exception Handling, Multithreading, Applet Programming. Connecting to a Server, Implementing Servers, Making URL Connections, Socket Programming.

UNIT-II

Preparing a Class to be a Java Bean, Creating a Java Bean, Java Bean Properties, Types of beans, Stateful Session bean, Stateless Session bean, Entity bean Servlet Overview and Architecture, Interface Servlet and the Servlet Life Cycle, Handling, HTTP GET Requests, Handling HTTP POST Requests, Session Tracking, Cookies.

UNIT-III

JSP- Introduction, Java Server Pages Overview, Implicit Objects, Scripting, Standard Actions, Directives, Custom Tag Libraries.

UNIT- IV

The Roles of Client and Server, Remote Method Invocations, Setup for Remote Method Invocation, Parameter Passing in Remote Methods, Introduction of HB, HB Architecture.

Textbook(s):
1. Kathy Sierra, Head First Servlets and JSP, O'Reilly Media.
2. Kanika Lakhani, Advance Java Programming, S.K. Kataria & Sons

References:
1. Brett Spell, Professional Java Programming, WROX Publication.
2. Harvey. M. Dietal, Advanced Java 2 Platform, How to Program, Prentice Hall.
3. Gajendra Gupta, Advanced Java, Firewall Media.

Advanced Java Programming Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-1	CIE-306P
EAE	6	FSD-EAE	FSD-EAE-1	FSD-318P
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OSD-453P
OAE	7	SD-OAE	SD-OAE-5A	OSD-453P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Advanced Java Programming) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a Java program to demonstrate the concept of socket programming.
2. Write a Java program to demonstrate the concept of applet programming.
3. Write a Java program to demonstrate the concept of multi-threading.
4. Write a Java program to demonstrate the concept of applet.
5. Write a Java program to demonstrate the use of Java Beans.
6. Write a Java program to insert data into a table using JSP.
7. Write JSP program to implement form data validation.
8. Write a Java program to show user validation using Servlet.
9. Write a program to set cookie information using Servlet.
10. Develop a small web program using Servlets, JSPs with Database connectivity.

Advanced Machine Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-2	MEE-324T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To be able to apply the fluctuating loads concepts in diverse design cases.
2.	To understand the stresses in materials at elevated temperatures and to determine the creep rates.
3.	To analyse the fracture criterion in the design of steam turbine rotors and pressure vessels.
4.	To thoroughly understand the design procedure for flywheels, screw gears, crankshafts.

Course Outcomes (CO)

CO 1	Conceptualise the dynamic loading designs where elements may fail under yield stress with criticality of presence of stress concentration.
CO 2	Sustainability synthesis of strain rates in machine parts at higher temperatures under various parameter methods.
CO 3	Design analysis of fracture development and propagation effects in high speed and high pressure elements.
CO 4	Conceptualise the dynamic loading designs where elements may fail under yield stress with criticality of presence of stress concentration.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	-	-	-	1	1	2	3
CO 2	3	3	3	3	3	-	-	-	1	1	2	3
CO 3	3	3	3	3	3	-	-	-	1	1	2	3
CO 4	3	3	3	3	3	-	-	-	1	1	2	3

UNIT-I

Introduction: Review of failure theories for static and dynamic loading (including fatigue failure).
Design against Fatigue: Dynamic loading and fluctuating stresses, fatigue failure and endurance limit, fatigue behaviour affecting factors, design under combined direct & varying stresses, Fatigue strength reduction due to stress raisers, Notch sensitivity, Fatigue design for finite-life, Low cycle and high cycle fatigue designs.
Design of shafts, springs, plates under variable fatigue loadings, Bolted& Welded joint under fluctuating loads. Numerical Design Problems.

UNIT-II

Design against Creep: True stress-true strain relationship, Creep of solids, Creep phenomenon – transient creep, secondary creep, Creep - Parameter methods, correlation of creep rupture data, Creep under biaxial stresses, Stress relaxation, Materials for application at elevated temperatures. Numerical Design Problems.

UNIT-III

Design against Fracture: Stress intensity factor of a crack in finite bodies, Fracture criterion, Fracture toughness, Fatigue crack propagation, Plastic deformation around crack tip, Effect of plastic deformation on fatigue crack growth rate, Crack opening displacement, Design of steam turbine rotors, rotor discs, Design of thin walled pressure vessel & pressure pipings, Partial crack in thin walled cylinder. Numerical Design Problems.

UNIT – IV

Flywheel: Need for flywheel and flywheel action, flywheel- governor differentiation, Materials, Torque analysis and coefficient of fluctuation of energy, Stresses in rimmed flywheel, Design analysis of Flywheel.
Screw Gearing: General considerations, Geometric relations, Design procedure. Numerical Problems.
Miscellaneous machine elements: Oil seals, Valves, rocker arm, Center and side crankshafts.

Textbook(s):
1. Maleeve Hartman and O.P.Grover, “Machine Design”, CBS Publishers, Sixth Edition (2015).
2. V.B. Bhandari, “Design of Machine elements”, Tata McGraw Hill Education Private Ltd. Third Edition (2012).

References:
1. Mahadevan, “Design Data Book”, CBS Publishers & Distributors.
2. J.E. Shigley& C.R. Mischke, "Mechanical Engineering Design”, Tata McGraw Hill Co. Inc.
3. Juvinal R C, Marshek K M, “Fundamentals of Machine Component Design”, Wiley India.
4. Norton Robert. L. “Machine Design-An integrated approach” Pearson, Second Edition (2010).
5. Abdul Mubeen, “Machine Design” Khanna Publishers, Fourth Edition (2005).

Advanced Machine Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-2	MEE-324P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Advanced Machine Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To perform standard rotating beam experiment on specimens on Fatigue testing machine under reversed bending load and to draw the S-N or log S-log N curve for the specimen material.
2. To establish the fatigue curve, Goodman diagram and Soderberg diagram for a non-ferrous material.
3. To establish the creep curve and steady state creep rate for a given material at different temperatures and stress levels.
4. To establish various creep parameters for a given material.
5. To determine the theoretical stress concentration factor Kt for a given geometrical configuration for a gear tooth with crack at its bottom.
6. To determine the theoretical stress concentration factor Kt for a given geometrical configuration for a shaft with crack at its shoulder.
7. To determine the law of fatigue crack propagation for a given material under given loading condition.
8. To determine the fracture toughness of material.
9. To determine the main dimensions of a flywheel for a given operation conditions.
10. To find the main dimensions of a crankshaft for a 2-stroke gas engine running at a speed. The maximum pressure and distance between cylinder centre lines being given.

Advanced Microprocessors (ARM) & Interfacing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	ES-EAE	ES-EAE-1C	ES-310T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn Generalized structures of embedded system.
2.	To understand ARM processor in detail.
3.	Apply hardware interfacing of ARM with different devices.
4.	To create different real time application based embedded system design.

Course Outcomes (CO)

CO 1	Ability to Understand and apply the concepts of ARM processors and understand various Bus structures in programming.
CO 2	Ability to understand different control units of ARM processor.
CO 3	To apply the knowledge of embedded bus structures to understand interfacing concepts.
CO 4	Ability to apply interfacing for real time applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	1	3	2	-	-	2	3	3	3
CO 2	2	2	3	2	3	2	-	-	2	3	3	3
CO 3	2	2	2	1	3	2	-	-	2	3	2	3
CO 4	3	3	3	3	3	2	-	-	2	3	3	3

UNIT-I

Generalized ARM Concepts: ARM Processors: ARM Processor Fundamentals, Comparison of ARM architecture with previous microcontrollers, ARM 7 Data Path, Registers, Memory Organization, Instruction set, Barrel shifter, Programming, Exception programming, Interrupt Handling, Thumb mode Architecture and instruction set. Bus structure: Time multiplexing, serial, parallel communication bus structure. Bus arbitration, DMA, PCI, AMBA, I2C and SPI Buses.

UNIT-II

Specific ARM: LPC 2148- Salient features, applications, block diagram, memory mapping. Functional features of Interrupt controller, RTC, USB, UART, I2C, SPI, SSP controllers, watch dog timers and other system control units.

UNIT-III

ARM and Digital Signal Processing (DSP): Interfacing and applications: Digital signal processing: Operating on

Values Stored in Fixed-Point Format, Addition and Subtraction of Fixed-Point Signals, Multiplication of Fixed-Point Signals, Division of Fixed-Point Signals, Square Root of a Fixed-Point Signal, FIR filters, IIR filters, The Discrete Fourier Transform

UNIT-IV

Hardware Interfacing: LCD and keyboard interfacing, ADC, DAC, and Sensor Interfacing, RTC Interfacing, Relay, Opto- isolator, and Stepper Motor Interfacing, PWM and DC Motor Control, DRAM Memory Technology and DMA Controller

Textbook(s):

5. ARM System Developer's Guide Designing and Optimizing System Software, Andrew N. Sloss, Dominic Symes, Chris Wright, Elsevier.
6. ARM Architecture Reference Manual, David Seal, Addison Wesley.

Reference Books:

4. TI ARM Peripherals Programming and Interfacing Using C Language for ARM Cortex, Muhammad Ali Mazidi, Shujen Chen, Sarmad Naimi, Sepehr Naimi.
5. ARM Assembly Language Programming & Architecture, Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Janice Mazidi.

Advanced Microprocessors (ARM) & Interfacing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	ES-EAE	ES-EAE-1C	ES-310P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Advanced Microprocessors (ARM) & Interfacing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Learn how to use Embest IDE for ARM and ARM Software Emulator.
2. Write a program to change ARM state mode by using MRS/MMSR instruction.
3. Write a delay function using C language. Use embedded assembly code.
4. Write a random number generation function using assembly language.
5. Use assembly and C language to read/write words, half-words, bytes, half bytes from/to RAM.
6. Get familiar with the method of configuring the ARM I/O port via programming. Implement the lighting and winking LED1, LED2 of the hardware board.
7. Write programs that implement an interrupt service routine.
8. Write programs that use the RTC. Modify the setting of time and date. Display the current system clock time through the serial port.
9. Write a program that displays 0-9, A-F to the 8-SEG LED.
10. Develop a project that accepts the keys of the keyboard pad through interrupt service routine and display the values on the 8-SEG LED.
11. Write programs to get the coordinate values when the touch panel is pressed. Write programs to output the coordinate values of the touch panel through the serial port. Write programs to display 0-9, A-F on the LCD to show the range of the coordinate.
12. Download the code to the target board through the local LAN using TFTP/IP protocol.

Advanced Microprocessors and Microcontroller	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-1	ECE-312T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the internal organization of 16-bit Intel microprocessors and apply the knowledge to develop assembly language programs using 8086 microprocessor.
2.	Understand the architecture and operation of Programmable Peripheral Devices and their interfacing with 8086 microprocessor.
3.	Understand the architecture and operation of advanced microprocessors.
4.	Understand the internal organization of 8-bit Intel microcontrollers and apply the knowledge to develop assembly language programs using 8051 microcontroller..

Course Outcomes (CO)

CO 1	Ability to understand and distinguish the use of different 8086 instructions and apply those instructions for implementing assembly language programs.
CO 2	Understand the architecture and operation of Programmable Peripheral Devices and ability to use them for interfacing I/O devices.
CO 3	Understand the architecture and operation of 80186, 80286, 80386, 80486 and Pentium processors.
CO 4	Design and implement assembly language programs for 8051 microcontroller.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	-	1	2	2	1	1	1
CO 2	3	3	3	2	3	-	1	2	2	1	1	1
CO 3	3	2	2	2	2	-	1	2	2	1	1	1
CO 4	3	3	3	2	3	-	1	2	2	1	1	1

UNIT-I

8086 Microprocessor: Architecture of 8086, Difference between 8086 and 8088, Programming Model, generation of physical address, Memory Segmentation, PIN diagram of 8086, Minimum mode and Maximum mode configurations, Timing Diagrams. Instruction set of 8086, Assembler Directives, Assembly Language Programming, 8086 Interrupts, Memory Interfacing. Architecture of NDP 8087.

UNIT-II

I**Interfacing and Programming of 8086 with 8255, 8254/ 8253, 8251, 8259, 8257:** Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI)-Intel 8255, Sample-and-Hold Circuit and Multiplexer, Keyboard and Display Interface, Keyboard and Display Controller (8279), Programmable Interval timers (Intel 8253/8254), USART (8251), PIC (8259), DMA (8257).

UNIT-III

Architecture of 80186, 80286, 80386, 80486 and Pentium Processors. Generation of physical address of 80286, 80386 and 80486.

UNIT-IV

Overview of Microcontroller 8051: Introduction to 8051 Microcontroller, Architecture, Memory organization, Special function registers, Port Operation, Memory Interfacing, I/O Interfacing, Programming 8051 resources, interrupts, Programmer‘s model of 8051, Operand types, Operand addressing, Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions, Timer & Counter Programming, Interrupt Programming. Interfacing of DAC, ADC and Stepper Motor with 8051.

Textbook(s):

1. Sunil Mathur and Jeebananda Panda, “Microprocessors and Microcontrollers: Programming and Interfacing”, PHI, 2019.
2. Muhammad Ali Mazidi, “Microprocessors and Microcontrollers”, Pearson, 2006.
3. Barry B. Brey, “The Intel Microprocessors: Architecture, Programming and Interfacing”, Eighth Edition, PHI.

References:

1. Douglas V Hall, “Microprocessors and Interfacing, Programming and Hardware” Tata McGraw Hill, 2006.
2. A K Ray, K M Bhurchandi, “Advanced Microprocessors and Peripherals”, Tata McGraw Hill, 2007.
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. MCKinlay, “The 8051 Microcontroller and Embedded Systems”, Second Edition, Pearson Education 2008.

Advanced Microprocessors and Microcontroller Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-1	ECE-312P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Advanced Microprocessors and Microcontroller) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to add & subtract two 16-bit numbers with/ without carry using 8086.
2. Write a program to multiply & divide two 8 bit numbers using 8086.
3. Write a program in 8086 to add two binary numbers of 16 byte lengths.
4. Write a program in 8086 to find the largest/ smallest numbers from ten bytes stored in consecutive memory location.
5. Write a Program to generate Fibonacci series using 8086.
6. Write a Program to generate Factorial of a number using 8086.
7. Write a Program to read 16-bit Data from a port and display the same in another port.
8. Write a Program to generate a square wave using 8254.
9. Write a Program to subtract the 16bit data of register $R_0 – R_1$ from another 16 bit data stored in $R_2 – R_3$. Save the result in memory location 40H and 41H using 8051.
10. Write a Program to multiply two numbers stored in external RAM location 8000H and 8001H and save the result in 8002H and 8003H using 8051.
11. Write a Program to transfer a block of 16 bytes from RAM location starting at 50H to RAM location starting at 70H using 8051.
12. Write a program in 8051 to find the largest/ smallest numbers from ten bytes stored in consecutive memory location.
13. Design a Minor project using 8086 Microprocessor (Ex: Traffic light controller/temperature controller etc)

Advanced Power Electronic Converters	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	PED-EAE	PED-EAE-1	PED-316T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of controlled rectifiers, their operation and analysis.
2.	To impart understanding of switching mode regulators, their classification and performance.
3.	To impart the knowledge of AC voltage controllers & cycloconverters, their working and applications.
4.	To impart the knowledge of Inverters, their working principle, voltage control techniques and design.

Course Outcomes (CO)

CO 1	The students will be able to understand about various types of converters, their working and analyse them at different type loads.
CO 2	The students will be able to understand the use of different converters in real time applications.
CO 3	The students will be able to carry out simulation of various converters and observing their response under different load conditions.
CO 4	The students will be able to select a converter for the desired applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	2	2	2	2	1	1	1	1
CO 2	3	3	3	3	2	2	2	2	1	1	1	1
CO 3	3	3	3	3	2	2	2	2	1	1	1	1
CO 4	3	3	3	3	2	2	2	2	1	1	1	1

UNIT-I

AC-DC Converters: Single phase half controlled and fully controlled converters-Evaluation of input power factor and harmonic factor, Continuous & discontinuous load current, Single phase dual converters, Power factor improvements-Extinction angle control, Symmetric angle control, PWM, Single phase sinusoidal PWM, Three phase half controlled and fully controlled converters-Evaluation of input power factor and harmonic factor, Continuous & discontinuous load current, Three phase dual converters, Power factor improvements, Three phase PWM, Twelve pulse converter.

UNIT-II

DC-DC Converters: Analysis of step-down and step-up DC-DC converters with resistive and resistive-inductive loads, Performance parameters-Ripple current of inductor, Maximum switching frequency, Switching mode regulators-Analysis of Buck regulators, Boost regulators, Buck-Boost Regulators and Cuk regulators, Condition for continuous inductor current and capacitor voltage, Comparison of regulators.

UNIT-III

AC-AC Converters: Working principle of single phase unidirectional and bidirectional AC voltage controllers, Analysis with resistive and resistive-inductive loads, single phase transformer connection changer, Three phase AC voltage controllers-Analysis with star and delta connected resistive, resistive-inductive loads, Effect of source inductances.
Cycloconverters: Analysis of midpoint and bridge configuration of single-single & three-three phase cycloconverters, advantages, limitations and applications of cycloconverters.

UNIT - IV

DC-AC Converters: Single Phase pulse width modulated inverters- Principle of operation, Performance parameters, Single phase bridge inverter-Evaluation of output voltage and current with resistive, inductive and capacitive loads, Voltage control of single-phase inverters-Single PWM, Multiple PWM, Sinusoidal PWM, Modified sinusoidal PWM, Phase displacement control.
Three phase pulse width modulated inverters- Analysis of 180- & 120-degree conduction for output voltage with resistive and resistive-inductive loads, Voltage control of three phase inverters,
Current source inverter, variable d.c. link inverter, boost inverter, buck and boost inverter design, introduction to multilevel inverters.

Textbook(s):
1. M.H. Rashid “Power Electronics: Circuits, Devices & Applications”, Pearson Education.
2. Ned Mohan, T.M.Undeland and W.P. Robbins “Power Electronics: Converters, Applications and Design”, Wiley India Ltd.

References:
1. D.W. Hart “Introduction to Power Electronics”, Prentice Hall Inc.
2. P. C. Sen, “Power Electronics”, TataMc Graw-Hill.
3. P.S. Bimbhra, “Power Electronics”, Khanna Publishers.
4. R.S. Ananda Murthy, V. Nattarasu, “Power Electronics”, Pearson.

Advanced Power Electronic Converters Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	PED-EAE	PED-EAE-1	PED-316P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Advanced Power Electronic Converters) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study single phase fully controlled bridge rectifier with resistive and inductive load.
2. To study single phase fully controlled bridge rectifier with DC motor load.
3. To study three phase fully controlled bridge rectifier with resistive and inductive load.
4. To study single phase AC voltage regulator with resistive and inductive load.
5. To study the operation of single phase cyclo-converter.
6. To study MOSFET/IGBT based single phase bridge inverter.
7. To simulate a single-phase half wave-controlled rectifier with R and RL loads and attain plot of load voltage and load current waveforms.
8. To obtain the simulation of single-phase fully controlled rectifier and plot the load voltage and load current waveforms for inductive load.
9. To obtain the simulation of single-phase full wave AC voltage controller and plot the load voltage and load current waveforms for inductive load.
10. To simulate the model of a Buk converter and plot the output voltage waveform.
11. To obtain the simulation of single-phase cyclo-converter feeding R and RL loads and plot load voltage waveforms.
12. To study the operation of SPWM Inverter.

Advanced Process Control	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-5	ICE-417T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the basic concepts of advanced process control schemes.
2.	To Learn the basics of linear and non-linear controllers.
3.	To Learn the multivariable control systems
4.	To study the evolution and advantages of computer control.

Course Outcomes (CO)

CO 1	Realization of stability techniques in Process Control System.
CO 2	Apply the concept of advanced control schemes in various processes
CO 3	Implement the linear and nonlinear controller on distinct systems..
CO 4	Design of control systems for multivariable process

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	3	1	2	1	2	2	-	3
CO 2	3	3	3	3	3	2	-	2	3	2	2	3
CO 3	3	3	2	2	3	2	2	3	2	2	2	3
CO 4	3	2	3	3	3	3	3	3	3	3	2	3

Unit I

Introduction to advanced Control Schemes: Cascade, Feed-forward, Feed-forward plus Feedback, Ratio control,Inferential control, Dead time and Inverse response compensation, Adaptive control, Model reference adaptive control, Self-tuning regulator Interactions and Decoupling of Control Loops.

Unit II

Nonlinear Control Systems: Definition and characteristics of nonlinear systems, Difference between linear and nonlinear systems,PID controller, Derivative action, Problems with proportional kick and reset wind-up,Internal Model Control(IMC), Dahlin's method,Stability Analysis, Interaction Analysis and Multi-loop Control, Soft Sensing and State Estimation.

Unit III

Design of control systems for multivariable process: Study of interactions and its effects, Modelling and transfer functions, Multivariable control system, multi-loop control Performance through: Loop Pairing, tuning, Enhancement through Decoupling, Single LoopEnhancements.Stability Analysis- Lyapunov Functions, Interaction Analysis and Multi-loop Control, inferential control.

Unit IV

Distributed Control System (DCS): Evolution and advantages of computer control, Configuration of Supervisory, Direct digital control (DDC), Model predictive control (MPC), Linear Quadratic Gaussian (LQG) Control, Statistical Process Control, Process Control System Synthesis- Some Case Studies.

Textbooks:

1. B.W. Bequette, “Process Control: Modeling, Design and Simulation”, Prentice Hall.
2. K. Ogata, Modern Control Engineering, Prentice Hall of India, 4th edition, 2002.

References:

1. Johnson Curtis D, “Process Control Instrumentation Technology”, Prentice Hall ofIndia, New Delhi (1997).
2. Liptak B G, “Handbook of Process Control “, 3rd Ed., Chilton Press (1995).
3. S.Bhanot, Process Control: Principles and Applications, Oxford University Press, 2008.
4. George Stephanopoulos, “Chemical Process Control – An introduction to Theory & Practice”, Prentice Hall of India, New Delhi (1995).
5. W.L. Luyben, Process Modelling Simulation and Control for Chemical Engineers, McGraw Hill, 2nd Ed, 1990.

Advanced Process Control Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-5	ICE-417P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Advanced Process Control) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the performance of ON –OFF/P/PI/PD/PID controllers on level process
2. To study the performance of ON –OFF/P/PI/PD/PID controllers on flow process.
3. To study the performance of ON-OFF/P/PI/PD/PID controllers on temperature process.
4. To obtain the open and closed loop response of a higher order system usingSIMULINK software.Given transfer function = $G(s) \ = \frac{1}{(s+1)^3}$
5. To study the complex control system using MATLAB and to compare theresponse of simple and cascade loop.
6. To study the response of process with and without transportation lag.
7. Internal Model Control based controller design forContinuous Stirred Tank Reactor(CSTR).
8. Study and perform Lyapunov-Function Based Control Schemes for inverted pendulum.
9. To obtain the time domain specification for a second order system using PID controller.
10. To study Distributed Control Systems application and logic operations with master and slave controllers.

Advanced Semiconductor Devices	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EEE	7	PCE	PCE-5	EEE-417T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic Knowledge of p-n junctions
2.	To impart the knowledge of functioning of Unipolar devices, working principle and characteristics.
3.	To impart the knowledge of special microwave devices and tunnelling phenomenon.
4.	To impart the knowledge of photonic devices and solar cells.

Course Outcomes (CO)

CO 1	To understand the basic laws of p-n junctions.
CO 2	To understand functioning of Unipolar devices, working principle and characteristics.
CO 3	Understand the characteristics special microwave devices and tunnelling devices.
CO 4	To analyse photonic devices and solar cells,

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Junctions and Interfaces: Description of p-n junction, Action, The Abrupt Junction, Example of an Abrupt Junction, The linearly graded Junction. The Ideal Diode Model, Real Diodes, Temperature Dependence of I-V Characteristics, High Level Injection Effects, Example of Diodes. Transient behaviour and Noise.
Junction breakdown: Description of Breakdown Mechanism, Zener and Avalanche Breakdown in p-n Junction, Introduction to Schottky junctions.

UNIT II

MOS Transistors: Basic Structures and the Operating Principle, I-V Characteristics,. Hetero junctions, Schottky effect, Metal insulator- Semiconductor diodes. Charge coupled devices.
Metal Semiconductor Field Effect Transistors: Basic Types of MESFETs, Models for I-V Characteristics of Short Channel MESFETs, High Frequency Performance, MESFETs Structures.

UNIT III

Tunnel Devices: Tunnel Diode, TUNNEL Transistors, Related Tunnel Devices, Resonant Tunneling Diode. IMPATT Diodes: Static Characteristics, Dynamic Characteristics, Power and Efficiency Noise Behaviour, Device Design and Performance, BARITT Diode, Trapatt diode.

UNIT IV

Photonic devices: Light Emitting Diodes (LED), semiconductor laser physics. Photo detectors: Photodiodes, Avalanche Photodiode and Phototransistor and Solar Cells

Textbook(s):

1. S. M. Sze, Kwok K. NG, Physics of Semiconductor Devices, 3rd Edition, Wiley Publication
2. B. G. Streetman and S. Banerjee Solid state electronics devices, 5th Edition, PHI.

References:

1. J. P. Colinge and C. A. Colinge, “Physics of Semiconductor Devices”, Kluwer Academic Publishers
2. M.S. Tyagi, “Introduction to Semiconductor Materials And Devices”, John Willy-India Pvt. Ltd

Advanced Semiconductor Devices Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EEE	7	PCE	PCE-5	EEE-417P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Advanced Semiconductor Devices) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study I-V characteristics and temperature dependent I-V characteristics of Diode.
2. To study I-V characteristics of Zener diode.
3. To study characteristics of NMOS and /or PMOS.
4. To study the various Short Channel Effects on MOSFET Structures.
   a) DIBL
   b) Threshold voltage roll off
5. To study the characteristics of heterojunction-based device (diode/ FET).
6. To study Schottky effect-based device (diode/ FET).
7. To study characteristics of Tunnel effect-based device (diode/ FET).
8. To study characteristics of IMPATT diode.
9. To study characteristics of photo effect-based device (diode/ FET).
10. To study characteristics of basic Solar cell.

Advanced Structural Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	6	PCE	PCE-2	CEE-312T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To know the concept of designing RCC structure using Indian codes.
2.	To know the concept design and analysis of earthquake-resistant structure.
3.	To calculate and design plate girder and gantry girder.
4.	To familiarize students about flat slab and its design.

Course Outcomes (CO)

CO 1	Analyse earthquake-resistant structure using IS: 1893:2016. Design of G+3 Building using IS: 456:2000
CO 2	Design of water tank using IS: 3370.
CO 3	Calculate and design girder using IS: 800:2007
CO 4	Analysis and Design of Industrial Building.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	-	-	-	-	-	-	-	-	-	3
CO 2	1	-	-	-	2	-	-	-	-	-	-	3
CO 3	3	1	-	-	-	-	2	-	-	-	-	-
CO 4	1	-	-	-	3	-	-	-	-	-	-	2

Unit I

Introduction to Seismic design: General principles of seismic design, Introduction to IS 1893 : 2002, Building equivalent static analysis, Vertical distribution of seismic forces and horizontal shears, dynamic analysis, design spectrum, Seismic weights, Modal combination, Load combinations and permissible stresses, Guidelines for earthquake resistant design, Ductile detailing for seismic design, Analysis for lateral Loads: Introduction to IS 875 Part-III. Design of G+3 Building. Design of slab, beam, column and footing as per IS 456:2000.

Unit II

Concrete structure design: Design of elevated and underground water tanks as per IS: 3370 and IS: 1893 Part-V. Forces acting on the water tank. Types of water tanks. Design of retaining walls, Types of retaining wall, Various conditions of backfill, Components of Retaining wall, Forces acting on retaining wall, stability checks, Design of Box culvert.

Unit III

Beam supported and unsupported, Plate girder, Types of Plate Girder, Components of Plate Girder, Gantry girder including lateral and flexural torsional building, design of structural elements, Components of plate girder. Components of Gantry Girder, Loads acting on gantry girder, Types of gantry girder, and design of gantry girder as per IS: 800:2007

Unit IV

Design of Industrial Building. Introduction, Roof and side coverings, Design loads, purlins, end bearings, general framing of industrial buildings, bracings. Components of Industrial Building. Wind load analysis using IS:875:2016 (All Parts), Orientation of Purlins. Types of Roof Coverings, Permissible loads to be considered for each component of industrial building.

Textbook(s):

1. N. Krishna Raju, R.N.Pranesh, "Reinforced concrete Design", CBS Publishers
2. S.K Duggal, Design of Steel Structure, P.C.Varghese, "Advance Reinforced Concrete Design" PHI Delhi

References:

1. N. Krishna Raju, "Prestressed concrete", Tata McGraw Hill.
2. Arther H. Nilson, "Design of concrete structures", Tata McGraw Hill
3. Arya and Ajamani, "Design of steel structures", Nem Chand and Bros. Publishers
4. C. Syal and A.K. Goel, "Reinforced concrete structures", S. Chand.
5. Prestressed concrete, Pandit and Gupta, CBS
6. T.Y. Lin, Design of Prestressed Concrete Structures, Asia Publishing House, 1955.
7. Edward Nawy, Prestressed Concrete: A fundamental approach, prentice hall, New Jersey
8. BIS 1893 – 2002 and BIS 875 Part III
9. Krishna Raju, "Advance Reinforced concrete Design" CBS Publishers

Advanced Structural Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	6	PCE	PCE-2	CEE-312P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Advanced Structural Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To design G+3 Building using STAAD PRO.
2. To determine and design a water tank in STAAD PRO using IS:3370 (Part IV)
3. Earthquake Analysis of Buildings as per IS:1893:2016.
4. Wind Analysis of Buildings as per IS 875:2007(Part 3).
5. Design of Retaining Wall.
6. Design of Industrial Building.
7. Design of gantry girder using IS:800:2007
8. Design of Prestressed Concrete Structure as per IS:1343
9. Design and prepare a prototype model of all structural components showing detailing of reinforcement.

Advanced Surveying	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	7	PCE	PCE-5	CEE-413T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To prepare the students to handle the errors they are likely to come across any large scale survey works.
2.	To make students aware with different advance surveying methodologies applied to carry out large scale survey works as modern instruments have largely changed the approach to survey works with the principles being same.
3.	Apply geometric principles to arrive at solutions to surveying problems.
4.	Use the concepts of advanced data capturing methods necessary for engineering practice.

Course Outcomes (CO)

CO 1	Define the fundamental of triangulation, theory of error, setting out of works, photogrammetric surveying and astronomical surveying.
CO 2	Explain geodetical observation, corrections in triangulation, and principles of photogrametry.
CO 3	Apply the concept of triangulation, probability curve, astronomy for coordinate study.
CO 4	Analyze triangulation survey, aerial photogramety, and time systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	-	2	1	-	-	-	1	1	-	-
CO 2	1	1	1	2	1	-	-	-	-	-	-	-
CO 3	1	2	-	1	1	-	-	-	-	-	-	3
CO 4	1	1	-	2	1	-	-	-	-	-	-	3

UNIT-I

Geodetic Surveying: Introduction & object of Geodetic Surveying**,** principal & classification of triangulation system, selection of base line and stations, order of triangulation, triangulation figures, scaffold and signals, marking of stations, Indivisibility and heights of stations, satellite stations, base line measurement and corrections, Introduction to adjustment of observations.
Survey Adjustments and Theory of Errors: Types of errors, law of errors, law of weights, distribution of error and field measurements, Probability cures, method of lest squares, determination of most probable value by normal adjustment and method of correlates, most probable error. Triangulation adjustments: Adjustment of geodetic quadrilateral with and without central station.

UNIT-II

Setting out works: Setting out of buildings, culverts, roads, pipelines, sewers, underground tunnels and centre line of dams, bridge survey, mine survey.
Route surveying: Reconnaissance, preliminary and location surveys for road, railway, canal and pipe alignments longitudinal and cross sections, computation of earthwork and mass haul curve.
Introduction to Hydrographic surveying: Shore line survey, soundings, tide and its characteristics, tide gauges, mean sea level as datum.

UNIT-III

Photogrammetric Survey: Basic principles, elevation of a point, determination of focal length of lens, aerial camera, scale of a vertical photograph, relief displacement of a vertical photograph, height of object from relief displacement, scale of a tilted photograph, tilt distortion, relief displacement of a tilted photograph, combined effects of tilt and relief, flight planning for aerial photography, selection of altitude, interval between exposures, crab and drift, location of principal points, transfer image from photograph to map, stereoscope parallax, parallax in aerial stereoscopic views, parallax equations.

UNIT - IV

Field Astronomy: Co-ordinate systems, latitude and longitude, spherical trigonometry, relation between degrees and hours of time, conversion of local time to standard time, conversion of mean time interval to sidereal time interval, to find local sidereal time (LST) at local mean midnight for given Greenwich sidereal time (GST) at Greenwich Mean midnight (GMN), determination of LST from LMT at any instant, determination of LMT of transit of a known star across the meridian for given GST of GMN, Local sidereal time of elongation of star, interpolation of values, instrumental and astronomical correction to observed altitude to the azimuth, observation for time by meridian transit of star and by meridian transit of Sun. Azimuth by observation on Polaris and ex-meridian observation on stars, determination of latitude, calculation of true altitude, declination, latitude, polar distance, determination of longitude

Textbook(s):
1. Surveying, B.C. Punmia Vol - I, II, III, Laxmi Publication
2. Duggal, S. K., Surveying Vol. I & II, Tata Mcgraw Hill, New Delhi

References:
1. Plane and Geodetic Surveying by D. Clark
2. Plane and Geodetic Surveying by S. Ramamrutham
3. Subramanian, R., Surveying & Levelling, Oxford University Press, New Delhi
4. Arora, K.R., Surveying Vol. I, II & III, Standard Book House. New Delhi

Advanced Surveying Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	7	PCE	PCE-5	CEE-413P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Advanced Surveying) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Adjustment of close traverse.
2. Adjustment of angles of a given triangulation network.
3. Computation of missing side/ angle of a polygon (triangle/ quadrilateral) and error estimation.
4. To give Layout for given plan of building.
5. To study of various components of total station and measuring horizontal angle, vertical angle, horizontal distance and slope distance.
6. To Form a Closed Traverse of about 1km periphery and Find the Area of a piece of land Using Total Station.
7. Measurement of Height (Remote elevation measurement- REM) by Total Station.
8. Fixing of missing pillars (or) Setting out (or) Stake out using Total Station.
9. Preparation of contour maps of given area drawn on the sheet / surfer software using total station.
10. Traverse computation using appropriate softwares like Autoplotter.
11. Mapping using handheld GPS.
12. Use of DGPS for drawing a map of roads covering an area of about 5 sq. kms.

Advances in Welding & Casting	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-3	MEE-334T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Study of various metal casting and joining processes.
2.	To understand the effects of design considerations on the quality of cast and weld products. And Thermal and fluid transfer mechanism during these processes.
3.	To understand the NDT techniques for the evaluation of cast and weld components and Control of parameters for sound casting and welding.
4.	To acquire the knowledge of Metallurgical effects of casting and joining and application of welding in Heavy Engineering and nuclear industries.

Course Outcomes (CO)

CO 1	Discriminate the knowledge of principles, operations and applications of different casting and welding processes.
CO 2	Analyse the effects of design parameters on the quality of cast and weld products.
CO 3	Select the NDT techniques for the evaluation of cast and weld components.
CO 4	Apply the knowledge of welding in Heavy Engineering nuclear industries.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Gating system for casting, Elements of a gating system, Sprue, Sprue base well, Gates, Gating System Design, pouring time, Choke area, Gating Ratios, In-gate design, Slag Trap Systems, Risering Design, Caine's Method, Modulus Method, Naval Research Lab Method, Chills, Feeding aids. Simple numerical problems on all topics

UNIT – II

Solidification of Metals, freezing of a pure Metal, Nucleation and Growth, Shrinkage, freezing of alloys, Thermal characteristics of the mould, casting defects, gas defects, pouring metal defects, Metallurgical defects. Castability of steel, Cast Iron, Al alloys, Babbit alloy and Cu alloy, Simple numerical problems. Recent Trends in Casting and Foundry Layout:

Shell molding, Stir Casting, CO2 molding, die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry –– Computer aided design of casting.

UNIT – III

Basic Metallurgy of fusion welds, general theory of solidification of metals and alloys, homogeneous and heterogeneous nucleation, Effect of welding speed on grain structure, properties of weld metals, fusion boundary zone, heat affected zone, properties of heat affected zone, Hydrogen embrittlement – Lamellar tearing Welding stress and distortion and its control, residual stress, causes and remedies of residual stress, effect of weld thermal cycle and shrinkage on residual stresses, Reaction stresses, stresses generated by phase transformation, Measurement and calculation of residual stresses in weld metals.

UNIT – IV

Weldability of steels, cast iron, stainless steel, aluminium, Mg, Cu, Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels–l. Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects –, Methods of Pre-heating, Weld inspection and Testing, residual inspection, NDT testing.
Recent trends in welding: Friction welding, explosive welding – diffusion bonding – high frequency induction welding - narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

Text Books:

1. P.N.Rao, “Manufacturing Technology”, Vol.1, TATA Mc Graw Hill.
2. R.S.Parmar, “Welding Engineering and Technology”, Khanna Publication.

Reference Books:

1. Carrry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002.
2. Jain P.L., Principles of Foundry Technology, Tata McGraw Hill Publishers, 2003.

Advances in Welding & Casting Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-3	MEE-334P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Advances in Welding & Casting) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study the effect of sand permeability for three sand-bind mixing ratios, 20, 25 and 30%.
2. Study the strength of the green sand moulding for the given three sand-bind mixing Ratios Moisture percent kept the same for all experimental tests.
3. To assess the finger casting fluidity of short arid long freezing range aluminium alloys.
4. Shrinkage behaviour during permanent mould casting by studying the pipe formation in a cast metal ingot in 3 different conditions.
5. Make a part using investment casting process to understand various steps involved
6. Perform and write the effect of heat affected zone (HAZ) on the microstructure and properties of steel weldment. (Plot hardness vs distance for various processes) with SMAW, MAG and TIG welded steel.
7. To prepare a butt joint with mild steel strips using brazing technique.
8. To compare the welding strength of single V joint of mild steel specimens with SMAW and MIG/TIG welding processes.

AI in Robotics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	RA-EAE	RA-EAE-5	RA-441T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To expose the students to Artificial Intelligence and Robotics
2.	To impart knowledge on search methods
3.	To expose the students on robot kinematics
4.	To impart knowledge on expert systems

Course Outcomes (CO)

CO 1	Ability to understand the basic fundamental of artificial intelligence and components of robot system
CO 2	Ability to apply the search methods and to apply the basic concepts of robot kinematics to find position of robot joints
CO 3	Ability to analyze the robot sensor
CO 4	Ability to evaluate the expert system

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	-	-	-	-	-	-	2	-	3
CO 2	3	3	2	-	-	2	-	-	2	2	-	3
CO 3	3	3	2	3	-	2	-	-	2	3	2	3
CO 4	3	3	3	3	-	2	2	2	2	3	2	3

Unit-I

Introduction to Artificial Intelligence: Introduction to Artificial Intelligence. Applications- Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems. AI techniques-search knowledge, abstraction. Introduction – History, Definition of AI, Emulation of human cognitive process,

Unit-II

Search Methods: Problem – Solving Agents : Problem Definitions, Formulating Problems, Searching for solutions – Measuring Problem – Solving Performance with examples. Search Strategies : Uninformed search strategies – Breadth – first Search, Uniform – Cost Search, depth –first search, depth – limited search, Iterative deepening depth – first search, bidirectional search, comparing uniformed search strategies. Informed search strategies – Heuristic information, Hill climbing methods, best – first search, branch and – bound search, optimal search and A* and Iterative deepening A*.

Unit-III

Introduction to Robotics: Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics, Fundamentals of Robotics, Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.

Unit-IV

Expert System: Expert system – Introduction, difference between expert system and conventional programs, basic activities of expert system – Interpretation, Prediction, Diagnosis, Design, Planning, Monitoring, Debugging, Repair, Instruction, Control. Basic aspects of expert system – Acquisition module, Knowledge base – Production rules, semantic net, frames. Inference engine – Backward chaining and forward chaining.
Text & References:

Textbook(s):
1. E. Rich and K. Knight, “Artificial intelligence”, TMH, 2nd ed., 1992.
2. John J. Craig, “Introduction to Robotics”, Addison Wesley Publication

References:
1. Dan.W.Patterson, “Introduction to Artificial Intelligence and Expert Systems”, PHI Learning, 2009.

AI in Robotics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	RA-EAE	RA-EAE-5	RA-441P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (AI in Robotics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of PROLOG
2. Write a program to solve 8 queens problem
3. Solve any problem using depth first search
4. Solve any problem using breadth search
5. Solve 8 puzzle problem using breadth first search
6. Study of different types of robots based on configuration and application.
7. Study of different type of links and joints used in robots
8. Study of components of robots with drive system and end effectors.
9. Determination of maximum and minimum position of links.

Analog and Digital Communications	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	6	PCE	PCE-1	CIE-328T
EEE	6	PCE	PCE-1	EEE-306T
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OECE-419T
OAE	7	ECE-OAE	ECE-OAE-4A	OECE-419T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand and introduce the concepts of communication systems, its channels and understand the handling of noise in communication systems.
2.	To understand the concept of analog communication system and its classification in detail.
3.	To understand the concept of digital communication system and its classification in detail.
4.	To interpret the various digital signalling formats, the multiplexing techniques and information coding methods.

Course Outcomes (CO)

CO 1	Identify and Solve basic random variable and random process-based problems.
CO 2	Identify, Analyze and Comparison of generation and detection circuits of different analog methods
CO 3	Identify, Analyze and Comparison of generation and detection circuits of different digital methods
CO 4	Identify the different signalling formats, multiplexing techniques and basics of information signal theory and its coding.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	1	1	-	-	-	-	-	1	-	3
CO 2	2	2	2	2	2	-	2	-	3	2	2	2
CO 3	1	3	1	3	-	-	-	-	1	1	1	2
CO 4	2	2	2	2	2	-	2	-	2	2	1	2

UNIT I

Introduction: Overview of Communication system, Types and Modes of Communication System, Frequency Spectrum of EM Waves, Mathematical Models for Communication Channels, Shannon-Hartley Law.
Introduction of random Variables: Probability, Concept of Random variable (Stationary, Non stationary), Classification of Random process(WSS, SSS), CDF, PDF, Joint CDF, Joint PDF, marginal PDF, Mean, Moments, Central Moment, Auto-correlation & Cross-correlation, covariance functions, ergodicity, Uniform distribution ,Gaussian distribution, Rayleigh distribution, Exponential Distribution, Binomial distribution, Poisson distribution, Wiener-Khinchine theorem, Power spectral density.

UNIT II

Amplitude Modulation: Need for modulation, AM: modulation and demodulation, DSB-SC: Modulation and demodulation, SSB: modulation and demodulation, VSB: modulation and demodulation, Power relation, modulation index, Bandwidth efficiency.
Angle Modulation Systems: Frequency Modulation, Types of Frequency Modulation, Generation of NBFM, WBFM, Transmission BW of FM (NBFM, WBFM), Phase Modulation, Comparison of AM, FM & PM.
Pulse Analog Modulation: Sampling-Ideal, Natural and Flat Top, Aliasing, Aperture Effect, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM)- Generation and Recovery.

UNIT III

Pulse Digital Modulation: Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), ADPCM.
Digital Modulation and Transmission: Advantages of digital communication. Modulation & Detection of ASK, FSK, & PSK, Comparison.

UNIT IV

Line coding: Unipolar, Polar and Bipolar (AMI) NRZ & RZ, Manchester encoding, Differential Manchester encoding, High density bipolar code, Binary with n-zero substitution codes.
Multiplexing: Time Division Multiplexing and Frequency Division Multiplexing
Information and Coding Theory: Entropy, Information, Channel Capacity, Source Coding Theorem: Shannon Fano Coding, Huffman Coding.

Textbook(s):
1. George Kennedy, “Electronics Communication System”, 5th Edition, 2012
2. B.P. Lathi, “Modern Digital & Analog & Communication Systems”, Oxford University Press 2011.
3. John G. Proakis & Masoud Salehi, “Communication System Engineering”, Pearson Education.

Reference Books:
1. Simon Haykins, “Communication Systems”, John Wiley, 5th Edition, 2013
2. Taub Schilling, “Principles of Communication Systems” TMH, 3rd Edition, 2008
3. Bernard Sklar, Digital Communications: Fundamentals and Applications, 2nd Edition, Pearson, 2009
4. W. Tomasi, “Electronic Communication systems”, Prentice Hall, 5th Edition, 2003.

Analog and Digital Communications Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	6	PCE	PCE-1	CIE-328P
EEE	6	PCE	PCE-1	EEE-306P
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OECE-419P
OAE	7	ECE-OAE	ECE-OAE-4A	OECE-419P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Analog and Digital Communications) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To perform DSB-FC Modulation & Demodulation.
2. To perform DSB-SC Modulation & Demodulation.
3. To perform SSB-SC Modulation & Demodulation.
4. To perform Frequency Modulation & Demodulation.
5. To perform Signal Sampling and Reconstruction Techniques.
6. To perform Pulse Amplitude Modulation and Demodulation.
7. To perform Pulse Width Modulation and Demodulation.
8. To perform ASK Modulation & Demodulation.
9. To perform PSK Modulation & Demodulation.
10. To perform FSK Modulation & Demodulation.
11. To perform Delta Modulation & Demodulation.
12. To perform different Line Codes – NRZ-L, NRZ-M, RZ, Biphase (Manchester), Biphase (Mark) and AMI.

Analysis and Design of High-rise Buildings and Bridges	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IE-EAE	IE-EAE-5	IE-439

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the concept of High rise buildings
2.	To impart knowledge on the planning and designing aspects of high rise buildings
3.	To expose the students to various types of structural systems that are employed for high rise buildings
4.	To impart knowledge about the special service requirements of high rise buildings

Course Outcomes (CO)

CO 1	The student should be able to sufficiently design a high rise building
CO 2	The students should be able to have sufficient knowledge to suggest appropriate structural systems for high rise buildings.
CO 3	The students should be able to design vertical transportation systems, Water supply systems, Electrical and Communication systems and Fire protection systems
CO 4	To enable student to apply aspects of sustainability in high rise building design

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	-	-	-	3	1	2	-	-	-	-	-	-
CO 2	1	-	-	2	-	3	-	-	-	-	-	-
CO 3	1	-	-	-	2	3	-	-	-	-	-	-
CO 4		-	-	-	1	3		-	-	-	-	2

UNIT-I

Introduction: Definition of High rise in different contexts – need – scope – advantages and disadvantages– History of high-rise structures –ages of high-rise structures -Current tall buildings and their salient features. Types of tall buildings. Various structural systems to be used in tall buildings.

UNIT-II

Design of High-Rise Buildings: High-rise building design approach – planning strategies–Building form – Plan shape efficiencies – Core Planning – Types, Components – Planning strategy for shafts and ducts – Parking strategies. Introduction to IS:16700 Criteria for Structural Safety of Tall Concrete Buildings.

Bridges:Understand the concept and application of FEM for bridge analyses, Use probabilistic methods in design and assessment of bridges, Calculate life-cycle-costs of bridges, Fatigue analysis, Use a commercial FE program to model and analyse bridges in 3D, Bearings and types of bearings, Joints used in bridges, Bridges used in metro construction. Prestressed Bridges.

UNIT-III

Structure Aerodynamics – Structural systems RCC – height vs footprint - Wind load issues – Seismic issues – Materials– foundation. Parameters to check the efficiency of highrise buildings. Various failure case studies of high-rise buildings. Finite Element Method adopted for highrise building. Efficiency of various grids in highrise buildings.

UNIT - IV

Services Vertical transportation –HVAC systems - Water supply transmission & distribution – waste disposal – Firefighting regulations & Strategies - Service Floor – relevant regulations in Indian Context SUSTAINABILITY 8 Building Automation – Green Elements – Passive and Active design – Works of Architects like Ken Yeang, Norman Foster.

Textbook(s):

1. Designing Tall Buildings: Structure as Architecture By Mark Sarkisian
2. Bryan Stafford and Alex Coull, Tall Building Structures, Analysis and Design, John Wiley & Sons, NewYork, 1991

References:

1. Krishna Raju .N, Pre Stressed Concrete, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1988 2.
2. Taranath .B.S, Structural Analysis and Design of Tall Buildings, McGraw Hill, New York, 1988.
3. Bennetts Ian & others – Tall building structural systems.
4. Proceedings of the Council for Tall buildings – Vol 1 to 10 Books – 1997.
5. Handbook on building fire codes by G.B.Menon.

Android App Development	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	OSD-334T
OAE	6	SD-OAE	SD-OAE-2A	OSD-334T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the basics of Android app development.
2.	Design user-friendly and visually appealing interfaces for Android apps.
3.	Implement various features and functionalities in Android applications.
4.	Analyze and debug Android applications.

Course Outcomes (CO)

CO 1	Understand the basics of Android app development, including the Android ecosystem, architecture, and components.
CO 2	Design user-friendly and visually appealing interfaces for Android apps using XML and various user interface components then Implement various features and functionalities in Android applications, such as activities, fragments, services, broadcast receivers, and content providers
CO 3	Debug and test Android applications, ensuring functionality, performance optimization, and adherence to best practices
CO 4	Work collaboratively in teams to develop complex Android applications and showcase their work through a final project

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2	3	2	-	-	-	3	2	2	3
CO 2	3	2	2	3	2	-	-	-	3	2	2	3
CO 3	3	2	2	3	2	-	-	-	3	2	2	3
CO 4	3	2	2	3	2	-	-	-	3	2	2	3

UNIT I

Introduction to Android Development: Introduction to Android ecosystem, History and evolution of Android, Android architecture and components, Setting up the development environment, Introduction to Android Studio. **Java Programming for Android:** Introduction to Java programming language, Variables, data types, and operators, Control structures: loops and conditional statements, Arrays and collections, Object-oriented programming in Java, Handling exceptions

UNIT II

User Interface Design: Introduction to user interface (UI) design for mobile apps, Building layouts using XML, User interface components: views, widgets, and layouts, Handling user input and events, Creating interactive and responsive UIs. **Android App Components:** Activities: lifecycle, intents, and activity navigation, Fragments: creating reusable UI components, Services: background processing and long-running tasks, Broadcast receivers: responding to system-wide events, Content providers: accessing and sharing data between apps

UNIT III

Data Storage and Retrieval: Saving and retrieving data using shared preferences, Working with databases: SQLite and Room, Using web services: RESTful APIs and JSON parsing, Accessing device sensors and hardware features. **Multimedia and Location Services:** Working with images and multimedia in Android, Using the camera and gallery, Integrating location-based services, Google Maps integration

UNIT IV

Application Deployment and Testing: Debugging and testing Android applications, Performance optimization and best practices, Deploying apps to the Google Play Store, App monetization strategies

Text Books:
1. "Android Application Development Cookbook - Second Edition" by Rick Boyer.
2. "Professional Android Application Development" by Reto Meier.
3. "Learning Android: Develop Mobile Apps Using Java and Eclipse" by Marko Gargenta.

Reference Books:
1. "Head First Android Development" by Dawn Griffiths and David Griffiths
2. "Android Programming: The Big Nerd Ranch Guide" by Bill Phillips and Brian Hardy
3. "Android Programming" by C. K. Velmurugan

Android App Development Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	OSD-334P
OAE	6	SD-OAE	SD-OAE-2A	OSD-334P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Android App Development) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Experiment 1: Setting Up the Development Environment

- Install and configure Android Studio.
- Create a new Android project.
- Familiarize yourself with the project structure.

Experiment 2: Building a Basic User Interface

- Design a simple user interface using XML.
- Add various user interface components, such as buttons, text fields, and images.
- Implement event handling for user interactions.

Experiment 3: Creating Activities and Navigating Between Screens

- Create multiple activities within an app.
- Implement navigation between activities using intents.
- Pass data between activities using intent extras.

Experiment 4: Implementing Fragments

- Create fragments to represent reusable UI components.
- Integrate fragments into activities.
- Manage fragment transactions and backstack.

Experiment 5: Implementing Services and Broadcast Receivers

- Implement a background service for performing a long-running task.
- Register and receive broadcasts using broadcast receivers.
- Communicate between services, broadcast receivers, and activities.

Experiment 6: Implementing Data Storage and Retrieval

- Use shared preferences for saving and retrieving data.
- Implement SQLite database for data persistence.
- Fetch data from web services and parse JSON responses.

Experiment 7: Integrating Multimedia and Location Services

- Capture and display images using the camera and gallery.
- Implement audio and video playback in the app.
- Integrate location-based services and display maps.

Experiment 8: Testing and Debugging Android Apps

- Use debugging tools in Android Studio to identify and fix issues.
- Perform unit testing to ensure app functionality.
- Optimize app performance using profiling tools.

Experiment 9: Deploying Android Apps

- Create a signed APK for deployment.
- Install and run the app on physical devices and emulators.
- Publish the app to the Google Play Store.

Experiment 10: Team Project

- Collaborate in a team to develop a complete Android app.
- Plan and document the project requirements, design, and implementation.
- Present the final app and demonstrate its functionality.

Antenna Design and Radiating Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-2	ECE-330T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge of the antenna basics, matching techniques and broadband antenna
2.	To design various microstrip lines and various patch antennas.
3.	To discuss the concept of antenna array.
4.	To study the antenna measurements

Course Outcomes (CO)

CO 1	Understand the basics of antenna parameters, radiation fields and matching networks.
CO 2	Analyze the designing of microstrip lines and microstrip patch antenna.
CO 3	Understand the concept of antenna array
CO 4	Perform measurements of the various antenna parameters.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	2	3	1	3	2	1	2
CO 2	3	2	2	2	3	2	2	2	2	3	3	2
CO 3	3	3	3	2	2	3	2	2	3	3	1	1
CO 4	2	2	3	3	3	2	2	2	3	3	2	1

UNIT-I

ANTENNA FUNDAMENTALS: Antenna parameters, Radiation potentials and Auxiliary potential functions, Fields radiated by an alternating current element and half wave dipole, monopole, loop antenna: Total power radiated and radiation resistance. Broadband antennas and matching techniques: balun and quarter wave transformer, polarization states, Introduction to various simulation tool for antenna design.

Unit-II

Analysis and Design of Microstrip Line and Microstrip Patch Antenna: Transmission Line and cavity model of rectangular patch, Design of various microstrip lines, Design of rectangular patch and circular patch, triangular patch antenna. Design of arrays and feed networks. Design of broad band antennas

Unit III

Antenna Array Theory: Array synthesis of linear elements, Linear and Planar arrays, Active and passive beam scanning, Excitation techniques in Array, synthesis of antenna arrays using Schelkunoff polynomial method, Fourier-transform method, and Woodward-Lawson method.

Unit IV

Antenna Measurements: Measurements of radiation pattern, Antenna Gain, Power, Half power Beam Width (HPBW,) Impedance and antenna factor. Experimentation of antenna parameters using Microwave test bench, anechoic chamber and VNA.

Text Books:

1. E.C. Jordan and Balmain, "Electromagnetic Waves and Radiating Systems", PHI, 1968, Reprint 2003.
2. C. A. Balanis, “ Antenna theory, analysis and design”, 3rd Edition, Wiley-publications

Reference books:

1. R. Garg, P. Bhartia, I. Bhel and A. Ittipiboon, “Microstrip antenna design handbook” Artech House Publication.
2. Girish Kumar, K. P. Ray, “Broadband Microstrip antennas”, Artech House publications
3. John D.Kraus and Ronald J. Marhefka, "Antennas for all applications", 3 rd Edition Tata McGraw-Hill Book Company, 2006.

Antenna Design and Radiating Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-2	ECE-330P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Antenna Design and Radiating Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To design a half wave dipole antenna.
2. To design a microstrip feed line with different characteristic impedances.
3. To design rectangular patch antennas using different feed lines.
4. To design rectangular patch antennas using different feed lines.
5. To design a broad band microstrip patch antenna.
6. To design a circularly polarized microstrip patch antenna.
7. To design a rectangular microstrip antenna array.
8. To design a circular microstrip antenna array.
9. To design a microstrip patch antenna with electronic band gap (EBG) structure.
10. To design a slotted / fractal microstrip patch antenna.
11. To design a triangular microstrip patch antenna.

Note: These experiments may be performed using simulation software like HFSS, CST or IE3D (for planar circuits) etc.

Arc GIS and Remote Sensing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	7	PCE	PCE-4	CEE-405T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understanding map projection and working with coordinate systems
2.	Understanding vector-based and raster-based data data analysis,
3.	Review of application areas of GIS in Civil Engineering,
4.	Understanding basic principles of remote sensing.

Course Outcomes (CO)

CO 1	Apply the concept of physics to the solution of complex engineering problems of Remote sensing and GIS world.
CO 2	Classify different types of data systems for complex engineering problems considering accuracy and economic factors.
CO 3	Categorise the information into a geo reference system that meets the specified needs with appropriate considerations.
CO 4	Design new or alternate solution of complex Remote sensing, GIS and GPS problems considering societal and environmental contexts.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	-	3	1	2	1	-	-	-	-	-	-
CO 2	-	2	3	1	1	2	-	-	-	-	-	-
CO 3	-	2	3	1	2	1	-	-	-	-	-	-
CO 4	2	3	2	1	2	1	-	-	-	-	-	-

UNIT-I

Introduction, concepts and physical basis of Remote Sensing, Electromagnetic spectrum, radiation laws, atmospheric effects, image characteristics. Remote sensing systems; sources of remote sensing information, spectral quantities spectral signatures and characteristics spectral reflectance curves for rocks, soil, vegetation and water.

UNIT-II

Optical, thermal and microwave sensors and their resolution, salient features of some of operating Remote Sensing satellites, Digital image processing; introduction, image rectification and restoration, image enhancement, manipulation, image classification, fusion.

Introduction to Aerial and space borne platforms. Global positioning system (GPS) photogrammetry – analog, analytical and digital photogrammetry, height and plan metric

UNIT-III

GIS system : Definition terminology and data types, Map projection and Coordinate system, basic components of GIS software, data models, data acquisition, both raster based and vector based data input and data processing and management including topology, overlaying and integration and finally data product and report generation, principle of cartography and cartographic design. GIS customization concepts, approaches of Multi-criteria decision making, concepts and applications of Geostatistics.

UNIT-IV

Application of Geo-spatial technology in Civil Engineering, assessment of cyclones, rainfall, atmospheric humidity etc., weather analysis, forecasting and modelling.Land use, inventory and monitoring, urban planning, snow and glaciers, coastal zone management, air and water pollution, commercially available remote sensing and GIS software.

Textbook(s):

1. Chang K.T., “Introduction to Geographic Information System”, Tata McGraw Hill Education (P) Ltd.,
2. John R.Jensen, “Remote Sensing of the Environment”, Pearson Education

References:

1. Clarke K.C., Parks B.O., Crane M.P., “GIS and Environmental Modeling”, PHI Learning (P) Ltd., ND
2. Lillesand T.M. and Kiefer R.W, “Remote Sensing and Image Interpretation”, John Wiley and Sons, NY
3. Lo C.P. and Yeung A.K.W., “Concept and Techniques of Geographic Information Systems”, PHI
4. Chakraborty D. and Sahoo R.N., “Fundamentals of Geographic Information System”, Viva Books, ND.
5. Joseph G., “Fundamentals of Remote Sensing”, University Press (India) Ltd., Hyderabad.
6. L.R.A. Narayan, “Remote Sensing and its Applications”, University Press.

Arc GIS and Remote Sensing Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	7	PCE	PCE-4	CEE-405P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Arc GIS and Remote Sensing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to basics of digital images and Data (Vector and Raster).
2. Interpretation of satellite images.
3. Understanding the basic principles of Photogrammetry.
4. An introduction to image classification.
5. Interpreting RADAR images.
6. Extracting information from thermal remote sensing data.
7. Using GIS Software for plotting points, lines, polygons on maps.
8. Application of GIS Software in Map making.
9. Calculate Geometry by using GIS Software.
10. Overlay analysis by using GIS software.

Artificial Intelligence	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-3	CIE-374T
ECE	6	PCE	PCE-1	ECE-318T
CSE-AI/CSE-AIML	6	PC	PC	AI-302T
EAE	6	AI-EAE	AI-EAE-1	AI-302T
EAE	6	AIML-EAE	AIML-EAE-1	AI-302T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the definition and basic knowledge of Artificial Intelligence.
2.	To introduces AI by examining the nature of the difficult problems.
3.	To understand with AI demonstration that intelligence requires ability to find reason.
4.	To understand the latest techniques and the future scope of the technology.

Course Outcomes (CO)

CO 1	Ability to use AI methods and control strategies to solve the problems.
CO 2	Understand the production system and its applications. Also, to understand the properties and applications for the different search algorithms.
CO 3	Applying the different algorithms and the techniques, also analyse the reason for the results.
CO 4	Study the expert systems and the modern approaches.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	3	2	2	-	-	-	-	2
CO 2	3	3	3	3	3	2	2	-	-	-	-	2
CO 3	3	3	3	3	3	2	2	-	-	-	-	2
CO 4	3	3	3	3	3	2	2	-	-	-	-	2

UNIT-I

AI Definition, Problems, The Foundations of Artificial Intelligence, Techniques, Models, Defining Problem as a state space search, production system, Intelligent Agents: Agents and Environments, Characteristics, Search methods and issues in the design of search problems.

UNIT-II

Knowledge representation issues, mapping, frame problem. Predicate logic, facts in logic, representing instance and Isa relationship, Resolution, procedural and declarative knowledge, matching, control knowledge. Symbolic reasoning under uncertainty, Non monotonic reasoning, statistical reasoning.

UNIT-III

Game Playing, minimax search, Alfa beta cut-offs, Natural Language Processing, Learning, Explanation-based learning, discovery, analogy, Neural net learning and Genetic Learning.

UNIT - IV

Fuzzy logic systems, Perception and action, Expert systems, Inference in Bayesian Networks, K-means Clustering Algorithm, Machine learning.

Textbook(s):
1. Elaine Rich, Kevin Knight, and Shivashankar B Nair, “Artificial Intelligence”, Tata McGraw Hill.
2. S. Russel and P. Norvig, “Artificial Intelligence: A Modern Approach”, Pearson Edu.

References:
1. Deepak Khemani, “A First Choice in Artificial Intelligence”, McGraw Hill.
2. K M Fu, “Neural Networks in Computer Intelligence”, McGraw Hill.

Artificial Intelligence Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-3	CIE-374P
ECE	6	PCE	PCE-1	ECE-318P
CSE-AI/CSE-AIML	6	PC	PC	AI-302P
EAE	6	AI-EAE	AI-EAE-1	AI-302P
EAE	6	AIML-EAE	AIML-EAE-1	AI-302P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Artificial Intelligence) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of PROLOG.
2. Write simple fact for the statements using PROLOG
   a. Ram likes mango.
   b. Seema is a girl.
   c. Bill likes Cindy.
   d. Rose is red.
   e. John owns gold.
3. Write predicates, one converts centigrade temperatures to Fahrenheit, the other checksif a temperature is below freezing using PROLOG.
4. Write a program to implement Breath First Search Traversal.
5. Write a program to implement Water Jug Problem.
6. Write a program to remove punctuations from the given string.
7. Write a program to sort the sentence in alphabetical order.
8. Write a program to implement Hangman game using python.
9. Write a program to implement Hangman game.
10. Write a program to implement Tic-Tac-Toe game.
11. Write a program to remove stop words for a given passage from a text file using NLTK.
12. Write a program to implement stemming for a given sentence using NLTK.
13. Write a program to POS (part of speech) tagging for the give sentence using NLTK.
14. Write a program to implement Lemmatization using NLTK.
15. Write a program for Text Classification for the given sentence using NLTK.

Artificial Intelligence and Machine Learning	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	6	PC	PC	AI-316T
EAE	6	DS-EAE	DS-EAE-2	AI-316T
MAE	7	OAE-MAE	OAE-1	MAO-431T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To acquire knowledge on intelligent systems and agents
2.	Learn the methods of solving problems using Artificial Intelligence
3.	To understand fundamental concepts of machine learning and learning techniques
4.	To understand various Machine learning algorithms related to classification and prediction

Course Outcomes (CO)

CO 1	Understand intelligent agents, search techniques and apply various problem-solving strategies to common AI applications
CO 2	Apply propositional logic and first order logic in reasoning
CO 3	Understand basic concepts of machine learning, its goals and applications.
CO 4	Analyse supervised learning techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	2	-	-	-	-	2
CO 2	3	3	3	3	3	2	2	-	-	-	-	2
CO 3	3	3	3	3	3	2	2	-	-	-	-	2
CO 4	3	3	3	3	3	2	2	-	-	-	-	2

UNIT-I

Artificial Intelligence: Introduction to intelligent agents, Problem solving: Problem formulation, uninformed search strategies, heuristics, informed search strategies, constraint satisfaction Solving problems by searching, state space formulation, depth first and breadth first search, iterative deepening

UNIT-II

Logical Reasoning : Logical agents , propositional logic, inferences ,first-order logic, inferences in first order logic, forward chaining, backward chaining, unification, resolution

UNIT-III

Machine Learning: Introduction, Basic concepts: Definition of learning systems, Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation.
Types of Learning: Supervised learning and unsupervised learning. Overview of classification: setup, training, test, validation dataset, over fitting.
Classification Families: linear discriminative, non-linear discriminative, decision trees, probabilistic (conditional and generative), nearest neighbor.

UNIT-IV

Logistic regression, Perceptron, Exponential family, Generative learning algorithms, Gaussian discriminant analysis, Naive Bayes, Support vector machines: Optimal hyper plane, Kernels. Model selection and feature selection. Combining classifiers: Bagging, boosting (The Ada boost algorithm), Evaluating and debugging learning algorithms, Classification errors.

Textbook(s):
1. Rich and Knight, “Artificial Intelligence”, Tata McGraw Hill, 1992
2. Tom M Mitchell, Machine Learning, McGraw Hill Education

References:
1. S. Russel and P. Norvig, “Artificial Intelligence — A Modern Approach”, Second Edition, Pearson Edu
2. Introduction to Machine Learning - Ethem Alpaydin, MIT Press, Prentice hall of India.

Artificial Intelligence and Machine Learning Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	6	PC	PC	AI-316P
EAE	6	DS-EAE	DS-EAE-2	AI-316P
MAE	7	OAE-MAE	OAE-1	MAO-431P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Artificial Intelligence and Machine Learning) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to implement Breath First Search Traversal.
2. Write a program to implement Water Jug Problem
3. Write a program in Python to predict the class of the flower based on available attributes.
4. Write a program in Python to predict if a loan will get approved or not.
5. Write a program to implement Hangman game using python.
6. Write a program in Python to indentify the tweets which are hate tweets and which are not.
7. Write a program to POS (part of speech) tagging for the given sentence using NLTK
8. Write a Program to implement HR Analytics on Employee Attrition & Performance using Random Forest Classifier
9. Write a program for face detection using machine learning
10. Write a program to show the concept of Ensemble Technique
11. Write a program for Text Classification for the given sentence using NLTK

Artificial Intelligence and Machine Learning for Electrical Systems	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-1	EEE-308

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To analyse basic concepts of probability and linear algebra
2.	To understand various aspects of self-learning.
3.	To implement AI in real time electrical based problems
4.	To create automatic systems in electrical engineering using ML

Course Outcomes (CO)

CO 1	Analyse basic concepts of probability and linear algebra
CO 2	Understand various aspects of self-learning systems
CO 3	Implement AI in real time electrical based problems
CO 4	Create electrical based automatic systems using ML.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	3	1	1	1	1	2	2	1
CO 2	3	3	3	3	3	1	1	1	1	3	3	1
CO 3	3	3	3	3	3	2	2	1	3	3	3	3
CO 4	2	3	3	3	3	3	2	1	3	3	3	3

UNIT I

Basic Familiarity: Familiarity with the basic probability theory, Familiarity with the basic linear algebra.

UNIT II

Supervised Learning: Generative/discriminative learning, parametric/non-parametric learning, neural networks, support vector machines.
Unsupervised Learning: clustering, dimensionality reduction, kernel methods.

UNIT III

Recent applications of AI and ML: Speed Control of Motor, Smart Grid Using Machine Learning, Battery Management, Home Automation, Fault Detection, Solar Power Plant, Control System.

UNIT IV

Recent applications of machine learning: Robotic control, data mining, autonomous navigation, bioinformatics, speech and text recognition, Autonomous Vehicle.

Textbook(s):

1. Rich and Knight, “Artificial Intelligence”, Tata McGraw Hill, 1992
2. Tom M Mitchell, Machine Learning, McGraw Hill Education
3. The Elements of Statistical Learning Data Mining, Inference, and Prediction, Trevor Hastie, Robert Tibshirani Jerome Friedman.

References:

1. S. Russel and P. Norvig, “Artificial Intelligence — A Modern Approach”, Second Edition, Pearson Edu
2. Introduction to Machine Learning - Ethem Alpaydin, MIT Press, Prentice hall of India.
3. Machine Learning A Probabilistic Perspective, Kevin P. Murphy
4. Computer Vision: Algorithms and Applications Richard Szeliski, 2010 Springer.

Artificial Intelligence Applications	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI	7	PC	PC	AI-403T
EAE	7	AI-EAE	AI-EAE-4	AI-403T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To acquire knowledge on intelligent systems and agents
2.	To understand fundamental concepts of machine learning and learning techniques
3.	To understand the fundamental concepts and techniques of natural language processing (NLP)
4.	Familiarize with soft computing concepts, introduce and use the idea of Neural networks, fuzzy logic and use of heuristics based on human experience

Course Outcomes (CO)

CO 1	Understand intelligent agents, search techniques and apply various problem solving strategies to common AI applications
CO 2	Understand basic concepts of machine learning, its goals and applications.
CO 3	Understand the algorithmic approach to NLP
CO 4	Understand basic principles, techniques, and applications of soft computing

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	2	-	-	-	-	2
CO 2	3	3	3	3	3	2	2	-	-	-	-	2
CO 3	3	3	3	3	3	2	2	-	-	-	-	2
CO 4	3	3	3	3	3	2	2	-	-	-	-	2

UNIT-I

Introduction: Introduction to intelligent agents
Problem solving: Problem formulation, uninformed search strategies, heuristics, informed search strategies, constraint satisfaction Solving problems by searching, state space formulation, depth first and breadth first search, iterative deepening

UNIT-II

Basic concepts: Definition of learning systems, Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation.
Types **of Learning:** Supervised learning and unsupervised learning. Overview of classification: setup, training, test, validation dataset, over fitting.

Classification Families: linear discriminative, non-linear discriminative, decision trees, probabilistic (conditional and generative), nearest neighbor

UNIT-III

Introduction to NLP: Characteristics of Natural Language, Language structure, Sentence Structure, Language analyzer, Lexicon, word formation, Morphology, syntax analysis (parsing), semantics, ambiguity, pragmatics and discourse

UNIT-IV

Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, Neural Computing, Fuzzy Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, Various applications of Soft Computing.

Textbook(s):

1. Rich and Knight, “Artificial Intelligence”, Tata McGraw Hill, 1992
2. Tom M Mitchell, Machine Learning, McGraw Hill Education
3. Chaitanya, Vineet, Rajeev Sangal, and AksharBharati. “Natural language processing: A Paninian perspective”. Prentice-Hall of India, 1996.
4. S.N.Sivanandam, S.N.Deepa, “Principles of Soft Computing “, Wiley India, 2007

References:

1. S. Russel and P. Norvig, “Artificial Intelligence — A Modern Approach”, Second Edition, Pearson Edu
2. Introduction to Machine Learning - Ethem Alpaydin, MIT Press, Prentice hall of India.
3. Syal, Pushpinder, and DharamVir Jindal. “An introduction to linguistics: Language, grammar and semantics” PHI Learning Pvt. Ltd., 2007.
4. S. Rajasekaran, G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2003.

Artificial Intelligence Applications Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI	7	PC	PC	AI-403P
EAE	7	AI-EAE	AI-EAE-4	AI-403P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Artificial Intelligence Applications) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to implement Breath First Search Traversal.
2. Write a program to implement Water Jug Problem.
3. Write a program to solve the Monkey Banana problem using PROLOG.
4. Write a program to remove stop words for a given passage from a text file using NLTK.
5. Write a program to POS (part of speech) tagging for the give sentence using NLTK.
6. Write a program to implement Lemmatization using NLTK.
7. Write a program for Text Classification for the given sentence using NLTK.
8. Program to demonstrate Simple Linear Regression
9. Program to demonstrate k-Nearest Neighbor flowers classification
10. Program to demonstrate Naïve- Bayes Classifier
11. Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform maxmin composition on any two fuzzy relations.
12. Solve Greg Viot's fuzzy cruise controller using MATLAB Fuzzy logic toolbox.
13. Solve Air Conditioner Controller using MATLAB Fuzzy logic toolbox.

Artificial Neural Networks	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI	6	PC	PC	ML-350T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Impart the knowledge of neural network, models of neuron and knowledge representation
2.	Analyse single layer and multi layer perceptrons and also describe application areas of each of them.
3.	Understand the importance of back propagation and self organization maps.
4.	Describe neuro dynamics and Hopfiled models.

Course Outcomes (CO)

CO 1	Compare the similarity between of Biological networks and Neural networks
CO 2	Perform the training of neural networks using various learning rules.
CO 3	Describe the concepts of forward and backward propagations
CO 4	Analyze and construct Hopfield Models

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	3	-	2	2	-	-	-	3	-	-
CO 2	-	3	2	3	2	-	-	3	-	-	-	-
CO 3	3	2	3	3	-	2	-	-	-	-	-	-
CO 4	-	3	3	2	-	-	-	-	-	-	-	-

UNIT-I

Introduction: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks
Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process

UNIT-II

Single Layer Perceptrons: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment
Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

UNIT-III

Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning

UNIT – IV

Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification
Neuro Dynamics: Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm Hopfield Models – Hopfield Models, Computer Experiment

Textbook(s):
1. Introduction to Artificial Neural Systems by Jacek M.Zurada. Jaico Publ.House.
2. Neural networks in Computer intelligence, Li Min Fu TMH 2003.

References:
1. "Neural Networks :A Comprehensive formulation", Simon Haykin, 1998, AW
2. "Neural Network Fundamentals" – N.K. Bose , P. Liang, 2002, T.M.H

Artificial Neural Networks Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI	6	PC	PC	ML-350P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Artificial Neural Networks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Setting up the Spyder IDE Environment and Executing a Python Program
2. Implementation of different activation function to train ANN.
3. Implementation of different learning rules.
4. Implementation of Perceptron Networks.
5. Program to calculate output in a multi-layer feed forward network.
6. How the Perceptron Learning rule works for Linearly Separable Problem.
7. How the Perceptron Learning rule works for Non-Linearly Separable Problem.
8. Program to train a neural network to classify two clusters in a 2-dimensional space
9. Make Predictions with k-nearest neighbors on the Iris Flowers Dataset
10. Installing Keras, Tensorflow and Pytorch libraries and making use of them

Artificial Neural Networks and Deep Learning

L	P	C
3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	SC-EAE	SC-EAE-2	ML-348T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the foundations of Artificial Neural Networks
2.	To acquire the knowledge on Deep Learning concepts
3.	To learn various types of Artificial Neural Networks
4.	To gain knowledge to apply optimization strategies

Course Outcomes (CO)

CO 1	Impart the knowledge of neural networks concepts
CO 2	Ability to select the Learning Networks in modelling real world systems
CO 3	Ability to use an efficient algorithm for Deep Models
CO 4	Apply optimization strategies for large scale applications

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2		-	-	3	-	-	3	-	-
CO 2	3	2	2	3	2	3	-	3	-	-	-	-
CO 3	-	-	3	2	-	-	-	-	-	2	3	2
CO 4	-	2	-	-	3	3	-	3	-	2	-	-

UNIT-I

Artificial Neural Networks Introduction, Basic models of ANN, important terminologies, Supervised Learning Networks, Perceptron Networks, Adaptive Linear Neuron, Back-propagation Network. Associative Memory Networks. Training Algorithms for pattern association, BAM and Hopfield Networks.

Unsupervised Learning Network- Introduction, Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter Propagation Networks, Adaptive Resonance Theory Networks. Special Networks-Introduction to various networks.

UNIT-II

Introduction to Deep Learning, Historical Trends in Deep learning, Deep Feed - forward networks, Gradient-Based learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms

UNIT-III

Regularization for Deep Learning: Parameter norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised learning, Multi-task learning, Early Stopping, Parameter Typing and Parameter Sharing, Sparse Representations, Bagging and other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, tangent Prop and Manifold, Tangent Classifier

UNIT – IV

Optimization for Train Deep Models: Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second- Order Methods, Optimization Strategies and Meta-Algorithms
Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing

Textbook(s):
1. Li Min Fu, “Neural Networks in Computer Intelligence”, McGraw-Hill, Inc. 2012.
2. Ian J. Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, 2016.

References:
1. “Neural Networks :A Comprehensive formulation”, Simon Haykin, 1998, AW
2. Deep Learning, Rajiv Chopra, Khanna Book Publication, Delhi 2020

Artificial Neural Networks and Deep Learning Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	SC-EAE	SC-EAE-2	ML-348P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Artificial Neural Networks and Deep Learning) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Setting up the Spyder IDE Environment and Executing a Python Program
2. Installing Keras, Tensorflow and Pytorch libraries and making use of them
3. Implementation of different activation function to train ANN.
4. Implementation of different learning rules.
5. Implementation of Perceptron Networks.
6. Applying the Convolution Neural Network on computer vision problems
7. Image classification on MNIST dataset (CNN model with Fully connected layer)
8. Applying the Deep Learning Models in the field of Natural Language Processing
9. Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU notes
10. Applying the Autoencoder algorithms for encoding the real-world data
11. Applying Generative Adversial Networks for image generation and unsupervised tasks.

Automation in Manufacturing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-4	MEE-411T
MAE	7	OAE-MAE	OAE-1	MAO-415T
OAE	7	ME-OAE	ME-OAE-5	OME-443T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about the fundamental concepts, the necessary knowledge and the basic skills related to automated manufacturing systems.
2.	To understand the techniques of Machine Tool Automation and NC systems.
3.	To understand working principle of different CNC Machine Tools.
4.	To provide an introduction to Robotics and Automation including robot classification, design and selection, analysis and applications in industry.

Course Outcomes (CO)

CO 1	To Provides theoretical and practical aspects of implementing automation in industry.
CO 2	To Understand the basic procedures and concepts of programming, set up and operation of a CNC Machining Centre.
CO 3	To Identify and define the functions of the CNC machine control.
CO 4	To understand basic components of robotics, classification of robots and their applications

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	2	-	2
CO 3	3	3	3	3	-	2	-	-	2	2	-	3
CO 4	3	3	3	2	-	3	-	-	2	2	-	3

UNIT-I

Introduction: Concept of Mechanization and Automation; Need philosophy; basic elements; classification of automated manufacturing systems [hard, programmable and flexible automation]; strategies for automation in production systems; on line condition monitoring of automated systems, Level of automation.

Parts handling automation: Basic concepts of chute, magazine, hopper, separator, feeders, ejectors, orienters and transfer machines

UNIT-II

Machine tool automation: Single and multi-spindle automats, Swiss type automats and design of automat for a specific product.

Basic principles of NC system: Components and their functions in NC machines; MCU, DPU and CLU; drives; special motors and screw-nut system; advantages of CNC over NC machines; Basic systems of NC and CNC machines: coordinate system, open loop and closed loop control; absolute and incremental mode.

UNIT-III

CNC machine tools: structure and working principle; examples and use of CNC machines; machining centre (MC) – characteristics and applications; Control of tool–work travel; PTP and Continuous; interpolation – linear and circular

Part programming for NC, CNC and MC systems: Manual part programming: different controllers and codes used; sequential steps of part programming; examples: part programming for machining in CNC lathes [step turning, taper turning, grooving, thread cutting, drilling, boring, facing, contouring etc. and milling [pocketing, island pocketing, grooving, peck drilling

UNIT – IV

Introduction to Robotics: Brief history of robotics; definition of robot; Main components of robot: manipulator, sensors, controller, power conversion unit; Robot geometry: types of joints, workspace, number of degrees of freedom; Common configurations used in arms: rectangular, cylindrical, spherical, joined; Classification of robot according to coordinate system: Cartesian, cylindrical, polar, articulated or jointed; Classification of robots according to control method: non-servo, servo; Robot specifications: payload, accuracy, repeatability resolution, maximum tip speed, reach stroke.

Textbook(s):

1. Automation, Production Systems and CIM–M.P.Groover, Pub- Prentice-Hall of India (P) Ltd.New Delhi
2. Fundamentals of Industrial Automation by V Tergan, I Andreev and B. Liberman, MIR Publisher.

References:

1. CNC Machines by N. K. Tewari, Kundra and P. N. Rao.
2. Introduction to Robotics by J. J. Craig, Addison-Wesley.
3. Computer Control of Manufacturing Systems by Y. Koren, Tata Mc Graw Hill.

Automation in Manufacturing Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-4	MEE-411P
MAE	7	OAE-MAE	OAE-1	MAO-415P
OAE	7	ME-OAE	ME-OAE-5	OME-443P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Automation in Manufacturing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study CNC Lathe and CNC Mill
2. To develop programs on CNC Lathe
3. To develop programs on CNC milling
4. To study working of a Flexible manufacturing system
5. To prepare APT program for the given diagram.
6. To prepare APT program for the given diagram.
7. To study working principle of Robotic Arm.
8. To operate perform Pick and Place task using Robotic Arm

Automobile Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	DT-EAE	DT-EAE-2	DT-316T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the construction and working principle of various parts of an automobile.
2.	To understand the construction and working of clutch, gear box, differential, propeller shaft, joints, etc.
3.	To understand the steering system and suspension system.
4.	To understand the alternative energy sources used as a fuel in automobile.

Course Outcomes (CO)

CO 1	Explain the construction details of chassis, frame, body and I C engine components used in automobile.
CO 2	Understand Transmission system (Clutch, gearbox, differential, etc.) used in automobile.
CO 3	Comprehend various type of steering system and suspension system.
CO 4	Analyze the alternative fuels used in SI and CI engines, and Electric and Hybrid vehicles.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	-	-	3	3	-	2	-	-	3
CO 2	3	3	3	-	-	3	3	-	1	-	-	3
CO 3	3	3	3	-	-	3	3	-	2	-	-	3
CO 4	3	3	3	-	-	3	3	-	2	-	-	3

UNIT-I

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines-components, function and materials, variable valve timing (VVT).
Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

UNIT-II

Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

UNIT-III

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS),electronic brake force distribution (EBD) and traction control.

UNIT - IV

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells.

Textbook(s):

1. Kripal Singh, "Automobile Engineering", 7th ed. Standard Publication, New Delhi, (1997).
2. Jain K.K. and Asthana R.B.," Automobile Engineering", Tata McGraw Hill, New Delhi, (2002).

References:

1. Heisler H., "Advanced Engine Technology", SAE International Publ., USA, (1998).
2. N. K. Giri, "Automobile Mechanics", 5th Edition, Khanna Publishers, (2014).
3. Narang G.B.S., "Automobile Engg.", Khanna Publishers.
4. Srinivasan, "Automotive Engines", Tata McGraw Hill.
5. Heitner J., "Automotive Mechanics", 2nd ed., East-West Press, (1999).

Automobile Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	DT-EAE	DT-EAE-2	DT-316P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Automobile Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To Study and Demonstration of different Automobile Engines (disassemble and assemble of any Engine).
2. To study and demonstration of the Fuels supply systems (Carburetor, Diesel Fuel Injection Systems and Gasoline Fuel Injection Systems.).
3. To study and demonstration of differential used in automobile.
4. To study the constructional details, working principles and operation of the Automotive Clutches.
5. To study the construction details, working principle, operation and demonstration the different types of gearbox used in Automobile.
6. To study and demonstration the different types of Steering Mechanism.
7. To study the constructional details, working principles and operation of the Automotive Suspension Systems.
8. To study the constructional details, working principles and operation of the Automotive Brake systems.
9. To study the constructional details, working principles and operation of the Automotive Tyres & wheels.
10. To Study on advanced technologies (ABS, EBD, VVT and Hybrid).

Automobile Engineering and Electric Vehicles	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-1	MEE-306T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the construction and working principle of various parts of an automobile.
2.	To understand the construction and working of clutch, gear box, differential, propeller shaft, joint, etc.
3.	To understand the steering system and suspension system.
4.	To understand the alternative energy sources used as a fuel in automobile.

Course Outcomes (CO)

CO 1	Explain the construction details of chassis, frame, body and I C engine components used in automobile.
CO 2	Understand Transmission system (Clutch, gearbox, differential, etc.) used in automobile.
CO 3	Comprehend various type of steering system and suspension system.
CO 4	Analyze the alternative fuels used in SI and CI engines, and Electric and Hybrid vehicles.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	-	-	3	3	-	2	-	-	3
CO 2	3	3	3	-	-	3	3	-	1	-	-	3
CO 3	3	3	3	-	-	3	3	-	2	-	-	3
CO 4	3	3	3	-	-	3	3	-	2	-	-	3

UNIT-I

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines-components, function and materials, variable valve timing (VVT).
Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

UNIT-II

Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

UNIT-III

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

UNIT – IV

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells.
Introduction to EVs, Comparison with Internal combustion Engine: Technology, Comparison with Internal combustion Engine: Benefits and Challenges Components of Electric Vehicle, Electric Vehicle Powertrain block diagram.
Battery Energy Storage Batteries in Electric and Hybrid Vehicles: Battery Basics, Battery Parameters, Electrochemical Cell Fundamentals.

Textbook(s):

1. Kripal Singh, "Automobile Engineering", 7th ed. Standard Publication, New Delhi, (1997).
2. Jain K.K. and Asthana R.B.," Automobile Engineering", Tata McGraw Hill, New Delhi, (2002).
3. Iqbal Husain , "Electric and Hybrid Vehicles Design Fundamentals", CRC Press.

References:

1. Heisler H., "Advanced Engine Technology", SAE International Publ., USA, (1998).
2. N. K. Giri, "Automobile Mechanics", 5th Edition, Khanna Publishers, (2014).
3. Narang G.B.S., "Automobile Engg.", Khanna Publishers.
4. Srinivasan, "Automotive Engines", Tata McGraw Hill.
5. Heitner J., "Automotive Mechanics", 2nd ed., East-West Press, (1999).

Automobile Engineering and Electric Vehicles Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-1	MEE-306P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Automobile Engineering and Electric Vehicles) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To Study and Demonstration of different Automobile Engines (disassemble and assemble of any Engine).
2. To study and demonstration of the Fuels supply systems (Carburetor, Diesel Fuel Injection Systems and Gasoline Fuel Injection Systems).
3. To study and demonstration of differential used in automobile.
4. To study the constructional details, working principles and operation of the Automotive Clutches.
5. To study the construction details, working principle, operation and demonstration the different types of gearbox used in Automobile.
6. To study and demonstration the different types of Steering Mechanism.
7. To study the constructional details, working principles and operation of the Automotive Suspension Systems.
8. To study the constructional details, working principles and operation of the Automotive Brake systems.
9. To study the constructional details, working principles and operation of the Automotive Tyres& wheels.
10. To Study on advanced technologies (ABS, EBD, VVT and Hybrid).
11. To study the characterization of power, torque and efficiency for EV over drive cycle.
12. To understand the flow of energy in the power train of EV during various modes of operation i.e. charging, V2G feeding, motoring and braking.
13. To conduct specific gravity test and open voltage test of the given battery used in automobile and find the state of charge.
14. To study the basics of induction motor used in EV’s.

Battery Management Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	EV-EAE	EV-EAE-2	EV-310T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the different types of energy storage system.
2.	To study about the battery characteristic & parameters.
3.	To know the concepts of battery management system and design the battery pack.
4.	To study about the battery testing, disposal and recycling.

Course Outcomes (CO)

CO 1	Discuss about the different types of energy storage system.
CO 2	Describe about the battery characteristic & parameters.
CO 3	Apply the concepts of battery management system and design the battery pack.
CO 4	Explain about the battery testing, disposal and recycling.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zine Chloride battery; Ultra capacitors, General approach to modelling batteries.

UNIT II

Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables tocharacterize battery operating conditions and Specifications to characterize battery nominal and maximumcharacteristics; Efficiency of batteries; Electrical parameters- Heat generation- Battery design- Performancecriteria for Electric vehicles batteries- Vehicle propulsion factors- Power and energy requirements ofbatteries, Meeting battery performance criteria- setting new targets for battery performance.

UNIT III

Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, BatteryState of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface,SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery ManagementSystem: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, BatteryPack Safety, Battery Standards & Tests

UNIT IV

Chemical & structure material properties for cell safety and battery design, battery testing, limitations fortransport and storage of cells and batteries, Recycling, disposal and second use of batteries. Battery Leakage:gas generation in batteries, leakage path, leakage rates. Ruptures: Mechanical stress and pressure tolerance ofcells, safety vents, Explosions: Causes of battery explosions, explosive process, ThermalRunway: Highdischarge rates, Short circuits, charging and discharging. Environment and Human Health impactassessments of batteries, General recycling issues and drivers, methods of recycling of EV batteries.

Textbook(s):

1. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric VehicleBattery Systems", John Wiley& Sons Ltd., 2016.
2. Chris Mi, Abul Masrur& David Wenzhong Gao, "Hybrid electric Vehicle- Principles & Applications with Practical Properties", Wiley, 2011.
3. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric Hybrid Electric and Fuel Cell Vehicles",Taylor& Francis Group, 2010.

Reference Books:

1. G. Pistoia, J.P. Wiaux, S.P. Wolsky, "Used Battery Collection and Recycling", Elsevier, 2001. (ISBN: 0-444-50562-8)
2. Guangjin Zhao, "Reuse and Recycling of Lithium-Ion Power Batteries", John Wiley & Sons. 2017. (ISBN: 978-1-1193-2185-9)
3. T R Crompton, "Battery Reference Book", 3rd Edition, Newnes- Reed Educational and ProfessionalPublishing Ltd., 2000.
4. Arno Kwade, Jan Diekmann, "Recycling of Lithium-Ion Batteries: The LithoRec Way", Springer,2018. (ISBN: 978-3-319-70571-2).
5. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2003.

Battery Management Systems Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	EV-EAE	EV-EAE-2	EV-310P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Battery Management Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study the basic parameters of battery.
2. Measure the charging voltage and current of given battery.
3. Demonstrate any charging technique of lead acid battery/ Lithium Ion battery.
4. Demonstrate the discharging process of battery using various values of C-rate and compare it.
5. Simulate battery model of given battery using any simulation tool.
6. Simulation on charging techniques of battery.
7. Study the process of battery testing and measure the parameters of battery.
8. Study and Demonstration of Battery Temperature Measurement (Thermocouple, Thermistor etc)
9. Battery pack design for given EV application (Testing Various series parallel combinations for given application)
10. Case Study: Design, selection, sizing and components of any developed charging station for EV.
11. Visit to any industry/ Research laboratory related to battery and EV.

Big Data Analytics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	7	PC	PC	DS-429T
EAE	7	DS-EAE	DS-EAE-4	DS-429T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the Big Data Platform and its Use cases
2.	Provide HDFS Concepts and Interfacing with HDFS
3.	Provide hands on Hodoop Eco System
4.	Exposure to Data Analytics with R

Course Outcomes (CO)

CO 1	Identify Big Data and its Business Implications
CO 2	List the components of Hadoop and Hadoop Eco-System
CO 3	Develop Big Data Solutions using Hadoop Eco System
CO 4	Manage Job Execution in Hadoop Environment

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	-	-	2	3	-	-	-	1	-	-	-
CO 2	-	2	-	-	-	2	3	-	1	2	-	-
CO 3	-	1	-	-	-	2	-	-	-	2	-	-
CO 4	-	3	-	-	-	2	-	-	-	2	-	-

UNIT-I

Introduction to Big Data: Introduction to Big Data, Big Data characteristics, Challenges of Conventional System, Types of Big Data, Intelligent data analysis, Traditional vs. Big Data business approach, Case Study of Big Data Solutions.

UNIT-II

Hadoop: History of Hadoop, Hadoop Distributed File System: Physical organization of Compte Nodes, Components of Hadoop Analyzing the Data with Hadoop, Scaling Out, Hadoop Streaming, Design of HDFS,Java interfaces to HDFS Basics, Developing a Map Reduce Application, How Map Reduce Works, Anatomy of a Map Reduce Job run, Failures, Job Scheduling, Shuffle and Sort, Task execution, Map Reduce Types and Formats, Map Reduce Features, Hadoop environment. Setting up a Hadoop Cluster, Cluster specification, Cluster Setup and Installation, Hadoop Configuration, security in Hadoop, Administering Hadoop, Monitoring-Maintenance, Hadoop benchmarks, Hadoop in the cloud

UNIT-III

NoSQL: What is NoSQL? NoSQL business drivers; NoSQL case studies; NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns; Using NoSQL to manage big data: What is a big data NoSQL solution? Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; Four ways that NoSQL systems handle big data problems

UNIT – IV

Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive services, HiveQL, Querying Data in Hive, fundamentals of HBase and ZooKeeper, IBM InfoSphere BigInsights and Streams. Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR

Textbook(s):
1. Jiawei Han, Micheline Kamber, Jian Pei, “Data Mining : Concepts and Techniques”, 3rd edition, MK Publisher
2. Tom White “Hadoop: The Definitive Guide” Third Editon, O’reily Media, 2012.

References:
1. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
2. Michael Berthold, David J. Hand, "Intelligent Data Analysis”, Springer, 2007

Big Data Analytics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	7	PC	PC	DS-429P
EAE	7	DS-EAE	DS-EAE-4	DS-429P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Big Data Analytics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files
2. Implement the following file management tasks in Hadoop:
    i. Adding files and directories
    ii. Retrieving files
    iii. Deleting files

    Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities
3. Implement of Matrix Multiplication with Hadoop Map Reduce
4. Write a Map Reduce program that mines weather data. Hint: Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented
5. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
6. Implementation of K-means clustering using Map Reduce.
7. Installation of Hive along with practice examples.
8. Installation of HBase, Installing thrift along with Practice examples
9. Run the Pig Latin Scripts to find Word Count.
10. Run the Pig Latin Scripts to find a max temp for each and every year.

Bio Medical Instrumentation	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-1	EEE-310T
ICE	7	PCE	PCE-4	ICE-407T
OAE	7	ICE-OAE	ICE-OAE-5	OICE-437T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To expose the students to biomedical instrumentation system
2.	To impart knowledge on origin of bioelectric potential and measurement system
3.	To expose the students on the medical imaging system
4.	To impart knowledge on biomedical instruments and their working

Course Outcomes (CO)

CO 1	Ability to understand origin bioelectric potential and construction of biomedical instrumentation system for their measurement
CO 2	Ability to apply measurement principles for measuring human body parameters
CO 3	Ability to analyzeanalog and digital circuits used in biomedical equipments
CO 4	Ability to plan and design computerized critical care unit

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	-	-	-	-	-	-	2	-	3
CO 2	3	3	2	-	-	2	-	-	2	2	-	3
CO 3	3	3	2	3	-	2	-	-	2	2	2	3
CO 4	3	3	3	3	-	2	2	2	2	2	2	3

UNIT I

Biomedical signals & Physiological transducers: Source of biomedical signal, Origin of bioelectric signals, recording electrodes, Electrodes for ECG, EMG &EEG .Physiological transducers: Pressure, Temperature, photoelectric & ultrasound Transducers. Measurement in Respiratory system**:** Physiology of respiratory system, Measurement of breathing mechanics Spiro meter, Respiratory therapy equipments Inhalators ventilators &Respirators , Humidifiers , Nebulizers Aspirators, Biomedical recorders: ECG, EEG & EMG.

UNIT II

Patient Monitoring systems & Audiometers: Cardiac monitor, Bedside patient monitor, measurement of heart rate, blood pressure, temperature , respiration rate, Arrhythmia monitor, Methods of monitoring fatal heart rate, Monitoring labor activity . Audiometers: Audiometers, Blood cell counters, Oximeter, Blood flow meter, cardiac output measurement, Blood gas analyzers.

UNIT III

Modern Imaging systems: Introduction, Basic principle & Block diagram of x-ray machine, x- ray Computed Tomography (CT), Magnetic resonance imaging system (NMR),ultrasonic imaging system. Eco-Cardiograph, Eco Encephalography, Ophthalmic scans, MRI. Therapeutic Equipments: Cardiac pacemakers, cardiac defibrillators, Hemodialysis machine, Surgical diathermy machine.

UNIT IV

Patients safety & Computer Applications in Biomedical field: Precaution, safety codes for electro medical equipment, Electric safety analyzer, Testing of biomedical equipment, Use of microprocessors in medical instruments, Microcontrollers, PC based medical instruments, Computerized Critical care units, Planning & designing a computerized critical care unit. Physiotherapy: Software Diathermy, microwave diathermy, Ultrasound therapy unit. Electrotherapy Equipments, Ventilators.

Text Books:

1. Joseph J. Carr& John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson.
2. Shakti Chatterjee, “Textbook of Biomedical Instrumentation System”, Cengage Learning

Reference Books:

1. R.S.Khandpur, “Hand book of Biomedical Instrumentation”, TMH
2. Walter Welko- Witiz and Sid Doutsch,“Biomedical Instruments: Theory and Design”Wiley
3. Lesile Cromwell, Fred J.Weibell& Erich A. Pfeiffer, “Biomedical Instrumentation & Measurements”, PHI

Bio Medical Instrumentation Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-1	EEE-310P
ICE	7	PCE	PCE-4	ICE-407P
OAE	7	ICE-OAE	ICE-OAE-5	OICE-437P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Bio Medical Instrumentation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study various transducers for biomedical applications
2. To study working principle & measure blood pressure using sphygmomanometer.
3. To study working principle of automatic blood pressure monitor and to measure blood pressure
4. To measure percentage amount of oxygenated arterial blood using oximeter.
5. To record ECG signal using ECG machine.
6. To study working principle & measure body temperature using Digital Thermometer
7. To study working principle of respiration measurement system and measure respiration rate.
8. To study working principle of pacemaker and different operating modes of pacemaker.
9. To study working of EMG machine and hence record EMG signal.

Biometrics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IPCV-EAE	IPCV-EAE-4A	IPCV-453T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the general principles of design of biometric systems and the underlying trade-offs. Personal privacy and security implications of biometrics based identification technology.
2.	To familiarize with Face recognition and Hand Geometry, feature extraction, pattern classification. Authentication Methods and their algorithms
3.	To acquire knowledge about various parameters involved in Iris and Voice recognition. Authentication Methods and their algorithms
4.	Introduction to multimodal Biometric system and its functional blocks and futuristic biometric systems.

Course Outcomes (CO)

CO 1	Demonstrate knowledge engineering principles underlying biometric systems and Finger print feature processing.
CO 2	Face recognition, how to perform Feature Extraction, classification of features, training of algorithm using neural network.
CO 3	To acquire knowledge about various parameters involved in Iris and Voice recognition. Authentication Methods and their algorithms
CO 4	Demonstration of innovative multimodal Biometric system and Statistical Measures of Biometrics

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	2	1	2	1	1	2
CO 2	3	3	3	3	2	2	1	-	2	1	-	2
CO 3	3	3	3	3	2	2	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Introduction to biometrics: Biometric technologies, Passive biometrics, Active biometrics, Biometric systems, Enrolment, Templates, Algorithm, Verification, Authentication technologies, Need for strong authentication, Protecting privacy and policy, Low level Feature Extraction: Edge Detection, phase congruency, localized feature extraction, describing image motion. High Level Extraction: Thresholding and subtraction, Template matching, feature extraction by low level features, Hough transformation.

Fingerprint Technology: History of fingerprint pattern recognition, General description of fingerprints, Finger print feature processing techniques, Fingerprint sensors using RF imaging techniques, Fingerprint quality assessment, Computer enhancement and modelling of fingerprint images, Fingerprint enhancement, Feature extraction, Fingerprint classification, Fingerprint matching

UNIT II

Face recognition & Hand Geometry: Introduction to face recognition, Neural networks for face recognition, Hand geometry, Scanning, Feature Extraction, Adaptive Classifiers, Classification of 3D biometric imaging methods, 3D biometric Technologies, 3D palm print capturing systems, Biometric fusion.
Iris and Voice recognition: Iris scan – Features, Components, Operation (Steps), Competing iris Scan technologies Strength and weakness. Voice Scan – Features, Components, Operation (Steps), Competing voice Scan (facial) technologies–Strength and weakness

UNIT III

Physiological and Behavioural Biometrics: Retina scan – AFIS (Automatic Finger Print Identification Systems) Behavioral biometrics – Signature scan-Keystroke scan biometrics application, Biometric Solution Matrix, Bio privacy, Comparison of privacy factor in different biometrics technologies.
Multimodal Biometrics: Introduction to multimodal Biometric system, Integration strategies – Architecture, Level of fusion –Combination strategy –Training and adaptability – Examples of multimodal biometric systems, Performance evaluation- Statistical Measures of Biometrics: FAR – FRR – FTE – EER – Memory requirement and Allocation

UNIT IV

Biometric Authentication: Biometric Authentication Methods, Biometric Authentication Systems, Biometric authentication by fingerprint, Biometric Authentication by Face Recognition - Expectation-Maximization theory – Support Vector Machines. Biometric authentication by fingerprint –Biometric authentication by hand geometry- Securing and trusting a Biometric transaction – Matching location – local host - authentication server – Match On Card (MOC) – Multi-Biometrics and Two-Factor authentication

Textbook(s):

1. James wayman, Anil k.Jain , Arun A.Ross , Karthik Nandakumar, Introduction to Biometrics, Springer, 2011
2. John Vacca "Biometrics Technologies and Verification Systems" Elsevier 2007
3. James Wayman, Anil Jain, David MAltoni, DasioMaio(Eds) "Biometrics Systems Technology", Design and Performance Evalution.Springer 2005

Reference Books:

1. Haizhou Li, Liyuan Li, Kar-Ann Toh, Advanced Topics in Biometrics, 2012, 1st edition, World Scientific Publisher, Singapore
2. Amine Nail -Ali and Regis Fournier "Signal and Image Processing for Biometrics" John wiley and sons,2012

Biometrics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IPCV-EAE	IPCV-EAE-4A	IPCV-453P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Biometrics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Installation and working on various AI tools such as Python / MATLAB.
2. Implement a face recognition system based on Linear Discriminant Analysis Implementation of anyone classification technique.
3. Implement a face recognition system using Gabor filters to extract features
4. Implementation of different feature extraction methods.
5. Design and Apply Image Acquisition and Feature Extraction for different Iris features
6. Compute the Classification Accuracy of Support Vector Machine & Convolutional Neural Network for a given dataset
7. Employ morphological operators and enhancement methods to the fingerprint images
8. Implement a center point detection algorithm for fingerprint recognition
9. Design and Development of Biometric Recognition and Matching System
10. Design and Apply 3D Biometric palmprint detection and Mobile Biometrics.
11. Develop simple applications for privacy

Bitcoin and Cryptocurrency Technologies	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	BT-EAE	BT-EAE-3	BT-413T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understanding the mechanism of Blockchain and Cryptocurrency
2.	Understanding why current implementations work
3.	Understanding the necessary cryptographic background
4.	Exploring applications of Blockchain to cryptocurrencies and beyond Understanding limitations of current Blockchain

Course Outcomes (CO)

CO 1	Understand the mechanism of Blockchain and Cryptocurrency
CO 2	Explain current implementations work
CO 3	Understand the necessary cryptographic background
CO 4	Explore applications of Blockchain to cryptocurrencies and beyond Understanding limitations of current Blockchain

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	3	3	3	2	2	2	2	1
CO 2	3	3	3	2	3	2	3	1	-	-	1	1
CO 3	3	3	2	2	2	3	3	2	2	2	-	-
CO 4	3	3	2	3	2	3	2	1	1	-	-	1

UNIT-I

Introduction to Cryptography & Cryptocurrencies: Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency.
How Blockchain Achieves & How to Store and Use: Decentralization-Centralization vs. Decentralization-Distributed consensus, Consensus without identity using a block chain, Incentives and proof of work. Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

UNIT-II

Bitcoin as a Platform: Bitcoin as an Append only Log, Bitcoins as "Smart Property", Secure Multi Party Lotteries in Bitcoin, Bitcoin as Public Randomness, Source-Prediction Markets, and Real World Data Feeds
Mechanics of Bitcoin: Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks,

The Bitcoin network, Limitations and improvements.
Bitcoin Mining: The task of Bitcoin miners, Mining Hardware, Energy consumption and ecology, Mining pools, Mining incentives and strategies.

UNIT-III

Bitcoin and Anonymity: Anonymity Basics, How to De-anonymize Bitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash.
Altcoins and the Cryptocurrency Ecosystem: Altcoins: History and Motivation, A Few Altcoins in Detail, Relationship Between Bitcoin and Altcoins, Merge Mining-Atomic Cross chain Swaps-6 Bitcoin Backed Altcoins, "Side Chains", Ethereum and Smart Contracts.

UNIT - IV

Community, Politics, and Regulation: Consensus in Bitcoin, Bitcoin Core Software, Stakeholders: Who's in Charge, Roots of Bitcoin, Governments Notice on Bitcoin, Anti Money Laundering Regulation, New York's BitLicense Proposal.
Recent Trends & applications

Textbook(s):

1. Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Goldfeder, S. (2016).Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press

References:

1. Nicholas Scott, "Bitcoin and Cryptocurrency Trading for Beginners 2021"
2. Antonopoulos, A.M. (2014). Mastering Bitcoin: unlocking digital cryptocurrencies. "O'Reilly Media, Inc.
3. Franco, P. (2014). Understanding Bitcoin: Cryptography, engineering and economics. John Wiley & Sons.

Bitcoin and Cryptocurrency Technologies Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	BT-EAE	BT-EAE-3	BT-413P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Bitcoin and Cryptocurrency Technologies) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Setting up a cryptocurrency wallet and conducting transactions.
2. Simulating cryptocurrency mining and analyzing profitability.
3. Analyzing blockchain network propagation and efficiency.
4. Implementing a simple smart contract on a blockchain platform.
5. Conducting a security audit of a cryptocurrency exchange.
6. Exploring privacy-enhancing techniques in cryptocurrencies.
7. Evaluating scalability solutions for blockchain networks.
8. Understanding compliance and regulatory considerations for cryptocurrencies.
9. Studying and analyzing a decentralized finance (DeFi) application.
10. Collaborating on a group project to develop an innovative cryptocurrency application.

Blockchain for Cyber Security	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	BT-EAE	BT-EAE-5A	BT-417T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the concepts of blockchain in cybersecurity.
2.	Understand cryptography and IAM for blockchain.
3.	Understand the concept of infrastructure security.
4.	Understand the application architecture and incident detection and response.

Course Outcomes (CO)

CO 1	Ability of students to understand the concepts of blockchain in cybersecurity.
CO 2	Ability of students to understand cryptography and IAM for blockchain.
CO 3	Ability of students to understand the concept of infrastructure security.
CO 4	Ability of students to understand the concepts of application architecture and incident detection and response.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	3	3	3	2	2	2	2	1
CO 2	3	3	3	2	3	2	3	1	-	-	1	1
CO 3	3	3	2	2	2	3	3	2	2	2	-	-
CO 4	3	3	2	3	2	3	2	1	1	-	-	1

UNIT-I

Cybersecurity for Blockchain: Introduction, The CIA Triad, The AAA of Security, Non-repudiation, How to Measure Risk?, Blockchain Governance, Types of Blockchains,The Blockchain Trilemma, Quantum Computing, Differences between blockchains.

UNIT-II

Cryptography, Hashing, and Digital Signatures: Introduction Consensus Mechanisms, Hashing, Hash Function, Characteristics, Digital Signatures, Multi-signature, Random Numbers, Prime Numbers, RSA, ECDSA.
IAM for Blockchain: MFA, Authorization and Permission, Permissioned and Permissionless, Node Permissions and ALC, Least Privilege and Segregation of Duties, Password Security,User Authentication.

UNIT-III

Infrastructure Security: Data Encryption, Denial of Service, Man-in-The-Middle Attack, System Resiliency Infrastructure Hardening, Blockchain Node Infrastructure.
Logging and Monitoring: Lodging and Monitoring.

UNIT - IV

Applications Architecture: Applications Architecture, VPCs, NACLs, Testing your Blockchain Application Other Security Practices.
Incident Detection and Response: Incident Detection and Response, Contingency Planning

Textbook(s):

1. Hands-On Cybersecurity with Blockchain: Implement DDoS protection, PKI-based identity, 2FA, and DNS security using Blockchain, Rajneesh Gupta, 2018.
2. Transforming Cybersecurity Solutions Using Blockchain, Springer book series, Rashmi Aggarwal and Neha Gupta (Guest Editors).

References:

1. Mastering ethereum: building smart contracts and dapps Antonopoulos, Andreas M., and Gavin Wood, O'Reilly Media, 2018

Blockchain for Cyber Security Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	BT-EAE	BT-EAE-5A	BT-417P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Blockchain for Cyber Security) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1 Write a program to implement Random Function.

2. Write a program to implement DES and AES algorithm for Encryption and Decryption.

3. Write a program to implement the RSA Algorithm.

4. Write a program to implement MD5 and calculate message digest of a file/image.

5. Write a program to implement SHA-256 and calculate message digest of a file/image.

6. Write a program to check the strength of the password.

7. Creating Merkle tree

8. Creation of Block Week

9: Block chain Implementation Programming code Week 4:

10. Creating ERC20 token

Blockchain Technology	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-ICB/CSE-CS	6	PC	PC	BT-308T
EAE	6	BT-EAE	BT-EAE-2	BT-308T
CSE/IT/CST/ITE	7	PCE	PCE-4	CIE-403T
EAE	7	ICB-EAE	ICB-EAE-5	BT-443T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the fundamental concepts along with cryptographic techniques of blockchain technology and analyze the architecture and components of a blockchain system.
2.	Explore various consensus algorithms and smart contracts employed in blockchain networks
3.	Evaluate the applications and use cases of blockchain technology.
4.	Discuss the challenges and potential future developments in blockchain.

Course Outcomes (CO)

CO 1	To be able to understand fundamental concepts, architecture, components and cryptographic techniques of blockchain technology
CO 2	To be able to understand various consensus algorithms and smart contracts
CO 3	To be able to understand the applications and use cases of blockchain technology.
CO 4	To be able to analyze challenges and potential future developments in blockchain technology.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	2	2	2	3
CO 2	3	2	2	2	3	-	-	-	2	2	2	3
CO 3	3	2	2	2	3	-	-	-	2	2	2	3
CO 4	3	2	2	2	3	-	-	-	2	2	2	3

UNIT I

Introduction to Blockchain Technology: Evolution and history of blockchain, Characteristics and features of blockchain, Blockchain vs. traditional databases. Blockchain Architecture: Distributed ledger technology, Types of Blockchains, Components of a blockchain: blocks, transactions, nodes, Consensus mechanisms. Cryptographic Foundations: Hash functions and digital signatures, Public-key cryptography, Merkle trees and their applications, Zero-knowledge proofs

UNIT II

Consensus Algorithms: Proof of Work (PoW), Proof of Stake (PoS), Practical Byzantine Fault Tolerance (PBFT), Delegated Proof of Stake (DPoS). Smart Contracts: Introduction to smart contracts, Solidity programming language, Ethereum Virtual Machine (EVM), Deploying and executing smart contracts

UNIT III

Blockchain Applications: Cryptocurrencies and digital assets, Supply chain management, Identity management, Healthcare and medical records. Privacy and Security in Blockchain, Privacy-enhancing techniques (e.g., ring signatures, zero-knowledge proofs), Security vulnerabilities and attacks, Auditing and accountability in blockchain systems

UNIT IV

Blockchain Governance and Regulations: Decentralized autonomous organizations (DAOs), Legal and regulatory considerations, Government initiatives and policies. Future Trends and Challenges: Scalability and performance issues, Integration with emerging technologies (e.g., AI, IoT), Sustainability and energy consumption, Industry adoption and standards

Text Books:

1. "Mastering Blockchain" by Imran Bashir
2. “Blockchain Basics: A Non-Technical Introduction in 25 Steps" by Daniel Drescher

Reference Books:

1. "Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations" by Henning Diedrich.

Blockchain Technology Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-ICB/CSE-CS	6	PC	PC	BT-308P
EAE	6	BT-EAE	BT-EAE-2	BT-308P
CSE/IT/CST/ITE	7	PCE	PCE-4	CIE-403P
EAE	7	ICB-EAE	ICB-EAE-5	BT-443P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Blockchain Technology) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Create a Simple Blockchain in any suitable programming language.
2. Use Geth to Implement Private Ethereum Block Chain.
3. Build Hyperledger Fabric Client Application.
4. Create and deploy a block chain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chaincode, and perform invoke and query on your block chain network.
5. Interact with a block chain network. Execute transactions and requests against a block chain network by creating an app to test the network and its rules (https://developer.ibm.com/patterns/interacting-with-a-block chain-network/)
6. Deploy an asset-transfer app using block chain. Learn app development within a Hyperledger Fabric network (https://developer.ibm.com/patterns/deploy-an-asset-transfer-app-using-block chain/)
7. Use block chain to track fitness club rewards Build a web app that uses Hyperledger Fabric to track and trace member rewards
8. Interat with a blockchain network. Execute transactions and requestes against a blockchain network by creatingan app to test the network and its rules.

Blockchain Technology in Web Development	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	BT-EAE	BT-EAE-5B	BT-419T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the fundamental concepts of blockchain technology, including decentralized networks, distributed ledgers, and consensus algorithms
2.	Explain the role of cryptography in blockchain and its importance for secure transactions.
3.	Integrate blockchain technology into web applications and understand the process of interacting with blockchain networks
4.	Design and build decentralized applications (DApps) using blockchain platforms

Course Outcomes (CO)

CO 1	Ability of students to understand the concepts of BlockChain Technology.
CO 2	Ability of students to analyse basics of Cryptography and the importance of secure transactions
CO 3	Ability of students to understand the integration of blockchain technology into web applications
CO 4	Ability of students to design and build decentralized applications using blockchain platforms

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	2	2	2	2	1
CO 2	3	3	3	2	3	2	3	1	-	-	1	1
CO 3	3	3	2	2	2	3	3	2	2	2	-	-
CO 4	3	3	2	3	2	3	2	1	1	-	-	1

UNIT I

Introduction to Blockchain Technology. Understanding decentralized networks and distributed ledgers. Types of blockchain: public, private, and consortium. Cryptography Fundamentals for Blockchain. Hash functions, digital signatures, and encryption techniques. Securing transactions and data using cryptography

UNIT II

Blockchain Architecture and Components- blocks, transactions, and Merkle trees. Consensus mechanisms: proof of work, proof of stake, and others. Blockchain data structures: Merkle Patricia tree, state trie. Smart contracts and their role in blockchain applications. Programming smart contracts using Solidity. Deploying and interacting with smart contracts on a blockchain network

UNIT III

Web Development and Blockchain Integration. Connecting web applications to public or private blockchain networks. Handling transactions and data storage on the blockchain. Understanding the architecture of decentralized applications (DApps). Using blockchain platforms for DApp development (e.g., Ethereum, Hyperledger). Deploying DApp.

UNIT IV

Security vulnerabilities in blockchain applications. Smart contract development. Blockchain Use Cases and Industry Applications. Opportunities and Challenges for blockchain adoption. Integration of blockchain with other technologies (AI, IoT).

Textbooks:

1. Richie Etwaru, “Blockchain Basics: A Practical Approach for Non-Developers”, Wiley,2019.
2. Santiago Palladino, “Ethereum for Web Developers”, Apress Publications, 2018.
3. Narayan Prusty ,“ Building Blockchain Projects”, Packt Publishing, 2017.

Reference Books:

1. Chris Dannen (2017), “Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners”.
2. Mark Gates(2018), “Blockchain: Ultimate guide to understanding blockchain, bitcoin, cryptocurrencies, smart contracts, and the future of money”

Blockchain Technology in Web Development Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	BT-EAE	BT-EAE-5B	BT-419P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Blockchain Technology in Web Development) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Setting up development environments and tools (Ethereum, Hyperledger, etc.)
2. Introduction to Solidity programming language for smart contracts
3. Understanding Solidity syntax and data types
4. Implementing smart contracts for different use cases
5. Writing code to read and write data to the blockchain for handling events and transactions
6. Implementation of Integrating with smart contracts and blockchain networks
7. Build a user interface for DApps using HTML, CSS, and JavaScript
8. Implementing user authentication and authorization in DApps
9. Write the Program to store data on the blockchain using IPFS (InterPlanetary File System)
10. Program for Integrating DApps with existing web applications and APIs

Building Material and Concrete Testing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	5	PC	PC	CEC-353

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Course Objectives:

1.	To understand the building material, characterization and its application
2.	To recognize the importance of material characteristics and their contributions to strength development in Concrete
3.	To identify the suitable material for construction and various building components
4.	To ascertain and measure engineering properties of concrete in fresh and hardened state which meet the requirement of real time structures

Course Outcomes (CO)

CO 1	Assess the different properties of Cement.
CO 2	Determine the different properties of aggregates.
CO 3	Understand the standard testing procedure of bricks, sand, concrete, aggregate, etc
CO 4	Design & describe the preparation of concrete and testing of concrete

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	3	3	2	-	-	3	2	-	2
CO 2	3	3	-	3	3	2	-	-	3	2	-	2
CO 3	3	3	-	3	3	2	-	-	3	2	-	3
CO 4	3	3	-	3	3	2	-	-	3	2	-	3

1. Shape & size, water absorption and compressive strength of brick
2. Normal consistency, initial and final setting time of cement.
3. Fineness and soundness of cement.
4. Heat of hydrations of cement, specific gravity of cement, fine and course aggregates.
5. Sieve analysis and fineness modulus of fine and course aggregates.
6. Water absorption fine and coarse aggregates and impurities tests on aggregates.
7. Compressive strength, workability of lime and cement mortars.
8. Proportioning of aggregates and mix design.
9. Work ability by slump test, compaction factors and Vee-bee consistometer test along with compressive and tensile strength of concrete.
10. Non-destructive tests on concrete (Rebound hammer and UPVT)

Business Intelligence	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	7	PC	PC	DS-431T
EAE	7	DS-EAE	DS-EAE-5A	DS-431T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the basics of business intelligence, business decisions, data warehouses and its architecture, KDD process.
2.	To understand the applications of data mining in business, data mining techniques for CRM, text mining and web mining.
3.	To acquire knowledge in business intelligence, application in various domains and best practice.
4.	To understand the knowledge management, its architecture, approaches and tools.

Course Outcomes (CO)

CO 1	Understand the basics of business intelligence, business decisions, data warehouses and its architecture, KDD process.
CO 2	Understand the applications of data mining in business, data mining techniques for CRM, text mining and web mining.
CO 3	Apply business intelligence in various domains.
CO 4	Understand the knowledge management, its architecture, approaches and tools.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	1	2	-	-	1	-	1	2
CO 2	3	3	3	3	2	2	-	-	1	-	1	2
CO 3	3	3	3	3	2	2	-	-	1	-	1	2
CO 4	3	3	3	3	1	2	-	-	1	-	1	2

UNIT-I

Introduction to business intelligence and business decisions - Data warehouses and its role in Business Intelligence, Creating a corporate data warehouse, Data Warehousing architecture, OLAP vs. OLTP, ETL process, Tools for Data Warehousing, Data Mining, KDD Process

UNIT-II

Applications of Data Mining in Business - Data Mining Techniques for CRM, Text Mining in BI, Web Mining, Mining e-commerce data, Enterprise Information Management, Executive Information Systems

UNIT-III

Business Intelligence, Function, Process, Services & Tools, Application in different domains, Operational BI, Customizing BI, Managing BI projects vs. Traditional IS projects, Managing BI projects, Best Practices in BI Strategy

UNIT - IV

The ten key principle of KM, Knowledge Management Architecture, Knowledge Management Vs. Knowledge Processing, KM approaches, KM Tools, KM Infrastructure, KM models, KM Strategies

Textbook(s):
1 Business Intelligence in the Digital Economy - Opportunities, Limitations and Risks, M.Raisinghani, Idea Group Publications, 2004
2 Knowledge Management and Business Innovation, Yogesh Malhotra, Idea Group, 2001

References:
1. Introduction to Data Mining and its Applications, Sumathy, Sivanandam, Springer Verlag, 2006

Business Intelligence Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	7	PC	PC	DS-431P
EAE	7	DS-EAE	DS-EAE-5A	DS-431P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Business Intelligence) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Import the legacy data from different sources such as (Excel, SqlServer, Oracle etc.) and load in the target system.
2. Perform the Extraction Transformation and Loading (ETL) process to construct the database in the Sqlserver / Power BI.
3. Data Visualization from ETL Process
4. Creating a Data Cubes
5. Apply the what – if Analysis for data visualization. Design and generate necessary reports based on the data warehouse data.
6. Implementation of Classification algorithm.
7. Practical Implementation of Decision Tree
8. Implementation of k-means clustering
9. Prediction Using Linear Regression
10. Data Analysis using Time Series Analysis
11. Data Modelling and Analytics with Pivot Table in Excel
12. Data Analysis and Visualization using Advanced Excel

C#.NET Programming

L	P	C
3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	7	PCE	PCE-5	CIE-417T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn detailed information and knowledge about successfully managing complex IT projects
2.	To learn self-learn and upskill one-self to apply advanced techniques and concepts in managing and completing IT projects
3.	To learn required maturity to manage the information security aspect of IT projects
4.	To learn necessary confidence and experience to predict challenges and risks and address these to prevent impact on project outcomes

Course Outcomes (CO)

CO 1	Understand the concepts of objects and types in C#, including classes, structs, and inheritance.
CO 2	Develop skills in handling errors and exceptions in C#.
CO 3	Learn to manipulate XML using SAX and DOM in C#.
CO 4	Develop skills in using .NET remoting to build distributed applications in C#.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT-I

.Net Architecture - Core C# - Variables - Data Types - Flow control - Objects and Types- Classes and Structs - Inheritance- Generics – Arrays and Tuples - Operators and Casts - Indexers

UNIT-II

Delegates - Lambdas - Lambda Expressions - Events - Event Publisher - Event Listener - Strings and Regular Expressions - Generics - Collections - Memory Management and Pointers - Errors and Exceptions - Reflection

UNIT-III

Diagnostics -Tasks, Threads and Synchronization - .Net Security - Localization - Manipulating XML- SAX and DOM - Manipulating files and the Registry- Transactions - ADO.NET- Peer-to-Peer Networking - PNRP - Building

P2P Applications - Windows Presentation Foundation (WPF).

UNIT – IV

Window based applications - Core ASP.NET- ASP.NET Web forms -Windows Communication Foundation (WCF)-Introduction to Web Services - .Net Remoting - Windows Service - Windows Workflow Foundation (WWF) - Activities – Workflows

Textbook(s):

1. "C# 9.0 in a Nutshell: The Definitive Reference" by Joseph Albahari and Eric Johannsen
2. "Head First C#: A Learner's Guide to Real-World Programming with C#, XAML, and .NET" by Jennifer Greene and Andrew Stellman

References:

1. "Pro C# 9 with .NET 5: Foundational Principles and Practices in Programming" by Andrew Troelsen and Philip Japikse
2. "C# Yellow Book" by Rob Miles
3. "CLR via C#" by Jeffrey Richter
4. "C# in Depth" by Jon Skeet
5. "Professional C# 6 and .NET Core 1.0" by Christian Nagel
6. "Microsoft Visual C# Step by Step" by John Sharp
7. "Pro ASP.NET Core MVC 2" by Adam Freeman
8. "Essential C# 7.0" by Mark Michaelis and Eric Lippert

C#.NET Programming Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	7	PCE	PCE-5	CIE-417P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (C#.NET Programming) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Basic data types and operators: Create a program that prompts the user for their name and age and prints a personalized message.
2. Conditional statements: Create a program that prompts the user for their age and tells them if they can vote in the next election.
3. Loops: Create a program that calculates the factorial of a number entered by the user using a loop.
4. Arrays and lists: Create a program that prompts the user for a list of numbers and then sorts them in ascending order.
5. Strings and string manipulation: Create a program that prompts the user for a string and then prints out the string reversed.
6. Functions and methods: Create a program that defines a function to calculate the area of a circle based on the radius entered by the user.
7. Classes and objects: Create a program that defines a class to represent a car and then creates an object of that class with specific attributes.
8. File input/output: Create a program that reads data from a file and writes it to another file in a different format.
9. Exception handling: Create a program that prompts the user for two numbers and then divides them, handling any exceptions that may arise.
10. Graphical User Interface (GUI) programming: Create a program that uses a graphical user interface to allow the user to perform simple calculations.
11. Multithreading: Create a program that uses multithreading to perform a time-consuming task in the background while the user can continue using the application.
12. LINQ (Language Integrated Query): Create a program that uses LINQ to query and manipulate data from a database.
13. ASP.NET: Create a web application using ASP.NET that allows the user to perform CRUD (Create, Read, Update, Delete) operations on a database.
14. Windows Forms: Create a desktop application using Windows Forms that allows the user to perform CRUD (Create, Read, Update, Delete) operations on a database.
15. WPF (Windows Presentation Foundation): Create a desktop application using WPF that allows the user to perform CRUD (Create, Read, Update, Delete) operations on a database with a modern user interface.

C++ Programming	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	CSE-OAE	CSE-OAE-1A	OCSE-306T
OAE	6	SD-OAE	SD-OAE-1A	OSD-328T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand and use the basic programming constructs of C/C++
2.	Manipulate various C/C++ datatypes, such as arrays, strings, and pointers
3.	Isolate and fix common errors in C++ programs
4.	Apply object-oriented approaches to software problems in C++

Course Outcomes (CO)

CO 1	Understand tokens, expressions, and control structures
CO 2	Explain arrays and strings and create programs using them
CO 3	Describe and use constructors and destructors
CO 4	Understand and employ file management

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1		3	-	-	-	2	-	2	-	-	3	2
CO 2		-	2	-	-	-	2	-	-	3	-	-
CO 3	-	-	-	2	3	-	-	3	-	-	2	-
CO 4	3	-	3	-	-	3	3	-	3	-	-	3

UNIT-I

Review of C, Difference between C and C++, Procedure Oriented and Object Oriented Approach. Basic Concepts: Objects, classes, Principals like Abstraction, Encapsulation, Inheritance and Polymorphism. Dynamic Binding, Message Passing. Characteristics of Object-Oriented Languages. Abstract data types, Object & classes, attributes, methods, C++ class declaration, Local Class and Global Class, State identity and behaviour of an object, Local Object and Global Object, Scope resolution operator, Friend Functions, Inline functions, Constructors and destructors, instantiation of objects, Types of Constructors, Static Class Data, Array of Objects, Constant member functions and Objects, Memory management Operators.

UNIT-II

Inheritance, Types of Inheritance, access modes – public, private & protected, Abstract Classes, Ambiguity resolution using scope resolution operator and Virtual base class, Aggregation, composition vs classification hierarchies, Overriding inheritance methods, Constructors in derived classes, Nesting of Classes.

UNIT-III

Polymorphism, Type of Polymorphism – Compile time and runtime, Function Overloading, Operator Overloading (Unary and Binary) Polymorphism by parameter, Pointer to objects, this pointer, Virtual Functions, pure virtual functions.

UNIT – IV

Manipulating strings, Streams and files handling, formatted and Unformatted Input output. Exception handling, Generic Programming – function template, class Template Standard Template Library: Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterators, Other STL Elements, The Container Classes, General Theory of Operation, Vectors.

Text Books:
1. A.R. Venugopal, Rajkumar, T. Ravishanker "Mastering C++", TMH, 1997
2. Schildt Herbert, "C++: The Complete Reference", Wiley DreamTech, 2005.

References:
1. "Object Oriented Programming with C++" By E. Balagurusamy.
2. R. Lafore, "Object Oriented Programming using C++", BPB Publications, 2004.
3. Parasons, "Object Oriented Programming with C++", BPB Publication, 1999.
4. Steven C. Lawlor, "The Art of Programming Computer Science with C++", Vikas Publication, 2002.
5. Yashwant Kanethkar, "Object Oriented Programming using C++", BPB, 2004

C++ Programming Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	CSE-OAE	CSE-OAE-1A	OCSE-306P
OAE	6	SD-OAE	SD-OAE-1A	OSD-328P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (C++ Programming) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program for multiplication of two matrices using OOP.
2. Write a program to perform addition of two complex numbers using constructor overloading.
   The first constructor which takes no argument is used to create objects which are not initialized, second which takes one argument is used to initialize real and imag parts to equal values and third which takes two argument is used to initialized real and imag to two different values.
3. Write a program to find the greater of two given numbers in two different classes using friend function.
4. Implement a class string containing the following functions:
   a. Overload + operator to carry out the concatenation of strings.
   b. Overload = operator to carry out string copy.
   c. Overload <= operator to carry out the comparison of strings.
   d. Function to display the length of a string.
   e. Function tolower( ) to convert upper case letters to lower case.
   f. Function toupper( ) to convert lower case letters to upper case.
5. Create a class called LIST with two pure virtual function store() and retrieve().To store a value call store and to retrieve call retrieve function. Derive two classes stack and queue from it and override store and retrieve.
6. Write a program to define the function template for calculating the square of given numbers with different data types.
7. Write a program to demonstrate the use of special functions, constructor and destructor in the class template. The program is used to find the bigger of two entered numbers.
8. Write a program to perform the deletion of white spaces such as horizontal tab, vertical tab, space, line feed new line and carriage return from a text file and store the contents of the file without the white spaces on another file.
9. Write a program to read the class object of student info such as name , age ,sex ,height and weight from the keyboard and to store them on a specified file using read() and write() functions. Again the same file is opened for reading and displaying the contents of the file on the screen.
10. Write a program to raise an exception if any attempt is made to refer to an element whose index is beyond the array size.

CAD/CAM	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	6	PC	PC	MAC-312

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Impart knowledge of computer-aided design (CAD) techniques.
2.	Impart knowledge of computer-aided manufacturing (CAM) techniques.
3.	Develop programming and operating skills for computer numerical control (CNC) machines.
4.	Enable students understand various stages of product development and their management.

Course Outcomes (CO)

CO 1	Understanding the scope and need of computer aided design & manufacturing and computer numeric technology.
CO 2	Applying the techniques to generate solid model and curves
CO 3	Develop the Skills to program the Computer Numerical Control of Machine Tools
CO 4	Apply the concepts of Automated Material Handling Systems and Advanced Manufacturing Systems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	1	3	2	1	2	2	2	2	3
CO 2	3	3	3	3	3	1	1	1	2	3	3	3
CO 3	3	2	2	3	3	2	1	2	3	3	3	3
CO 4	3	2	3	1	3	2	2	2	3	3	3	3

UNIT- I

Introduction: Definition and scope of CAD/CAM, Introduction to design process and role of computers in the design process.

Mapping of Geometric Models: Translation, Rotational, General, Changes of Coordinate System, Numerical problems. Three Dimensional Transformations: Point representations, Transformation Matrices, Scaling, Translation, Rotation, Reflection.

Curves: Representation of Space Curves, Cubic Spline, Normalized Cubic Splines, Bezier Curves, B-spline Curves, Numerical problems. Surface Generation: Plane Surfaces, Ruled Surfaces, Surface of Revolution, Sweep Surface, Bezier Surface, Cubic Surface Patch, B-Spline Surface, Composite Surface, Numerical problem.

UNIT II

Solid modeling: Solid models, Fundamentals of solid modeling, Different solid representation schemes, Half - spaces, Boundary representation (B-rep), Constructive solid geometry (CSG), Sweep representation,

Perspective, Parallel projection, Hidden line removal algorithms.
CAD/CAM Data Exchange Formats: Types of file formats & their exchange, Graphics standards.

UNIT III

Need of NC technology, Fundamental concepts in numeric control: structure and functions of NC System, advantages of NC technology over conventional manufacturing.
NC Machine Tools: Types, Definition and designation of control axes,Special constructional and design characteristics of NC machine tools, Standard tooling used for NC turning and milling centres. NC Part Programming: Work holding and tool setting procedure for NC turning and milling centres, Tool zero presetting, Block formats and introduction to ISO based G & M codes for NC part programming, Concepts of tool length and radius compensation, Standard canned cycles used in CNC turning and milling centres, Introduction to automatic NC part program generation from CAD models using standard CAD/CAM software for machining of surfaces, moulds and dies etc.

UNIT IV

Computer Numerical Control of Machine Tools: Types and functions of computer numeric control (CNC), Types and functions of direct numeric control (DNC), Need of adaptive control types, functions and types of adaptive control, its uses & benefits, Advantages of combined CNC/DNC systems.
Automated Material Handling Systems and Advanced Manufacturing Systems: Industrial Robots, Conveyors, AGVs, Automatic Storage and Retrieval Systems; Lean Manufacturing Systems.

Textbook(s):
1. Ibrahim Zeid, CAD/CAM Theory and Practice, Tata McGraw-Hill Publishing Company Limited. 2nd Edition.
2. S.K. Sinha, CNC Programming, Galgotia Publications 2003.
3. David F. Rogers and J. Alan Adams, Mathematical Elements for Computer Graphics, Prentice Hall India
4. T.K. Kundra, P. N.Rao&N.K.Tiwari, Numerical Control and Computer Aided Manufacturing,TMH

References:
1. Mikell P. Groover, Emory W.Zimmers, “CAD/CAM”, Pearson Education, 2001.
2. P.N. Rao, “CAD/CAM Principles and Applications”, Tata McGraw Hill, 2003.

CAD/CAM Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	6	PC	PC	MAC-358

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (CAD/CAM) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the characteristic features of CNC machine.
2. Part programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine.
3. Part programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine.
4. Part programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine.
5. Experiment on Robot and programs.
6. Experiment on Transfer Line/Material Handling.
7. Experiment on study of system devices such as motors and feedback devices.
8. Experiment on Mechatronics and Controls.
9. Experiment based on CAD part of the syllabus.

Cellular and Mobile Communication	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	WMC-EAE	WMC-EAE-2	WMC-338T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To know the evolution of Mobile communication and cell concept to improve capacity of the system
2.	To study fading mechanism and types of fading and effect of fading on Mobile communication.
3.	To know the types of channel coding techniques, data transmission modes and services of GSM
4.	To know the types of channel coding techniques, data transmission modes and services of CDMA

Course Outcomes (CO)

CO 1	Demonstrate knowledge on cellular concepts like frequency reuse, fading, equalization, GSM, CDMA
CO 2	Demonstrate knowledge hand-off and interface and apply the concept to calculate link budget using path loss model
CO 3	Apply the concept of GSM in real time applications
CO 4	Compare different multiple access techniques in mobile communication.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	1	2	3	3	2	2	-	2	2	3	3
CO 2	3	1	2	2	2	2	3	-	3	2	2	3
CO 3	3	3	3	2	3	2	3	-	2	2	3	2
CO 4	3	3	3	3	3	3	2	-	2	3	3	2

UNIT I

Basic Cellular System – Cellular communication infrastructure: Cells – Clusters – Cell Splitting – Frequency reuse concept and reuse distance calculation – Cellular system components – Operations of cellular systems – Handoff/Handover – Channel assignment – Fixed and dynamic – Cellular interferences: Co-Channel and adjacent channel and sectorization.

UNIT II

Large Scale Fading: Free space propagation model, Three basic propagation mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical link budget using path loss models.
Small Scale Fading: Multipath Propagation, Types of small-scale fading, Parameters of Mobile Multipath channels, fading effects due to multipath time delay Spread and Doppler spread**.**

UNIT III

Air Interface – GSM Physical Layer: Logical channels, Physical channels, Synchronization- Frequency and clock synchronization, Adaptive frame synchronization, Mapping of logical onto physical channels, Radio subsystem link control.

GSM Protocols: Protocol architecture planes, Protocol architecture of the user plane, Protocol architecture of the signaling plane, Signaling at the air interface (Um), Signaling at the A and Abis interfaces, Signaling at the user interface.

UNIT IV

GSM Roaming Scenarios and Handover: Handover, Services: Classical GSM services, Popular GSM services: SMS and MMS.Improved data services in GSM: GPRS, HSCSD and EDGE GPRS System architecture of GPRS, Services, Session management, mobility management and routing.
Introduction to CDMA: CDMA frequency bands, CDMA Network and System Architecture.

Textbook(s):
1. Theodore S. Rappaport, “Wireless Communications Principles and Practice”, Second Edition, 2002.
2. Gottapu Sasibhushana Rao, “Mobile Cellular Communication” Pearson Education, 2012.

Reference Books:
1. Kamilo Feher - Wireless Digital Communications, PHI, 2003
2. W.C.Y. Lee - Mobile Cellular Communications, 2nd Edition, MC Graw Hill, 1995.
3. Yi-Bing Lin - Wireless and Mobile Network Architectures, 2nd Edition, Wiley, 2008.

Cellular and Mobile Communication Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	WMC-EAE	WMC-EAE-2	WMC-338P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Cellular and Mobile Communication) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Computer Simulation and MATLAB.
2. Propagation Models and Path Loss Estimation in Cellular Mobile Communication.
3. Outdoor Propagation using Okumura Model and Hata Model.
4. Estimation of Received Bit Energy for Data Rates in Wireless Communication.
5. Multipath Fading in Cellular Mobile Communication.
6. Power-Delay Profile and Doppler Spectrum for Channel Classification in Cellular Mobile Communication.
7. Design of Cellular Mobile System.
8. Estimation of Bit Error Probability of Modulation Schemes
9. Radio Resource Allocations and Scheduling in Cellular Mobile Communication
10. Design of Inland Digital Microwave Link
11. Design of Satellite Link
12. Free Space Propagation – Path Loss Model

Cloud Computing and Security	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-CS	6	PC	PC	CS-316T
CSE-NET	7	PC	PC	NET-473T
EAE	7	NET-EAE	NET-EAE-4	NET-473T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Provides an in-depth understanding of cloud computing “concepts”, architectures, and services that underlie today's cloud computing technologies.
2.	To develop cloud computing model and understand the need for different types of securities.
3.	To create efficient Cloud-based Secure Software Systems for Low Latency, Fault Tolerance, High Availability and Performance
4.	To globally deploy security on the Cloud serving millions of users, billions of requests & petabytes of data.

Course Outcomes (CO)

CO 1	Explain cloud computing concept, architecture, security issues & challenges.
CO 2	Analyse the need for infrastructure security in a cloud environment and apply it in compute, memory and storage levels.
CO 3	Explain different types of security on large datasets over cloud platforms. Analyse the security issues on SPI infrastructure and explain the need for secure encryption.
CO 4	Explain the role of application security, data security & infrastructure security in cloud.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	2	2	1	1	1	1	1	1	1	2
CO 2	2	3	2	3	3	2	2	1	2	1	2	3
CO 3	2	3	2	3	3	2	2	1	2	1	2	3
CO 4	2	3	2	3	3	2	2	1	2	1	2	3

UNIT I

Introduction & Identity and Access Management: Introduction of Cloud and Cloud Concepts, Cloud Architecture, Service Models and Design, Cloud Security Concepts, Legal, Compliance & Industry Standards, Security Challenges, Introduction to Federated Identity Management: SAML & OAuth, identify security holes in their cloud account's IAM service, Principle of least privilege access, Discover and protect various secrets related to cloud service authentication.

UNIT II

Cloud Infrastructure Security: On-prem to Cloud Migration security considerations (Hybrid cloud) -During Migration, during integration, Cloud Configuration & Patch Management, Cloud Change management, Securing Compute and Storage, Cloud Infrastructure Audit (Intro, Audit, Best Practice).

UNIT III

Cloud Data Security: Data Protection (rest, at transit, in use), Data Information lifecycle, Cloud Data Security Foundational Strategies, Encryption (Egress monitoring, Masking, Obfuscation, Anonymization & tokenization, Key management), Near-time data, Real time data, Batch processing, Cloud Data Audit (Intro, Audit, Best Practice) Cloud Key Management Audit (Intro, Audit, Best Practice).

UNIT IV

Cloud Application Security: Cloud Application Challenges &Development Basics, Cloud applications access to resource, Common Pitfalls & Vulnerabilities, Cloud Software Assurance and Validation, Secure Software Development Lifecycle (SDLC), OWSAP Top 10, DevSecOps.

Textbooks:

1. Tim Mather, S. Kumaraswamy and S. Latif, “Cloud Security and Privacy: An EnterprisePerspective on Risks and Compliance”, O’Reilly Media, 2009
2. Ronald L. Krutz Russell Dean Vines “Cloud Security: A Comprehensive Guide to SecureCloud Computing”, Wiley ,2010

References:

1. **Mastering AWS Security** by Albert Anthony.
2. Practical Cloud Security: A Guide for Secure Design and Deployment by Chris Dotson
3. CSA Guide to Cloud Computing: Implementing Cloud Privacy and Security 1st Edition by Raj Samani (Author), Jim Reavis (Author), Brian Honan (Author).

Cloud Computing and Security Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
CSE-CS	6	PC	PC	CS-316P
CSE-NET	7	PC	PC	NET-473P
EAE	7	NET-EAE	NET-EAE-4	NET-473P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Cloud Computing and Security) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Install Virtual box /VMware Workstation with different flavours of Linux or Windows OS on top of Windows 7 or 8.
2. Install a C Compiler in virtual machine create using virtual box & execute simple programs
3. Install google app engine. Create hello world app & other simple web application using Python/ Java.
4. Use GAE Launcher to launch the web application.
5. Simulate a cloud scenario using CloudSim & run a scheduling algorithm that is not present in Cloud Sim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version).
8. Install Hadoop single node cluster & simple applications like word count.
9. To learn and use version control systems & To develop web applications in cloud.
10. To learn the design and development process involved in creating a cloud based application

CMOS Analog Integrated Circuit Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-338T
EAE	7	VLSI-EAE	VLSI-EAE-3	VLSI-443T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of basic MOS device Physics, low and high frequency analog MOSFET modelling.
2.	To provide the concepts of Single Stage and Differential amplifiers and their analysis.
3.	To provide the concepts of active and passive current mirrors, large signal analysis, small signal analysis and frequency response of amplifiers.
4.	To provide the concepts of feedback circuits, their topologies, operational amplifier and oscillators.

Course Outcomes (CO)

CO 1	To understand the basics of MOS device and its low and high frequency modelling.
CO 2	To understand the concepts of Single Stage and Differential amplifiers and their analysis
CO 3	To understand the concepts current mirrors, large signal analysis, small signal analysis and frequency response of amplifiers.
CO 4	To understand the concepts of feedback circuits, their topologies, operational amplifier and oscillators

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	3	3	2	2	2	-	1	2	2	3
CO 2	3	2	3	3	3	2	2	-	1	2	2	3
CO 3	3	2	3	3	3	2	2	-	1	2	2	3
CO 4	3	2	3	3	3	2	2	-	1	2	2	3

UNIT-I

Introduction: Analog integrated circuit design, Circuit design consideration for MOS challenges in analog circuit design, Recent trends in analog VLSI circuits.

Basic MOS Device Physics. Analog MOSFET modeling: MOS transistor, Low frequency MOSFET model, High frequency MOSFET model, temperature effect in MOSFET and Noise in MOSFET.

UNIT-II

Single Stage Amplifier: Basic concept, Introduction to CS, CD, CG Amplifiers, analysis of CS amplifier with (resistive load, diode connected load, current source load, triode load, source degeneration), Analysis of Source Follower (CD amplifier), analysis of CG amplifier, analysis of cascode stage and folded cascode.

Differential amplifiers: Single ended and differential operation, basic differential pair, common mode response.

UNIT-III

Passive and active current mirrors: Basic current mirrors, cascade current mirrors, active current mirrors; large signal analysis, small signal analysis, common mode properties.
Frequency Response of amplifiers: General consideration: Association of Poles with Nodes, Miller Effect and Miller's Theorem and its dual Frequency Response of CS stage, source follower, common gate stage, cascade stage. Frequency Response of Differential Amplifier ,

UNIT - IV

Feedback: Properties of Feedback Circuits, Feedback Topologies.
Operational amplifier: one-stage and two- stage Op Amps, gain boosting, comparison, Common-Mode Feedback, Input Range Limitations, Slew Rate. Bandgap references, **Oscillators:** Ring oscillator, LC oscillator, voltage controlled oscillator.

Textbook(s):

1. Design of Analog CMOS Integrated Circuits" by Behzad Razavi; Tata McGraw-Hill.
2. CMOS analog Circuit Design by Allen Holberg, Oxford University Press.

References:

1. Analog Integrated Circuit Design by David A. Johns and Ken Martin John Wiley & Son.
2. R. J. Baker, H. W. Li, and D. E. Boyce , " CMOS circuit design, layout, and simulation", Wiley-IEEE Press,2007.

CMOS Analog Integrated Circuit Design Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-338P
EAE	7	VLSI-EAE	VLSI-EAE-3	VLSI-443P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (CMOS Analog Integrated Circuit Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Cadence Virtuoso full custom design flow.
2. To design and study the Characteristics of MOS transistors.
3. To design and study inverter in CMOS configuration..
4. To study and design CS amplifier using resistive load and diode connected load.
5. To study and design CS amplifier using current source load and triode load.
6. To study and design CS amplifier as source degeneration.
7. To design and analyze source follower (Common Drain) amplifier.
8. To design and analyze Common Gate amplifier.
9. To design and analyze Cascode amplifier using ideal current source and PMOS current source.
10. To design and analyze Basic current mirror and Cascode current mirror.
11. To design and analyze differential amplifier using current mirror.
12. To design and analyze Ring Oscillator circuit.

CMOS Digital Circuits Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	VLSI-EAE	VLSI-EAE-4	VLSI-445T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide the concepts of VLSI Design flow, basics of MOS device, CMOS Inverter, Circuit Characterization and Performance Estimation, BiCMOS logic.
2.	To provide the concepts of Switching characteristics, Clocking Strategies, combinational and Clocked sequential circuits.
3.	To provide the concepts of Subsystem designing and Semiconductor Memories.
4.	To provide the concepts of FSM, digital phase-locked loop (DPLL), adiabatic logic circuits and Field Programmable Devices.

Course Outcomes (CO)

CO 1	To understand the concepts of VLSI Design flow, basics of MOS device, CMOS Inverter, Circuit Characterization and Performance Estimation, BiCMOS logic.
CO 2	To understand the concepts of Switching characteristics, Clocking Strategies, combinational and Clocked sequential circuits.
CO 3	To understand the concepts of Subsystem designing and Semiconductor Memories.
CO 4	To understand the concepts of FSM, digital phase-locked loop (DPLL), adiabatic logic circuits and Field Programmable Devices.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	3	2	3	2	2	-	1	2	2	2
CO 2	2	2	3	3	3	2	2	-	1	2	2	3
CO 3	2	2	3	3	3	2	2	-	1	2	2	3
CO 4	2	2	3	3	3	2	2	-	1	2	2	3

UNIT-I

VLSI Design flow, Design Hierarchy, Regularity, Modularity and Locality. VLSI design styles, Design quality, Packaging technology. MOS device design equations, second order effects, the complementary CMOS Inverter DC characteristics, Circuit Characterization and Performance Estimation: Parasitic effect in Integrated Circuits, Resistance estimation. Capacitance estimation, Inductance. BiCMOS logic gates, super-buffers.

UNIT-II

Switching characteristics, CMOS - Gate transistor sizing. Power dissipation, CMOS Logic Structures, Clocking

Strategies, CMOS Process Enhancement & Layout Considerations: Interconnect circuit elements. Stick diagram, Layout design rules, Latch up, Technology related CAD issues. Multiplexer, code converters.

Clocked sequential circuits-two phase clocking, charge storage, dynamic register element, dynamic shift register.

UNIT-III

Subsystem design: Subsystem design process, Design of ALU subsystem, Adders, Multipliers, barrel and logarithmic shifters.

Semiconductor Memories: Dynamic Random Access Memories (DRAM), Static RAM, non-volatile memories, flash memories, low-power memory.

UNIT – IV

Finite State Machine (FSM), digital phase-locked loop (DPLL), adiabatic logic circuits

Field Programmable Devices: Definitions of Relevant Terminology, Evolution of Programmable Logic Devices, User-Programmable Switch Technologies. Computer Aided Design (CAD) Flow for FPDs, Programmable Logic, Programmable Logic Structures, Programmable Interconnect. Reprogrammable Gate Array, Commercially Available SPLDs, CPLDs and FPGAs, Gate Array Design, Sea-of-Gates.

Textbook(s):

1. Design of Analog CMOS Integrated Circuits” by Behzad Razavi; Tata McGraw-Hill.
2. CMOS analog Circuit Design by Allen Holberg, Oxford University Press.
3. Introduction to VLSI Circuits and Systems, John P. Uyemura John Wiley & Sons.

References:

1. Analog Integrated Circuit Design by David A. Johns and Ken Martin John Wiley & Son.
2. R. J. Baker, H. W. Li, and D. E. Boyce, "CMOS circuit design, layout, and simulation", Wiley-IEEE Press,2007.

CMOS Digital Circuits Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	VLSI-EAE	VLSI-EAE-4	VLSI-445P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (CMOS Digital Circuits Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the MOS characteristics and introduction to tanner EDA software tools.
2. To design and study the transient and DC characteristics of CMOS inverter.
3. To design and study ALU.
4. To design and study the characteristics of CMOS Full adder.
5. To design and study the characteristics of CMOS multiplexer.
6. To design and study the code converters.
7. To design any Boolean function using transmission gates.
8. To design and study the transient characteristics of CMOS XOR/XNOR.
9. To design and study the characteristics of Multiplier circuit.
10. To design and study the characteristics of CMOS D- Flip Flop.
11. To design and study the characteristics of CMOS J-K Flip Flop.
12. To design study 3- bit counter.

CMOS Mixed Signal Circuit Design	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	VLSI-EAE	VLSI-EAE-5A	VLSI-447

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide the concepts of CMOS comparator, analog multiplier design, Phase Locked Loop and Delay locked loop circuits.
2.	To provide the concepts of Sampling Circuits and Sample-and-Hold Architectures.
3.	To provide the concepts of D/A and A/D Converter Architectures
4.	To provide the concepts of Integrator Based Filters and Filtering topologies - bilinear transfer function and bi-quadratic transfer function.

Course Outcomes (CO)

CO 1	To understand the concepts of CMOS comparator, analog multiplier design, Phase Locked Loop and Delay locked loop circuits.
CO 2	To understand the concepts of Sampling Circuits and Sample-and-Hold Architectures.
CO 3	To understand the concepts of D/A and A/D Converter Architectures.
CO 4	To understand the concepts of Integrator Based Filters and Filtering topologies - bilinear transfer function and bi-quadratic transfer function.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	3	3	3	2	3	-	2	2	2	3
CO 2	3	2	3	3	3	2	3	-	2	2	2	3
CO 3	3	2	3	3	3	2	3	-	2	2	2	3
CO 4	3	2	3	3	3	2	3	-	2	2	2	3

UNIT-I

Phase Locked Loop: Characterization of a comparator, basic CMOS comparator design, analog multiplier design, simple PLL, charge-pump PLL, Non-ideal effects in PLL, Delay locked loop, applications of PLL.

UNIT-II

Sampling Circuits: Basic sampling circuits for analog signal sampling, performance metrics of sampling circuits, different types of sampling switches.

Sample-and-Hold Architectures- Open-loop & closed-loop architectures, open-loop architecture with miller capacitance, multiplexed-input architectures, recycling architecture, switched capacitor architecture, current-mode architecture.

UNIT-III

D/A Converter Architectures: Input/output characteristics of an ideal D/A converter, performance metrics of D/A converter, D/A converter in terms of voltage, current, and charge division or multiplication, switching functions to generate an analog output corresponding to a digital input. Resistor-Ladder architectures, Current steering architectures.

A/D Converter Architectures: Input/output characteristics and quantization error of an A/D converter, performance metrics of pipelined architectures, Successive approximation architectures, and interleaved architectures.

UNIT – IV

Integrator Based Filters: Low Pass filters, active RC integrators, MOSFET-C integrators, trans-conductance-c integrator, discrete time integrators. Filtering topologies - bilinear transfer function and bi-quadratic transfer function.

Textbook(s):

1. Design of Analog CMOS Integrated Circuits" by Behzad Razavi; Tata McGraw-Hill.
2. Baker, Li, Boyce, "CMOS: Circuit Design, layout and Simulation", PHI, 2000.

References:

1. Analog Integrated Circuit Design by David A. Johns and Ken Martin John Wiley & Son.
2. R. J. Baker, H. W. Li, and D. E. Boyce , " CMOS circuit design, layout, and simulation", Wiley-IEEE Press,2007.
3. Razavi, "Principles of data conversion system design", Wiley IEEE Press, 1st Edition, 1994.
4. Jacob Baker, "CMOS Mixed-Signal circuit design", IEEE Press, 2009.
5. Gregorian, Temes, "Analog MOS Integrated Circuit for signal processing", John Wiley & Sons, 1986.
6. CMOS analog Circuit Design by Allen Holberg, Oxford University Press.

Cognitive Radio & Networks	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	WMC-EAE	WMC-EAE-4	WMC-457

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of basic features of software defined radio & cognitive radio & using SDR as a platform for CR.
2.	To understand spectrum sensing, detection & sharing techniques & related models.
3.	To impart the knowledge of capabilities & limits of CR, algorithms for DSA, and mathematical models for CR networks.
4.	To impart the knowledge of network coding for CR relay networks, CRN architecture, different type of relay networks and performance parameters such as QOS.

Course Outcomes (CO)

CO 1	Able to understand the basic definitions of software defined radio & cognitive radio & implement CR using SDR.
CO 2	Able to understand spectrum sensing, detection & sharing techniques & related models.
CO 3	Able to understand & analyze the capabilities & limits of CR, algorithms for DSA, and mathematical models for CR networks.
CO 4	Able to understand & apply network coding for CR relay networks, CRN architecture, different type of relay networks and performance measures such as QOS.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	3	1	2	1	1	1	1	2	1	3
CO 2	2	3	2	2	1	-	1	1	-	2	1	2
CO 3	2	3	1	1	-	1	1	1	-	3	2	3
CO 4	2	3	2	3	2	1	1	2	-	3	2	3

UNIT I

Introduction: Definition & Evolution of software defined radio (SDR) & cognitive radio (CR), key applications- Interoperability & dynamic spectrum access (DSA), SDR as a platform for CR, SDR architecture; brief review of digital communication fundamentals (from CR perspective), multicarrier modulation & OFDM.

UNIT II

Spectrum Sensing & Identification: primary signal detection (energy detector, cyclostationary feature detector, matched filter, cooperative sensing), spectrum opportunity detection- fundamental tradeoffs, MAC layer performance measures, global & local interference models.

UNIT III

Cognitive Radio Communications: capabilities of CR, spectrum sharing models of DSA, basic components of opportunistic spectrum access, algorithms for DSA, fundamental limits of cognitive radios, mathematical models for networking CRs.

UNIT IV

CR Networks (CRNs): Network coding for CR relay network - system model, assumptions, decode and forward cooperation policy, one-hop relay network, tandem & cooperative relay networks, CRN architecture, terminal architecture of CRN (CR device architecture), QOS provisional diversity radio access networks, scaling laws of CRNs.

Textbooks:

1. Alexander M. Wyglinski, Maziar Nekovee, and Y. Thomas Hou, “Cognitive Radio Communications and Networks - Principles and Practice”, Academic Press (Elsevier Inc.), 2010.
2. Kwang-Cheng Chen, Ramjee Prasad, “Cognitive Radio Networks”, John Wiley and Sons Ltd., 2009.

Reference Books:

1. Bruce A Fette, “Cognitive Radio Technology”, 2nd ed., Academic Press (Elsevier Inc.), 2009.
2. Jeffrey H. Reed “Software Radio: A Modern Approach to Radio Engineering”, Pearson Education Asia.
3. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, “Software Defined Radio: Architectures, Systems and Functions”, Wiley, 2007.
4. Huseyin Arslan, “Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems”, Springer, 2007.

Communication Systems Analysis	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EEE	7	PCE	PCE-5	EEE-419T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce and analyse the concepts of communication systems, modulations and analyse the random nature of noise in communication systems.
2.	To analyse the concept of analog communication systems and its types in detail.
3.	To analyse the concept of sampling, Pulse analog modulation systems and Pulse digital modulation systems and its classification in detail.
4.	To analyse various kinds of receivers and various digital modulation techniques in delail.

Course Outcomes (CO)

CO 1	To analyse basic communication systems, basic random variables and associated problems.
CO 2	Identify & Analyze the concepts of sampling and use it to understand analog communication systems.
CO 3	Identify and analyze various pulse modulation systems and Compare various parameters of those systems.
CO 4	Design different types of filters and receivers and analyse various digital modulation systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	1	1	-	-	-	-	-	1	-	3
CO 2	2	2	2	2	2	-	2	-	2	2	2	2
CO 3	1	3	1	3	-	-	-	-	1	1	1	2
CO 4	2	2	2	2	2	-	2	-	2	2	1	2

UNIT I

Introduction: Frequency spectrum of EM waves, Basic electronic communication system, Modulation: need & types, Frequency translation, Bandwidth and Information capacity, Shannon-Hartley law.
Random variables: Concept of random variables: discrete, continuous, Classification of random processes (WSS, SSS), CDF and it's properties, PDF, Joint distributions, Mean, Moment, Central moment, Auto-correlation & Cross-correlation, Covariance functions, Ergodicity, Uniform distribution ,Gaussian distribution, Rayleigh distribution, Binomial distribution, Poisson distribution, Power spectral density, Central limit theorem.

UNIT II

Amplitude Modulation Systems: AM: modulation and demodulation, principle, spectrum, modulation index, power relations, bandwidth, efficiency, DSB-SC: Modulation and demodulation, SSB: modulation and

demodulation.
Angle Modulation Systems: Frequency Modulation, Types of Frequency modulation, Modulation index, Frequency spectrum & Transmission BW of FM, Generation and demodulation of FM, Introduction to Phase modulation, Comparison of AM, FM & PM.

UNIT III

Pulse Analog Modulation: Sampling, Types of sampling, Aliasing, Aperture effect, Pulse amplitude modulation (PAM), Pulse width modulation (PWM), Pulse position modulation (PPM), Generation and Demodulation of all three.
Pulse Digital Modulation: Analog to digital conversion, Uniform & Nonuniform quantisation, Companding, Concept and Analysis of Pulse code modulation (PCM), Differential pulse code modulation (DPCM), Delta modulation (DM), Adaptive delta modulation (ADM), S/N ratio for all modulations.

UNIT IV

Receiver Analysis: Orthogonal signals, Gram-Schmidt Orthogonalization procedure, Analysis of Digital receiver, Analysis & Properties of Matched filter, Prediction filter, Maximum likelihood receiver, Inter symbol interference.
Digital Modulation and Transmission: Advantages of digital communication.
Coherent Binary Schemes: ASK, FSK, PSK, & QPSK, Comparison, Incoherent Schemes: DPSK & DEPSK, Average probability of error & Power specra of various digitally modulated signals.
Multiplexing: Time Division Multiplexing and Frequency Division Multiplexing

Textbook(s):
1. B.P. Lathi, “Modern Digital & Analog Communication Systems”, Oxford University Press 2011.
2. R.P.Singh & S.D.Sapre, “Communication Systems: Analog & Digital”, 2nd Edition, TMH.

Reference Books:
1. Simon Haykins, “Communication Systems”, 5th Edition, John Wiley.
2. Taub Schilling, “Principles of Communication Systems”, 3rd Edition, TMH.
3. George Kennedy, “Electronics Communication System”, 5th Edition, MGH.
4. W. Tomasi, “Electronic Communication systems”, 5th Edition, Prentice Hall.

Communication Systems Analysis Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EEE	7	PCE	PCE-5	EEE-419P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Communication Systems Analysis) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To perform AM Modulation & Demodulation.
2. To perform DSB-SC Modulation & Demodulation.
3. To perform SSB-SC Modulation & Demodulation.
4. To perform Frequency Modulation & Demodulation.
5. To perform Signal Sampling and Reconstruction Techniques.
6. To perform Time Division Multiplexed Pulse Amplitude Modulation and Demodulation.
7. To perform Pulse Width Modulation and Demodulation.
8. To perform Pulse Code Modulation and Demodulation.
9. To perform Delta Modulation & Demodulation.
10. To perform ASK Modulation & Demodulation.
11. To perform PSK Modulation & Demodulation.
12. To perform FSK Modulation & Demodulation.

Compiler Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-303

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	introduce the major concept areas of language translation and compiler design.
2.	To enrich the knowledge in various phases of compiler ant its use, code optimization techniques, machine code generation, and use of symbol table.
3.	To extend the knowledge of parser by parsing LL parser and LR parser.
4.	To provide practical programming skills necessary for constructing a compiler.

Course Outcomes (CO)

CO 1	Able to apply the knowledge of LEX tool & YACC tool to develop a scanner & parser.
CO 2	Able to design & implement a software system for backend of the compiler.
CO 3	Able to design syntax tree and intermediate code generator.
CO 4	To understand the concept of symbol table and to use various code optimization techniques

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	2	3	2	-	-	-	-	-	3
CO 2	3	2	-	2	3	2	-	-	-	-	-	3
CO 3	3	2	-	2	3	2	-	-	-	-	-	3
CO 4	3	2	-	2	3	2	-	-	-	-	-	3

UNIT-I

Compilers and translators, need of translators, structure of compiler: its different phases, compiler construction tools, Lexical analysis: Role of lexical analyzer, Input Buffering, A simple approach to the design of Lexical Analyzers, Specification and recognition of tokens, Finite automata, From regular expressions to automata, and vice versa, minimizing number of states of DFA, A language for specifying Lexical Analyzers, Design and implementation of lexical analyzer.

UNIT-II

The role of the parser, Context free grammars, Writing a grammar: Lexical versus Syntactic analysis, Eliminating ambiguity, Elimination of left recursion, Left factoring, Top Down Parsing: Recursive- Decent parsing, Non-recursive Predictive parsing, LL(1) grammars, Bottom Up Parsing: Shift Reduce Parsing, Operator precedence parsing, LR Parsing: SLR, LALR and Canonical LR parser, Parser Generators.

UNIT-III

Syntax Directed Translation: Syntax directed definitions, Evaluation orders for SDD's, construction of syntax trees, syntax directed translation schemes, implementation of syntax directed translation,
Intermediate Code Generation: Kinds of intermediate code: Postfix notation, Parse trees and syntax trees, Three-address code, quadruples and triples, Semantic Analysis: Types and Declarations, Translation of Expressions, Type checking.

UNIT - IV

Symbol Table: Symbol tables, its contents, Data Structure for Symbol Table: lists, trees, linked lists, hash tables, Error Detection and Recovery: Errors, lexical phase errors, syntactic phase errors, semantic errors, Error seen by each phase.
Code Optimization: The principal sources of optimizations, Loop optimization, Basic blocks and Flow Graphs, DAG representation of basic blocks, Code Generation: Issues in the design of code generation, A simple target machine mode, A Simple Code Generator, Peep-hole optimization, Register allocation and assignment.

Textbook(s):

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, "Compilers Principle, Techniques, and Tool", Pearson.
2. Alfred V. Aho, Ravi Sethi and Jeffrey D. Ullman, "Compilers Principle, Techniques, and Tool", Addison Wesley.

References:

1. Trembley and Sorenson, "Theory and Practice of Compiler Writing", McGraw Hill.
2. Jhon R. Levine, Tony Mason and Doug Brown, —Lex &Yacc, O'Reilly.
3. M. Joseph, "Elements compiler Design", University Science Press.

Compiler Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-351

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Compiler Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Practice of LEX/YACC of compiler writing.
2. Write a program to check whether a string belong to the grammar or not.
3. Write a program to check whether a string include Keyword or not.
4. Write a program to remove left Recursion from a Grammar.
5. Write a program to perform Left Factoring on a Grammar.
6. Write a program to show all the operations of a stack.
7. Write a program to find out the leading of the non-terminals in a grammar.
8. Write a program to Implement Shift Reduce parsing for a String.
9. Write a program to find out the FIRST of the Non-terminals in a grammar.
10. Write a program to check whether a grammar is operator precedent.

Compressible Flow and Jet Propulsion	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	TES-EAE	TES-EAE-3	TES-447T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the basic concepts and isentropic flow.
2.	To understand physical science governing normal and oblique shocks.
3.	To understand the jet propulsion.
4.	To understand the space propulsion.

Course Outcomes (CO)

CO 1	Explain the basic fluid and thermodynamic principles governing compressible flow.
CO 2	Analyse the flows containing normal and oblique shocks.
CO 3	Apply gas dynamics principles in the jet Propulsion.
CO 4	Apply gas dynamics principles in the Space Propulsion.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	2	-	-	-	-	--	-	-	2

UNIT-I

Introduction to compressible flow: governing equations of compressible fluid flows, speed of sound – definition and derivation, Types of flow- Mach number and Mach cone, reference stagnation and critical conditions, Numerical problems.
Isentropic Flow: Basic equations for one-dimensional isentropic compressible flow, Isentropic flow of an ideal gas with area variation, reference stagnation and critical conditions for isentropic flow of an ideal gas, isentropic flow in a converging nozzle, isentropic flow in a converging-diverging nozzle, Numerical problems.

UNIT-II

Normal shocks: introduction to shock waves, types and conditions for shock, Mach number across the shock, Static properties across the shock, Stagnation properties across the shock, Fanno and Rayleigh interpretation of normal shock, flow in converging-diverging flow with normal shock, supersonic wind tunnels, Numerical problems.

Oblique shocks: introduction to oblique waves, Flow with oblique shock waves Relations, Variation of Flow Parameters with the oblique shock, Use of table and charts – Applications, Numerical problems.

UNIT-III

Jet propulsion: Introduction to Jet propulsion, Types of jet propulsive systems, turbo jet engine and turbo prop engine, Ram jet engine, turbo fan engine and Pulse jet engine, Energy relations equations, Thrust Power and efficiencies, Numerical problems.

UNIT - IV

Introduction to rocket propulsion, Types of Rocket Engine -Propellants, Feeding system, Ignition and combustion, Theory of rocket propulsion – performance study, terminal and characteristics velocity, power and efficiencies, rocket engine applications, space flight, Numerical problems.

Textbook(s):

1. R. W. Fox, A. T. Mcdonald, P. J. Pritchard, “Fluid Mechanics”, John Wiley & Sons, 8th ed. (2013).
2. S. Balamurali, and T. Prakash, “Gas dynamics and jet propulsion”, A. R. S. Publications, (2015).

References:

1. S. M. Yahya, “Fundamentals of Compressible flow”, New Age International Publishers, 6th ed. (2018).
2. J. D. Anderson Jr. – ‘’Modern Compressible Flow with historical perspective’’, McGraw Hill, 2nd ed. (1990).
3. George P. Sutton, “Rocket Propulsion Elements”, John Wiley & Sons, 9th ed. (2017).

Compressible Flow and Jet Propulsion Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	TES-EAE	TES-EAE-3	TES-447P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Compressible Flow and Jet Propulsion) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study sound speed in different solids and fluids.
2. Study wave propagation at different Mach number.
3. Study isentropic flow from variable area duct.
4. Study Fanno flow (flow with constant area duct with friction).
5. Study Rayleigh flow (flow with constant area duct with heat transfer).
6. Study the flow through supersonic wind tunnel.
7. Study the different types of aerospace vehicles.
8. Study the shock wave generated in the flow field.
9. Simulate the shock generated in a compressible flow around a wedge.
10. Carry out the parametric analysis of the shock generated in a compressible flow around a wedge.
11. Study or simulate the compressible flow in a converging nozzle.
12. Study or simulate the compressible flow in a converging-diverging nozzle.

Computational Fluid Dynamics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CADM-EAE	CADM-EAE-3	CADM-401T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about the Governing Differential Equations and application of Finite Difference Method.
2.	To understand the Conduction Heat Transfer and Convection Heat Transfer.
3.	To understand the Incompressible Fluid Flow.
4.	To understand the Applications of Computational Fluid Dynamics using some software (e.g. ANSYS).

Course Outcomes (CO)

CO 1	Able to write the Governing Differential Equations and apply Finite Difference Method for a physical problem.
CO 2	Analyse the Conduction Heat Transfer and Convection Heat Transfer for steady state and unsteady state heat transfer problem.
CO 3	Analyse the Incompressible Fluid Flow using Navier- Stokes equations.
CO 4	Able to apply Computational Fluid Dynamics using some software for different types of problems in heat transfer and fluid flow.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Governing Differential Equations and Finite Difference Method: Classification of PDEs, Initial and Boundary conditions, Initial and Boundary value problems, Finite difference method Central, Forward, Backward difference for a uniform grid, Central difference expressions for a non-uniform grid, Numerical error, Accuracy of solution, Grid independence test.

UNIT-II

Conduction Heat Transfer: Applications of Heat conduction:Steady and Unsteady conductions, One dimensional steady state problems, Two dimensional steady state problems, Three dimensional steady state problems, Transient one dimensional problems, Convection Heat Transfer: Introduction, Steady one dimensional convection, Diffusion, unsteady one Dimensional Convection – Diffusion – Unsteady two dimensional, Convection, Diffusion.

UNIT-III

Incompressible Fluid Flow: Introduction- Governing equations, Difficulties in solving Navier- Stokes equation, Stream function, Vorticity method, In viscid flow (steady) Determination of pressure for viscous flow.

UNIT - IV

Applications of Computational Fluid Dynamics, Computer graphics in CFD, Future of CFD, Enhancing the design process, understanding, Applications, Automobile, Engine, Industrial, Civil, Environmental.

Textbook(s):

1. Muralidhar, K., and Sundararajan, T., “Computational Fluid flow and Heat Transfer", Narosa Publishing House.
2. Ghoshdasdidar, P.S., “Computer simulation of flow and heat transfer", Tata McGraw – Hill, New Delhi.

References:

1. Anderson, D. A., Tannehill, J. L, and Pletcher, R.H., “Computational fluid mechanics and Heat Transfer", Hemisphere Publishing Corporation.
2. John David Anderson, "Computational Fluid Dynamics: The Basics with Applications", McGraw Hill

Computational Fluid Dynamics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CADM-EAE	CADM-EAE-3	CADM-401P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Computational Fluid Dynamics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Computational Fluid Dynamics.
2. Introduction to commercial software package (e.g. ANSYS).
3. Flow over a flat plate.
4. Flow through a pipe.
5. Flow through a diffuser.
6. Flow over a circular cylinder.
7. Flow over a wedge.
8. Flow over a cone.
9. Flow over a symmetric aerofoil.
10. Flow over a cambered aerofoil.

Computer Aided Design and Drafting	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CADM-EAE	CADM-EAE-4	CADM-403T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Impart knowledge of computer-aided design (CAD) basics, concepts and methods with introduction to drafting.
2.	Empower with knowledge of programmable parametric space curves and surfaces for industrial applications.
3.	Develop drafting and solid modelling programming and operating skills for parts for assemblage purpose.
4.	Enable the students to understand data exchange between CAD-CAM systems and to familiarise them with FEM analysis process.

Course Outcomes (CO)

CO 1	Understand CAD hardware & software concepts and methods of 2D-3D transformations & projections in traditional manufacturing system using CAD.
CO 2	Apply representation of Curves and Surface generation in modelling of the machine and automobile parts.
CO 3	Develop skills in Solid Modelling and Create part drawings as 3D models using CAD software.
CO 4	Understand the need of CAD/CAM data exchange and build skill in Finite Element Analysis of a machine part.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	3	2	2	2	2	3	3	3
CO 2	3	3	3	3	3	2	3	1	3	3	2	3
CO 3	3	3	3	3	3	2	2	2	3	3	1	3
CO 4	3	3	3	3	3	2	3	1	3	3	2	3

UNIT-I

Introduction to CAD: Need for CAD tools over manual drafting, CAD product cycle, CAD Systems Evaluation Criteria.

CAD Software: Database (Global) Coordinate System, Working (User) Coordinate System, Screen Coordinate System, User Interface, Modelling and Viewing. Computer graphics software and configuration.

2-D & 3-D Transformations: Point representations, Homogeneous Transformation Representation, Transformation Matrices for Translation, Rotation, Scaling, Reflection and Shearing, Composite transformations, Geometric Model Mappings, Numerical problems.

Projections: Orthographic, Oblique, Isometric and Perspective Projections.

UNIT-II

Parametric Curves: Representation of Space Curves, Analytical and synthetic curves, Cubic Polynomial curves &Splines, Hermite curves, Bezier Curves, B-spline Curves, NURBS, Numerical problems.

Mathematical Representation of Surface Entities: Analytical surfaces - Plane Surface, Ruled Surface, Tabulated Surface, Surface of Revolution, Sweep Surface. Synthetic Surfaces - Hermite-Bicubic surface, Bezier Surface, B-Spline Surface, Coons Surface, Numerical problems.

UNIT- III

Computer Aided Drafting and Geometric Modelling: Computer aided drafting system – layers, grid & snap, Basic features of a drafting software, Use of drafting commands- Loft, Extrude, Revolve, Sweep, Mirror, Pattern, Pocket, Fillet, Chamfering.

Generation of graphic elements (Primitives), Addition, Subtraction, Intersection for drafting of 3D geometric model.

Geometric Modelling: Need & requirements of geometric modelling, Representation schemes of geometric models – Wireframe, surface and solid modelling. Comparative Analysis.

Solid Modelling: Set Theory, Boolean Operations, B-rep Modelling, Constructive Solid Geometry, Sweep Representations, Pure primitive Instancing, Cellular Decomposition, Spatial Occupancy Enumeration Numerical problems.

UNIT-IV

CAD/CAM Data Exchange: Introduction, IGES – Initial Graphic Exchange Specification, STEP – Standard for Exchange of Product Data, PDS.

Finite Element Method: General Method for FEM of a geometric model, Finite Element Analysis Process, Element and Global Stiffness Matrix formulation, Solution methods, Numerical problems for FEM on 1D Bar element only.

Textbook(s):

1. Ibrahim Zeid, “CAD/CAM Theory and Practice”, Tata McGraw-Hill Publishing Company Limited. 2nd Edition.
2. Srinivas J., “CAD/CAM-Principles and Applications”, Oxford University Press, 2017.
3. David F. Rogers and J. Alan Adams, “Mathematical Elements for Computer Graphics”, Prentice Hall India, Tata McGraw-Hill.

References:

1. Ibrahim Zeid, “Mastering CAD/CAM”, Tata McGraw-Hill Publishing Company Limited.
2. Foley et. al., “Computer Graphics Principles & practice”, Addison Wesley,1999.
3. Chougule N.K., “CAD/CAM/CAE”, Scitech Publications (India) Pvt. Ltd., 2014.

Computer Aided Design and Drafting Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CADM-EAE	CADM-EAE-4	CADM-403P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Computer Aided Design and Drafting) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to implement Digital Differential Analyzer (DDA) Algorithm for drawing a line segment between two given end pixel points A (x1, y1) & B (x2, y2) with any slope.
2. Write a program to implement (Bresenham's) Mid-point Circle drawing algorithm for drawing a circle with a given center of circle C(Xc,Yc) and radius R in terms of pixels.
3. Write a program to apply the basic 2D transformations - Translation, Reflection & Scaling, for a given 2D polynomial of side n.
4. Write a program to apply the basic 2D transformations - Rotation & Shearing for a given 2D object (rectangle).
5. To apply the basic transformations such as Translation, Scaling, & Rotation for a given 3D object (cube or triangle).
6. Write a program to generate a smooth curve by using Bezier Curve technique for a given set of 4 control points.
7. Draft a dimensioned component 3D model using Extrude, Loft, Revolve, Sweep or their combination on a suitable available drafting software.
8. Draft the assembly of Rigid coupling on the suitable drafting software.
9. Write a program to generate a smooth curve by using Hermit's Cubic Curve technique for a given set of 2 control points. and 2 tangents.
10. Write a program for displaying 3D objects as 2D display using Perspective Projection.
11. Write a program for displaying 3D objects as 2D display using Orthographic Projection.

Note:
1. The Program codes may be written on C++ or MATLAB.
2. Drafting/Sketching may be done on suitable available commercial software e.g. FUSION 360, SOLIDWORKS, Pro-E, CATIA etc.

Computer Aided Electrical Machine Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	6	PCE	PCE-2	EEE-322T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To design DC Machine
2.	To design Transformer
3.	To design Induction Motor
4.	To design Synchronous Machines

Course Outcomes (CO)

CO 1	Ability to Create Various Part of Dc machine
CO 2	Ability to Design Various Part of Transformer
CO 3	Ability to Design Various Part of Induction motor
CO 4	Ability to Design Various Part of Synchronous Machines

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	-	-	-	1	1	1	2
CO 2	3	3	3	3	3	-	-	-	1	1	1	2
CO 3	3	3	3	3	3	-	-	-	1	1	1	2
CO 4	3	3	3	3	3	-	-	-	1	1	1	2

UNIT I

General Concepts: Major considerations in Design of Electrical Machines Electrical Engineering Materials, Space factor, Choice of Specific Electrical and Magnetic loadings, Thermal considerations, Heat flow, Temperature rise, Rating of machines, Standard specifications.

DC Machines : Output Equations, Main Dimensions, Magnetic circuit calculations, Carter's Coefficient, Net length of Iron, Real & Apparent flux densities, Selection of number of poles, Design of Armature, Design of commutated and brushes, performance prediction using design values. Computer based design of machine

UNIT II

Transformers: Output Equations, Main Dimensions, KVA output for single and three phase transformers, Window space factor, Overall dimensions, Operating characteristics, Regulation, No load current, Temperature rise in Transformers, Design of Tank, Methods of cooling of Transformers. Computer based design of machine

UNIT III

Induction Motors: Output equation of Induction motor, Main dimensions, Length of air gap, Rules for selecting rotor slots of squirrel cage machines, Design of rotor bars & slots, Design of end rings, Design of wound rotor, Magnetic leakage calculations, leakage reactance of polyphase machines, Magnetizing current, Short circuit current, Circle diagram, Operating characteristics. Computer based design of machine

UNIT IV

Synchronous Machines: Output equations, choice of loadings, Design of salient pole machines, Short circuit ratio, shape of pole face, Armature design, Armature parameters, Estimation of air gap length, Design of rotor, Design of damper winding, Determination of full load field mmf, Design of field winding, Design of turbo alternators, Rotor design. Computer based design of machine

Text Books:

1. Electrical Machine Design the Design and Specification of Direct and Alternating Current Machinery, Alexander Gray, Nabu Press, First reprint edition, 2014
2. Electric Machines Steady State, Transients, and Design with MATLAB, IonBoldea, Lucian Tutelea, CRC Press, Taylor & Francis, First edition, 2010.

Reference

1. Principles of Electrical Machine Designs with Computer Programmes, Sen, S.K., Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, 1987.
2. Electrical Machine Design Data Book, A. Shanmugasundaram, G. Gangadharan, R. Palani, New Age International Pvt. Ltd., Reprint 2007.
3. Design and Testing of Electrical Machines, M.V. Deshpande, PHI, 2013.
4. Sawhney, A.K., ‘A Course in Electrical Machine Design’, Dhanpat Rai & Co., New Delhi, 6th Edition, 2013.

Computer Aided Electrical Machine Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	6	PCE	PCE-2	EEE-322P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Computer Aided Electrical Machine Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Perform the following experiments using C++/MATLAB or any other related software.

1. Design of Armature
2. Design of Commutator
3. Design of Armature winding
4. Design of Magnetic Core of Transformer
5. Design of rotor bars and slots of squirrel cage induction motor
6. Design of rotor core of slip ring induction motor
7. Design of salient pole rotor of synchronous machine
8. Design of stator core and winding for synchronous machine
9. Design of rotor for turbo alternators
10. Design of damper winding

Computer Graphics and Multimedia Technologies	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CST/ITE	7	PCE	PCE-4	CIE-411T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide the necessary theoretical background of applications of the computer graphics and learn to generate basic graphical objects using Scan conversion algorithms.
2.	To learn the reposition of the objects on the 2-D and 3-D coordinate system by understanding the concepts of homogeneous coordinate system.
3.	To provide the insight into the mapping of 3D to 2D coordinate systems.
4.	To understand various aspects of media and to learn the concept of sound, images and videos.

Course Outcomes (CO)

CO 1	Understood various input/output devices for computer graphics and able to implement various graphical transformations.
CO 2	Apply various clipping algorithms and design parametric curves.
CO 3	Apply Illumination models, Shading models and hidden surface algorithms as well as understood various multimedia file formats.
CO 4	Evaluate various image compression methods.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	-	3	2	2	-	2	3	2	3
CO 2	3	3	-	3	3	-	2	-	2	3	2	2
CO 3	2	2	-	2	3	2	2	-	2	3	2	2
CO 4	2	2	-	3	3	3	2	-	2	3	2	3

UNIT-I

Introduction, Applications areas, Components of Interactive Computer Graphics System. Overview of Input devices, Output devices, raster scan CRT displays, random scan CRT displays. Scan Conversion algorithms: DDA and Bresenham's Line Drawing Algorithms, Bresenham's and Mid-Point Circle Drawing Algorithms, Mid- Point Ellipse Drawing Algorithm.

Transformations: Homogeneous Coordinate System for 2D and 3D, Various 2D, 3D Transformations (Translation, Scaling, Rotation, Reflection, Shear), Composite Geometric Transformations.

UNIT-II

Window to Viewport Normalization, Clipping Algorithms: Point Clipping, Cohen-Sutherland line Clipping

Algorithm, Sutherland-Hodgeman Polygon Clipping Algorithm.
Representing Curves and Surfaces: Polygon Mesh, Parametric and Geometric curves, Bezier Curves, B-Spline Curves. Projection: Taxonomy of Projection- Parallel Projection, Perspective Projection.

UNIT-III

Illumination Model for diffused Reflection, Ambient light, Specular Reflection Model, Reflection Vector.
Shading Models: Flat shading, Gourard Shading, Phong Model. Visible surface detection, Back Face Detection, Depth Buffer (Z-Buffer, A-Buffer) Method. Overview of multimedia: Classification, basic concepts of sound/audio MIDI: devices, messages, software, Authoring tools, Video and Animation: controlling animation, display and transmission of animation

UNIT - IV

Data Compression: storage space, coding requirements, Basic compression techniques: run length code, Huffman code, Lempel-Ziv JPEG: Image preparation, Lossy sequential DCT, expanded lossy DCT, Lossless mode, Hierarchical mode. MPEG, Media synchronization, Media Integration, Production Standards.

Textbook(s):
1. Donald Hearn and M.Pauline Baker, "Computer Graphics C version", Second Edition, Pearson Education.
2. Ralf Steinmetz & Klara Nahrstedt, "Multimedia Computing Communication & Applications", Pearson Education.

References:
1. C, Foley, VanDam, Feiner and Hughes, "Computer Graphics Principles & practice", 2nd Edition.
2. R. Plastock and G. Kalley, "Theory and Problems of Computer Graphics", McGraw Hill, 2nd edition.
3. Fred Halsall, "Multimedia Communications Applications, Networks, Protocols & Standards", Pearson.
4. David F. Rogers, "Procedural elements for computer graphics", McGraw- Hill.

Computer Graphics and Multimedia Technologies Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CST/ITE	7	PCE	PCE-4	CIE-411P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Computer Graphics and Multimedia Technologies) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of Fundamental Graphics Functions.
2. Implementation of Line drawing algorithms: DDA Algorithm, Bresenham's Algorithm
3. Implementation of Circle drawing algorithms: Bresenham's Algorithm, Mid Point Algorithm.
4. Implementation of Ellipse drawing algorithms: Mid Point Algorithm.
5. Programs on 2D transformations: Translation, Scaling, Rotation
6. Implement window to viewport transformation.
7. Write a program to implement cohen Sutherland line clipping algorithm
8. Write a program to draw Bezier curve.
9. Using Flash/Maya/Blender perform different operations (rotation, scaling move etc.) on objects
10. Create a Bouncing Ball using Key frame animation and Path animation.

Computer Integrated Manufacturing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-4	MEE-405T
MAE	7	PC	PC	MAC-403

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the need, scope and importance of computers in machining industry.
2.	To study different codes, their meaning and write the program for turning and milling operation using these codes.
3.	To study the use of CIM and various planning tools for automation of an industry.
4.	To study CAPP, FMS and Group technology tools and various material handling methods in an industry.

Course Outcomes (CO)

CO 1	Understand CNC machines and its various aspects with various terminologies related to its constituting parts in CIM environment.
CO 2	Desing fabrication of CNC programs for turning and milling operations using various canned cycles and study of different feedback system used in CNC machines.
CO 3	Understand importance of CIM environment for automation in industry considering various planning and scheduling function.
CO 4	Apply CAPP approaches in CIM system, importance of FMS & Group technology, study of various material handling system in automated industry.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	2	2	-	-	-	-	-	-	-	3
CO 2	3	3	3	3	-	-	-	-	-	-	-	3
CO 3	3	3	2	2	-	-	-	-	-	-	-	3
CO 4	3	3	3	2	-	-	-	-	-	-	-	3

UNIT-1

Functions and Components of CIM System: CIM, Definition, elements of CIM system-benefits, Production system facilities low-medium-high-Manufacturing support systems, Automation in production systems, Automated manufacturing systems-Computerized Manufacturing Support Systems, Reasons for Automating.
An overview of CNC machines: Need, benefits & limitations, classification of CNC machines, DNC, Constructional features of CNC machines, Design considerations of CNC machine tools, elements of CNC machine & systems, precision measuring & positioning of CNC, Function of MCU, Machining centre, Turning centre, Tool and pallet changer, Adaptive Control system, Punch tape and reader, Ball screw mechanism.

UNIT- II

Manual part programming: Preparatory and miscellaneous functions- Fanuc control (M Codes and G Codes). Linear interpolation, circular interpolation, canned cycles, cycles of threading & grooving operations, tool compensation, part programming structure, work co-ordinate system, absolute & incremental commands, axis and co-ordinate system, process planning & flow chart for part programming, scaling, rotating, mirroring, copy & special canned cycles for CNC lathe and milling.

Open loop and closed loop systems, Precision in NC positioning systems: Control resolution, Accuracy and repeatability. Actuators: DC servomotor, AC servomotor, stepper motor. Transducers and feedback elements: resolvers, inductosyn optical grating and encoders.

UNIT-III

Automation principles, scheduling functions and strategies, CNC controller & motion control in CNC system. Application of CNC and recent advances in CNC machines. Planning and scheduling functions like APP, MPS, MRP, MRPII and JIT.

Automatically Programmed tool: Terminologies and Part Programming.

UNIT-IV

Group Technology: Definition, Advantages and limitations of GT-Part family formation, Classification and coding-Opitz coding system, Applications & benefits of GT.

Flexible manufacturing system: Scope of FMS, FMS elements, benefits.

Automated Material Handling Systems and Advanced Manufacturing Systems: Industrial Robots, Conveyors, AGVs, Automatic Storage and Retrieval System. Advantages and application in Industries. Inspection and quality control using CMM machine, Machine Vision.

Textbook(s):

1. Mikell P. Groover, “Automation, Production Systems and Computer- Integrated Manufacturing”, 2nd Edition, Prentice Hall, 2001.
2. S.K. Sinha, “CNC Programming”, Galgotia Publications, 2003.

References:

1. P. Radhakrishnan, “Computer Numerical Control Machine & Computer Aided Manufacturing”, New Academic Science Limited.
2. U.Rembold, “Computer Integrated Manufacturing and Engineering”, Addison Wesley Publishers, 1993
3. S. Kant Vajpayee, “Principles of Computer Integrated Manufacturing”, PHI Learning Private Limited, 2012.
4. M. Adithan, B.S. Pabla, “CNC Machines”, New Age.
5. Binit Kumar Jha, “CNC programming made easy”, Vikas Publications.
6. T.K. Kundra, P. N.Rao & N.K.Tiwari, “Numerical Control and Computer Aided Manufacturing”, TMH.

Computer Integrated Manufacturing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-4	MEE-405P
MAE	7	PC	PC	MAC-455

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Computer Integrated Manufacturing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the basic characteristics of CNC Machine, types of CNC machine.
2. Part programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine/simulator.
3. Part programming (in word address format) experiment for milling operation (including operations such as engraving a character, pocketing and mirroring) and running on CNC machine/simulator.
4. Part programming (in word address format or APT) experiment for drilling operation (point to point.
5. Part programming (in word address format or APT) experiment for milling operation (contouring).
6. Experiment on Transfer Line/Material Handling.
7. Experiment on difference between ordinary and NC machine, study or retrofitting.
8. Experiment on study of system devices such as motors and feedback devices.
9. Study about the FMS and its applications in industry with a case study.

Computer Networks	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-307
ICE	5	PC	PC	CIC-313

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	ild an understanding of the fundamental concepts of computer networking.
2.	Familiarize the student with the basic taxonomy and terminology of the computer networking area.
3.	Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
4.	Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Course Outcomes (CO)

CO 1	Understand basic computer network technology.
CO 2	Understand and explain Data Communications System and its components.
CO 3	Implements various network topologies and IP addressing, subnetting.
CO 4	Enumerate the layers of the OSI model and TCP/IP.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	1	1	3	1	-	-	-	-	-	3
CO 2	3	2	1	1	3	1	-	-	-	-	-	3
CO 3	3	2	1	1	3	1	-	-	-	-	-	3
CO 4	3	2	1	1	3	1	-	-	-	-	-	3

UNIT-I

Data Communications: Components, Networks, The Internet, Protocols and Standards, Network Models: The OSI Model, TCP/IP Protocol Suite , A Comparison of the OSI and TCP/IP Reference Models, Addressing, Physical Layer: Analog and Digital Signals, Transmission modes, Transmission Media: Guided Media, Unguided Media, Review of Error Detection and Correction codes.
Switching: Circuit switching (space-division, time division and space-time division), packet switching (virtual circuit and Datagram approach), message switching.

UNIT-II

Data Link Layer: Design issues, Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, Point-to –Point Access: PPP Point –to-

Point Protocol, PPP Stack,
Medium Access Sub layer: Channel allocation problem, Controlled Access, Channelization, multiple access protocols, IEEE standard 802.3 & 802.11 for LANS and WLAN, high-speed LANs, Token ring, Token Bus, FDDI based LAN, Network Devices-repeaters, hubs, switches bridges.

UNIT-III

Network Layer: Design issues, Routing algorithms, Congestion control algorithms, Host to Host Delivery: Internetworking, addressing and routing, IP addressing (class full & Classless), Subnet, Network Layer Protocols: ARP, IPV4, ICMP, IPV6 ad ICMPV6.

UNIT - IV

Transport Layer: Process to Process Delivery: UDP; TCP, congestion control and Quality of service. Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP), file transfer (FTP), HTTP and WWW.

Textbook(s):
1. Behrouz A. Forouzan, “Data Communications and Networking”, Tata McGraw-Hill.

References:
1. A. S. Tannenbum, D. Wetherall,, “Computer Networks”, Prentice Hall, Pearson.
2. Fred Halsall, “Computer Networks”, Addison – Wesley.
3. Tomasi, “Introduction To Data Communications & Networking”, Pearson.

Computer Networks Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-355
ICE	5	PC	PC	CIC-365

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Computer Networks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Networking Simulation Tools: Wireshark, Cisco Packet Tracer.
2. To understand the operation of TELNET by accessing the router in server room from a PC in IT office.
3. To implement an IP Addressing Scheme and Subnetting in small networks using Cisco Packet Tracer.
4. To implement the static routing using Cisco Packet Tracer.
5. To implement the DHCP onto the Network Topology using Cisco Packet Tracer.
6. To implement the DNS, Email Services in the Network using Cisco Packet Tracer.
7. To implement the Dynamic Routing Protocols: RIP, IGRP using Cisco Packet Tracer.
8. To construct multiple router networks and implement the EIGRP Protocol.
9. To implement the Network Address Resolution (NAT) using Cisco Packet Tracer.
10. Conducting a Network Capture and Monitoring with Wireshark Simulation Tool.

Computer Vision	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IPCV-EAE	IPCV-EAE-3	IPCV-451T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the basics of Computer Vision.
2.	To understand and apply theories, models and methods in the field of computer vision.
3.	To discuss the model reconstruction and tracking system.
4.	To understand the motion analysis and object recognition system

Course Outcomes (CO)

CO 1	Understand the concept of computer vision.
CO 2	Understand and apply filtering, feature detection and model fitting methods in Computer Vision
CO 3	Analyse and apply the different types of model reconstruction and motion tracking methods.
CO 4	Apply the different concepts of computer vision for motion analysis and object recognition.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	1	1	-	1	1	-	2
CO 2	3	3	3	3	3	1	1	-	1	1	-	2
CO 3	3	3	3	3	3	1	1	-	1	1	-	2
CO 4	3	3	3	3	3	1	1	-	1	1	-	2

UNIT I

Introduction and Fundamentals: Anoverview of computer vision, related areas, and applications; overview of software tools; overview of course objectives.; introduction to OpenCV.
Image formation and representation: Image formation and representation: imaging geometry, radiometry, digitization, cameras and projections, rigid and affine transformations.

UNIT II

Filtering and Feature Detection: convolution, smoothing, differencing, and scale space. edge detection, corner detection, line and curve detection, active contours, SIFT and HOG descriptors, and shape context descriptors.
Model Fitting: Hough transform, line fitting, ellipse and conic sections fitting algebraic and Euclidean distance measures.

UNIT III

Model Reconstruction: reconstruction by triangulation; Euclidean reconstruction; affine and projective reconstruction.
Motion tracking: statistical filtering; iterated estimation; observability and linear systems; the Kalman filter; the extended Kalman filter.

UNIT IV

Motion analysis: the motion field of rigid objects; motion parallax; optical flow, the image brightness constancy equation, affine flow; differential techniques; feature-based techniques; regularization and robust estimation; motion segmentation through EM.
Object recognition and shape representation: alignment, appearance-based methods, invariants, image eigenspaces, data-based techniques.

Textbook(s):
1. Shah M., Fundamentals of Computer Vision, 1997.
2. Szeliski R., Computer Vision: Algorithms and Applications, Springer, 2011.

Reference Books:
1. Computer Vision: A Reference Guide by by Katsushi Ikeuchi .
2. Computer Vision: Models, Learning, and Inferenceby Simon J. D. Prince

Computer Vision Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IPCV-EAE	IPCV-EAE-3	IPCV-451P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Computer Vision) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a Program to Flip the image around the vertical and horizontal line
2. Write a Program to display the colour components of the image and also get its negative image.
3. Calculate the Histogram of a given image and Histogram Equalization of an image.
4. Write a Program for Image Filtering (low pass filter)

   1) Average filter

   2) Weighted Average filter

   3) Median filter

   high pass filters using

   1) Sobel operator

   2) Laplacian operator
5. Implement the Edge detection Technique of an Image.
6. Write a Program to find the threshold of the grayscale image.
7. Write a Program to detect a line and circle in an Image.
8. Write a Program for the detection and tracking of an object
9. Write a program to detect an object using YOLO.
10. Write a program for Human Pose Estimation.

Contract Management	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	CTM-EAE	CTM-EAE-1	CEC-308

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To make students who take this course be able to design sound contracts by training to interpret legal provisions and effectively administer and fulfill the requirements of a contract
2.	To be able to effectively administer contract and identify tools available for contract preparation and administration
3.	To identify good practice important stages of contract and wordings in contract
4.	Understand jurisprudence to effectively administer contracts and a construction organization

Course Outcomes (CO)

CO 1	Prepare contract schedules, notice inviting tender and contract documents.
CO 2	Understand laws of construction contract.
CO 3	Implement dispute resolution.
CO 4	Prepare contract management plan as per standards.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	3	2	-	2	-	1	-	-	-	-	-
CO 2	2	3	1	-	2	-	1	-	-	-	-	-
CO 3	2	2	3	-	2	-	1	-	-	-	-	-
CO 4	2	2	1	-	2	-	1	-	-	-	-	-

UNIT-I

Definition of Contract Legal issues in contract – Standard forms of contracts- General and special conditions of contracts- Contract pricing by the client, project management consultants and the contractor, Contract correspondence and contract closure.
Construction Laws: Public law, Government Department and Local authorities, Private law, contracts, Tort, property law and building law.
Construction contracts: Contract specification, types of contract documents used for construction. Contract procurement: Selecting a contractor.

UNIT-II

Construction Contracts: Type of construction contracts: Lump sum contracts, fixed price contracts, Percentage rate contracts, cost plus contracts, Target contracts, Design-Build contracts, Turn-key contracts, BOT contracts.

Parties to a Contract, Contract Formation, Common contract clauses: Notice to proceed, rights and duties of various parties, Contract Duration and Price.

Tendering: Process of tendering: Tender notice, EOI, RFQ & RFP, Bid security, Prequalification process, Bidding Models and bidding strategy, Tender submission and evaluation, Tender rejection, Security deposits / performance guarantee & Defect liability, Contract agreement & contract documents

UNIT-III

Contract Management: Scope of work, Detailed Estimate [approved plan], Administrative approval/Estimate Sanction, Notice inviting tenders and its types, Tender, earnest money deposit, security deposit, types of contracts, Essentials of legally valid contract, Contract between Engineer and Employers, Appointment and authority of Engineer for execution of civil construction works, Category of contractors.

Public Works Administration: C.P.W.D. Organization set up, system of accounts, classes of works in PWD, Estimates, Delhi Scheduled Rules [CPWD], Cost adjustment indices sub head, sub works, administrative approval, technical sanction, possession of funds, expenditure sanction, Various methods of executing works.

UNIT - IV

Arbitration: Comparison of Actions and Laws – Agreements –Appointment of Arbitrators Contract procedure: Disputes, arbitration and litigation procedure-preparation, settlement, evidence. Arbitration Tribunals, Powers and Duties of Arbitrator, Enforcement of Award, Arbitration and Conciliation Act 1996 - Arbitration case study.

Building formulae: Price adjustment-need for formulae, comparison with previous system, civil engineering and building formulae, practical implication.

Textbook(s):

1. Jimmie Hinze, Construction Contracts, 3rd Edition, McGraw Hill, New Delhi, (2013)
2. Sharma M.R., Fundamentals of Construction Planning & Management S.K. Kataria & Sons, (2013)

References:

1. Joseph T. Bockrath and Fredric L. Plotnick, Contracts and the Legal Environment: for Engineers and Architects, 7th Edition, McGraw Hill, New Delhi, (2013)
2 Markanda P.C., Naresh Markanda and Rajesh Markanda, Law Relating to Arbitration and Conciliation, 9th Edition, Lexis Nexis, New York., (2016)
3. Martin Brook, Estimating and Tendering for Construction Work, 5th Edition, Routledge, Taylor & Francis. (2016)
4. Govt of India, Central Public Works Department, CPWD Works Manual(2019)

Control Hardware and Interfacing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	RA-EAE	RA-EAE-4	RA-439T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To create control structures
2.	To create interface between contol hardware and PLC
3.	To design hydraulic and pneumatic sequential circuits
4.	To create control circuits for ACdrives

Course Outcomes (CO)

CO 1	Ability to create control structures
CO 2	Ability to create interface between contol hardware and PLC
CO 3	Ability to design hydraulic and pneumatic sequential circuits
CO 4	Ability to create control circuits for ACdrives

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT I

Automatic Control Introduction, P-I-D Control, manual and auto PID Control Tuning, Feed forward Control Ratio Control, Time Delay Systems and Inverse Response Systems, Special Control Structures. Temperature controller hardware architecture.

UNIT II

PLC Introduction to Sequence Control, PLC, RLL (Relay Ladder Logic), Sequence Control. Scan Cycle, Simple RLL Programs, Sequence Control. More RLL Elements, RLL Syntax, A Structured Design Approach to Sequence, PLC Hardware Environment, Introduction To CNC Machines, Contour generation and Motion Control, Allen Bradley PLC and SIEMEN PLC.

UNIT III

Industrial Control Basics of hydraulics, Hydraulic components their functions and symbols Hydraulic actuators, Pumps and its operation, pump control, Hydraulic valves (Direction control, pressure and flow control), special valves, pressure gauges and switches, hydraulic logic circuits, Hydraulic Control System, Multiple pressure and speed operations, Industrial Hydraulic Circuit, Pneumatic systems and components Pneumatic Control Systems, compressor operation and control, air treatment.

UNIT IV

Industrial Drives AC Drive basics, Electrical specifications and hardware architecture .AC drive and AC motor specification matching. AC drive power wiring and Interfacing input and output signals. Operation and control of AC motor in scalar mode. Operation and control of AC drive in vector. control mode. Performance verifications of special features of AC drive. Requirement and specifications of input and output chokes, braking applications, methodology and specifications of braking resistors. Selection of power, motor and signal cables for AC drive application. Wiring and lay outing guidelines of AC drive .Energy Savings with Variable Speed Drives, DC Motor Drives, DC and BLDC Servo Drives

Text Books:

1. Lingefeng Wang, Kay Chen Tan,"Modern Industrial Automation and Software Design" John Wiley & Sons
2. Kok Kiong “Drives and Control for Industrial Automation”, Springer

Reference Books:

1. Norman S. Nise, “Control systems engineering” John Wiley & Sons (Asia) Singapore.
2. Raymond T. Stefani, Design of Feedback Control System, Oxford University Press.
3. K. Ogata, “Modern control engineering”, Pearson 2002.
4. S. P.Eugene Xavier, “Modern control systems”, S. Chand & Company.
5. M. Gopal “Control Systems-Principles and Design” TMH 4th Edition 20

Control Hardware and Interfacing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	RA-EAE	RA-EAE-4	RA-439P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Control Hardware and Interfacing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study, understand and perform experiments on timers and counters.
2. To control the water level in a Process Tank using Feed forward Control.
3. To control the batch process reactor using programmable logic controller.
4. Logic implementation for Bottle Filling Application.
5. Write a program for sequencing of two cylinders using pneumatic components only.
6. Write a program for sequencing of two cylinders using electro pneumatic components.
7. Sequencing of multiple double acting piston cylinder arrangement using electro-pneumatic components.
8. PLC programming- Operate single acting cylinder and double acting cylinder using push button and direction
9. Control valve. Use push buttons in the AND, OR and Latching conditions.
10. Write a PLC program for to and fro motion of single acting cylinder and double acting cylinder automatically.
11. Write a PLC program for sequencing of three cylinders in following sequence

    A+B+C+ A-B+C+ A- B-C+ A-B-C

Control System Components	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-1	ICE-310

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To familiarize with various control system components with their working and construction
2.	To get knowledge about various electrical control system components to apply in various control projects
3.	To get knowledge about various hydraulic and mechanical components used in control system
4.	To learn about different electronic components to be used in control system

Course Outcomes (CO)

CO 1	ply the knowledge of control system components to solve any control system problem
CO 2	ility to develop the control system using different components.
CO 3	Understanding of mechanical and hydraulic components to develop a control system
CO 4	Design and development of electronic components for control purpose

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	1	2	-	2	3	1	-	2	3	2
CO 2	3	1	2	1	-	1	1	1	-	2	1	3
CO 3	3	2	1	2	-	-	1	-	-	1	2	3
CO 4	2	1	2	3	-	-	-	-	-	1	1	1

Unit I

Introduction: Introduction to control system components; Different types of potentiometer and its applications, synchro's construction and operation, synchro'scharacteristics, synchro's application, synchro's pair as an error detector, Rotating Amplifier, Magnetic Amplifier

Unit II

Electrical components: DC servomotor,AC servomotor,Permanent magnet stepper motor,VariableReluctance stepper motor,applications of stepper motor,Tachometers: Characteristic and requirement of Tachogenerator, DC tachogenerator,ACtachogenerator,applications of tachogenerator,Ac and DC relays,electromechanical and solid-state relays.Power relays,plunger relays,optoelectronic relays,vacuum relays,Relay Problems and Remedies.

Unit III

Hydraulic and Mechanical components: Hydraulic Tank,Filter,Pumps,accumulator,Relief valves,check valve,Needle Valve,Pressure regulator,spur Gear and pinion,Rack and Pinion,Helical Gear,Bevel Gear.

Unit IV

Electronic components: Modulators and Demodulators,Diode discriminators,push buttons,limit switches and other special switches,Cam switches, pilot light.

Textbooks:

1. M.D Desai, “Control system Components”, PHI Learning Pvt.Ltd.
2. I.G Nagrath, M. Gopal, “Control system engineering”, New age International.

References:

1. Arun K. Ghosh, “Introduction to control system”PHI Learning Pvt. Ltd.
2. Norman S. Nise, “Nise’s Control system engineering”, Wiley.

Control System Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-4	ICE-409T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To make student capable in analyzing the system in time and frequency domain.
2.	To make students capable of doing reliazation of compensators.
3.	To make students enable to design the controllers
4.	To make students remember the concepts of stste feedback controllers and observers.

Course Outcomes (CO)

CO 1	Analyze the system in time and frequency domain as well as design the compensator using root locus approach
CO 2	Realization of compensator using frequency response approach.
CO 3	Design the controllers using classical method as well as synthesis of controller
CO 4	Understand the concept of state feedback controllers and observers

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	-	3	-	3	3	3	-	-	3
CO 2	3	3	-	-	3	-	3	3	3	-	-	3
CO 3	3	2	3	-	3	-	3	3	3	-	-	3
CO 4	3	-	-	-	3	-	-	-	-	-	-	3

Unit I

State Space Representation of Continuous Time Systems: Terminology of state space representation, advantages of state space representation over classical representation, physical variable form, phase variable forms: controllable canonical form (companion I), observable canonical form (companion II), diagonal/Jordon canonical form (parallel realization), cascade realization, conversion of state model to transfer function.
Solution of State Equation: State Transition Matrix and its properties, computation of state transition matrix using Laplace transformation method, Cayley Hamilton theorem

Unit II

Analysis and Design of Control System in State Space: Controllability, obersvability and detectability properties, Necessary and sufficiency conditions for complete state controllability and observability, State feedback structure, Pole placement design using state feedback. State observers – Full state observer.

Unit III

Introduction to Compensator: Derivative and integral error compensation, Analysis of the basic approaches to compensation, cascade compensation, feedback compensation
Compensator Design using Root-locus: Improving steady-state error and transient response by feedback compensation, cascade compensation, integral, derivative compensation, Lag, Lead, Lag-Lead compensation

Unit IV

Compensator Design using Frequency response: Systems with time delay, transient response through gain adjustment, Lag, Lead, Lag-Lead compensation
PID Controller Design: PID controller tuning: Ziegler-Nichols method, Cohen-coon method, Designing PID controller using Root-Locus

Textbooks:
1. I.J Nagrath, M.Gopal, "Control system engineering", 3rd ed. John Wiley & Sons 2003.
2. K.Ogata, "Modern Control Engineering", 2nd ed. PHI New Delhi, 1994.

References:
1. Norman S. Nise, "Control System Engineering", 4th ed. John Wiley and Sons, 2003.
2. B.C. Kuo, "Automatic Control Systems", 3rd ed., PHI New Delhi, 1979.
3. Graham C. Goodwin, Stefan F. Graebe and M.E. Salgado, "Control System Design", PHI, New Delhi , 2002

Control System Design Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
ICE	7	PCE	PCE-4	ICE-409P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Control System Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of magnitude and phase characteristics of lead, lag and lead-lag compensator.
2. Design a lead/lag compensator for getting desired specifications by root locus approach.
3. Design a lead/lag compensator for getting desired specifications by bode plot approach.
4. Simulation of controller settings of P, PI ,PID controllers (K_P ,T_i , T_d) obtained through Ziegler-Nichols first and second method.
5. Design of PI/PD/PID controller for getting required performance specifications (damping factor, natural frequency, steady state error, phase margin, static error constants) using root locus and bode plot approaches.
6. Design a controller using direct controller synthesis for getting specified closed loop response.
7. Conversion of transfer function model to state space and vice versa.
8. Check for complete state controllability and complete state observability of a given system.
9. Design full order state observer using principle of duality between state feedback gain matrix K and observer gain matrix Ke
10. Performance comparison two controller tuning methods based on performance indices such as ISE, IAE, ITAE and ITSE.

Control Systems	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	ECE-OAE	ECE-OAE-5A	OECE-423

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand basics of control systems and its mathematical modelling.
2.	To analyse non-linear control system and determine the describing function and stability.
3.	To represent various systems in state space form and evaluate their transfer function.
4.	To compare advanced control systems and study their applications.

Course Outcomes (CO)

CO 1	Able to classify control systems and derive transfer function using various methods. They will easily demonstrate mathematical modelling of various control systems.
CO 2	Able to understand significance of non-linear systems and relevance of describing function approach.
CO 3	Able to represent systems in matrix form.
CO 4	Able to gain knowledge about modern control systems and their advantages to assess modern technology.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	2	2	3	3	3
CO 2	3	3	3	3	3	3	3	2	2	3	2	3
CO 3	3	3	3	3	3	2	2	2	2	2	2	3
CO 4	3	3	3	3	3	3	3	2	2	3	3	3

UNIT-I

Introduction to Control Systems and its Applications: Introduction to Control systems and its significance, Importance and limitation of transfer function approach, Mathematical modelling of Translational, Rotational, Electrical Analog of Mechanical Systems

UNIT-II

Non-Linear Control Systems: Introduction to Non-linear Control System, Methods to find transfer function of non-linear systems, Describing function analysis of dead zone, relay, backlash, saturation and element with hysteresis, Lyapunov’s stability.

UNIT-III

State Space Analysis: Concept of state, state space equations, state space representation of multivariable systems, Deriving state equation from transfer function, Properties of linear transformation, Vander-monde Matrix.

UNIT-IV

Analysis of Modern Control systems: Introduction to controllability and observability, State observer, Design of state Observer, Transfer function Matrix, Introduction to Adaptive control, Fuzzy logic and Neuro-Fuzzy control system with their applications, block diagram representation and limitations.

Textbook(s):
1. B. C. Kuo, “Automatic control system”, Prentice Hall of India, 7th edition 2001.
2. Nagrath Gopal, “Control Systems Engineering: Principles and Design”, New Age Publications.
3. M. Gopal, “Control Systems-Principles and Design” TMH 4th Edition 2012.
4. K. Ogata, “Modern Control Engineering” Pearson 5th Edition 2009.

Reference Book(s):
1. Norman S. Nise, “Control systems engineering” John Wiley & Sons (Asia) Singapore.
2. Raymond T. Stefani, Design of Feedback Control System, Oxford University Press.

Control Systems and Applications	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	5	PC	PC	MAC-313
ME	7	PCE	PCE-4	MEE-407T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide an understanding about the concepts of transfer unction and its evaluation.
2.	To expose the students to time response of control systems
3.	To understand the frequency response of control systems
4.	To study compensators and controllers

Course Outcomes (CO)

CO 1	Ability to define, understand various terms related to control system and evaluation of transfer function
CO 2	Ability to apply knowledge of various types of signals in time response of systems
CO 3	Ability to analyse frequency response of systems
CO 4	Ability to design compensators and controllers

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT I

Control Systems - Basics & Components Introduction to basic terms, classifications & types of Control Systems, Mathematical modelling of real life systems, block diagrams & signal flow graphs. Transfer function, determination of transfer function using block diagram reduction techniques and Mason’s Gain formula. Control system components: Electrical/ Mechanical/Electromechanical/A.C./D.C. Servo Motors, Stepper Motors, Tacho Generators,thermal , hydraulic and pneumatic systems.

UNIT II

Time – Domain Analysis of real life problems, Time domain performance specifications, transient response of first & second order systems, steady state errors and static error constants in unity feedback control systems, response with P, PI and PID controllers, limitations of time domain analysis.

UNIT III

Frequency Domain Analysis Polar and inverse polar plots, frequency domain specifications and performance of LTI systems, Logarithmic plots (Bode plots), gain and phase margins, relative stability. Correlations with time domain performance closes loop frequency responses from open loop response. Limitations of frequency domain analysis, minimum/nonminimum phase systems.

UNIT IV

Stability & Compensation Techniques Concepts, absolute, asymptotic, conditional and marginal stability, Routh–Hurwitz and Nyquist stability criterion, Root locus technique and its application. Concepts of compensation, series/parallel/ series-parallel/feedback compensation, Lag/Lead/Lag-Lead networks for compensation, compensation using P, PI, PID controllers.

Text Books:

1. B. C. Kuo, “Automatic control system”, Prentice Hall of India, 7th edition 2001.
2. Nagraath Gopal “Control Systems Engineering -Principles and Design” New Age Publishers

Reference Books:

1. Norman S. Nise, “Control systems engineering” John Wiley & Sons (Asia) Singapore.
2. Raymond T. Stefani, Design of Feedback Control System, Oxford University Press.
3. K. Ogata, “Modern control engineering”, Pearson 2002.
4. S. P.Eugene Xavier, “Modern control systems”, S. Chand & Company.
5. M. Gopal “Control Systems-Principles and Design” TMH 4th Edition 201

Control Systems and Applications Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	5	PC	PC	MAC-359
ME	7	PCE	PCE-4	MEE-407P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Control Systems and Applications) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of open loop and closed loop time/ frequency responses of first/second order LTI system
2. Conversion of transfer functions to state model of LTI system and vice versa
3. Determine State Space Model of a given system and determine its controllability and observability.
4. Analysis of Zero order hold and first order hold circuits.
5. Conversion of transfer functions to state model of discrete time system.
6. To determine state transition matrix of a given system.
7. Study of saturation and dead zone non-linearity using describing function technique of a relay control system.
8. To draw phase trajectory of a given non-linear system.
9. Experiments based on PLC applications e.g. Lift control models, pick and place module etc.
10. Study of operation of a stepper motor interface with microprocessor.

Control Systems for Electrical Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	EE-OAE	EE-OAE-3	OEE-427T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide an understanding about the concepts of transfer unction and its evaluation.
2.	To expose the students to time response of control systems
3.	To understand the frequency response of control systems
4.	To study compensators and controllers

Course Outcomes (CO)

CO 1	Ability to define, understand various terms related to control system and evaluation of transfer function
CO 2	Ability to apply knowledge of various types of signals in time response of systems
CO 3	Ability to analyse frequency response of systems
CO 4	Ability to design compensators and controllers

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT I

Control Systems - Basics & Components Introduction to basic terms, classifications & types of Control Systems, Mathematical modelling of real life systems, block diagrams & signal flow graphs. Transfer function, determination of transfer function using block diagram reduction techniques and Mason’s Gain formula. Control system components: Electrical/ Mechanical/Electromechanical/A.C./D.C. Servo Motors, Stepper Motors, Tacho Generators, Synchros, Magnetic Amplifiers, Servo Amplifiers.

UNIT II

Time – Domain Analysis of real life problems, Time domain performance specifications, transient response of first & second order systems, steady state errors and static error constants in unity feedback control systems, response with P, PI and PID controllers, limitations of time domain analysis.

UNIT III

Frequency Domain Analysis Polar and inverse polar plots, frequency domain specifications and performance of LTI systems, Logarithmic plots (Bode plots), gain and phase margins, relative stability. Correlation with time domain performance closes loop frequency responses from open loop response. Limitations of frequency domain analysis, minimum/nonminimum phase systems.

UNIT IV

Stability & Compensation Techniques Concepts, absolute, asymptotic, conditional and marginal stability, Routh–Hurwitz and Nyquist stability criterion, Root locus technique and its application. Concepts of compensation, series / parallel / series-parallel / feedback compensation, Lag / Lead / Lag-Lead networks for compensation, compensation using P, PI, PID controllers.

Text Books:

1. B. C. Kuo, “Automatic control system”, Prentice Hall of India, 7th edition 2001.
2. Nagraath Gopal “Control Systems Engineering -Principles and Design” New Age Publishers

Reference Books:

1. Norman S. Nise, “Control systems engineering” John Wiley & Sons (Asia) Singapore.
2. Raymond T. Stefani, Design of Feedback Control System, Oxford University Press.
3. K. Ogata, “Modern control engineering”, Pearson 2002.
4. S. P. Eugene Xavier, “Modern control systems”, S. Chand & Company.
5. M. Gopal “Control Systems-Principles and Design” TMH 4th Edition 201

Control Systems for Electrical Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	EE-OAE	EE-OAE-3	OEE-427P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Control Systems for Electrical Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of open loop and closed loop time/ frequency responses of first/second order LTI system
2. Conversion of transfer functions to state model of LTI system and vice versa
3. Determine State Space Model of a given system and determine its controllability and observability.
4. Analysis of Zero order hold and first order hold circuits.
5. Conversion of transfer functions to state model of discrete time system.
6. To determine state transition matrix of a given system.
7. Study of saturation and dead zone non-linearity using describing function technique of a relay control system.
8. To draw phase trajectory of a given non-linear system.
9. Experiments based on PLC applications e.g. Lift control models, pick and place module etc.
10. Study of operation of a stepper motor interface with microprocessor.

Cryogenic Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	TES-EAE	TES-EAE-1	TES-330T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the history, developments, principles, scope and applications of Cryogenic Engineering and materials.
2.	To understand the thermal analysis of Liquefaction cycles.
3.	To understand the operation of various cryogen liquefaction systems with critical components involved.
4.	To understand the vacuum technology as well as safety aspects in the domain of Cryogenic engineering.

Course Outcomes (CO)

CO 1	To explain and exemplify the history and developments as well as scope and applications of Cryogenic Engineering and interpret behaviour of engineering materials and fluids at cryogenic temperatures.
CO 2	To discuss and analyse Liquefaction cycles.
CO 3	To explain the fundamental principles of various cryogen liquefaction systems with critical components involved.
CO 4	To interpret the various vacuum technology and apply various safety aspects in Cryogenic engineering.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	3	-	-	-	-	--	-	-	2

UNIT-I

Introduction & History of Cryogenic Engineering: Historical background, Developments, Scope of application, Present areas involving Cryogenic Engineering, Principles of Thermodynamics, Heat Transfer, Momentum Transfer, Cool down.
Low Temperature Properties of Engineering Materials: Mechanical Properties, Thermal Properties, Electrical and Magnetic Properties of solids including metals and nonmetals (insulators), Design considerations, Material selection criterion.
Cryogenic Fluids: P-V-T Behaviour of a Pure substance, T-s and T-h diagrams of a Pure substance, Properties of cryogenic fluids.

UNIT-II

Thermodynamics of Ideal Liquefaction Cycles: Joule-Thompson effect, Linde cycle, Precooled Linde cycle, Exercise, Claude, Heylandt, and Kapitza cycles.
Measurement of Temperature: Gas and vapour pressure Thermometers, Thermocouple, RTD and Semiconductors sensors, Types of cryogenic.
Insulation: Foam, Fibre, Powder vacuum.

UNIT-III

Gas Liquefaction Systems: Properties of materials at cryogenic temperature, Gas Liquefaction and Refrigeration Systems, Heat exchangers and definition of effectiveness, Coiled tube (Hampson type) and Brazed Aluminum heat exchangers, Cryogenic expansion engines and turbines, Principal of binary Distillation, Linde signal & double column system, Liquefaction systems for Neon and Hydrogen, Liquefaction systems for Helium.

UNIT - IV

Vacuum Technology: Importance of vacuum technology in cryogenic, Flow regimes in vacuum systems, Conductance in vacuum system, Components of vacuum system, Different types of vacuum pumps, Cryo pumping, Getter sand sorption pumping, Vacuum gauges, Vacuum valves.
Safety with Cryogenic Systems: Introduction, Physiological hazards, Suitability of materials and construction techniques, Explosions and flammability, Excessive pressure gas, Special considerations for Hydrogen and Oxygen gas, General safety principles, Safety checklist.

Textbook(s):

1. R. F. Barron, "Cryogenics Systems", Oxford Univesity Press New York, Clarendon Press, Oxford.
2. Flynn & M Thomas, "Cryogenic Engineering", CRC Press, New York.

References:

1. Pipkov, "Fundamentals of Vacuum Engineering", Meer Publication.
2. G.M Walker, "Cryocooler-Part 1 Fundamentals", Plenum Press, New York and London.
3. 3. G.M Walker, "Cryocooler-Part 2" Plenum Press", New York and London.

Cryogenic Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	TES-EAE	TES-EAE-1	TES-330P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Cryogenic Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study and analysis of cryogenic properties of hydrogen and helium.
2. Study of low temperature measurement instrument.
3. Study of flow measurement and quality measurement instrument.
4. Study of liquid level measurement.
5. Study of insulation used in cryogenic equipment.
6. Study of cryogenic application (superconductivity).
7. Study of cryogenic application in space technology.
8. Study of cryogenic application in bio medical and food preservation.
9. Study of safety while handling fluid.
10. Study and analysis of ideal liquefaction system.
11. Study and analysis of isothermal source cryo-refrigeration system.
12. Study and analysis of hydrogen liquefaction system.
13. Study and analysis of helium liquefaction system.
14. Thermodynamic analysis of low temperature application refrigeration system.
15. Performance evaluation of low temperature application refrigeration system.

Cyber Crime and Cyber Laws	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-ICB/CSE-CS	7	PC	PC	CS-421

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the threats in networks and security concepts.
2.	Apply authentication applications in different networks.
3.	Understand security services for email.
4.	Awareness of firewall and it applications

Course Outcomes (CO)

CO 1	Understands the different elements of cybercrime and how to deal with such issues with clarity
CO 2	Analysis of various legal provisions of cyber-crimes and the mechanism of their enforcement.
CO 3	To Know the essential legal provisions of internet-governance.
CO 4	To understand the Prevention of Cyber Crimes.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1		-	-	-	1	1	-	1
CO 2	3	3	2	1		-	-	-	1	1	-	1
CO 3	3	2	1	2	2	-	-	-	1	1	-	2
CO 4	3	3	1	1	2	-	-	-	1	1	-	1

UNIT-I

Cyber Crime- Overview, Internal and External Attacks, Attack Vectors. Cybercrimes against Individuals – E-mail spoofing and online frauds, Phishing and its forms, Spamming, Cyber-defamation, Cyberstalking, Cyber Bullying and harassment, Computer Sabotage, Pornographic offenses, Password Sniffing. Keyloggers and Screenloggers.

UNIT-II

Cybercrime against organization – Unauthorized access of computer, Password Sniffing, Denial-of-service (DOS) attack, Backdoors and Malwares and its types, E-mail Bombing, Salami Attack, Software Piracy, Industrial Espionage, Intruder attacks. Security policies violations, Crimes related to Social Media, ATM, Online and Banking Frauds. Intellectual Property Frauds. Cyber Crimes against Women and Children

UNIT-III

The World Wide Web, Web Centric Business, e-Business Architecture, Models of e-Business, e-Commerce, Threats to virtual world. IT Act 2000 - Objectives, Applicability, Non-applicability, Definitions, Amendments and Limitations. Cyber Crimes- Cyber Squatting, Cyber Espionage, Cyber Warfare, Cyber Terrorism, Cyber Defamation. Social Media-Online Safety for women and children, Misuse of Private information.

UNIT - IV

Information Technology Act 2000, Digital Signature, E-Signature, Electronic Records, Electronic Evidence and Electronic Governance. Controller, Certifying Authority and Cyber Appellate Tribunal. (Rules announced under the Act), Network and Network Security, Access and Unauthorized Access, Data Security, E Contracts and E Forms.

Textbook(s):

1. Nina Godbole and Sunit Belapore; "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publications, 2011.
2. Karnika Seth; "Computers, Internet and New Technology Laws", Lexis Nexis Buttersworth Wadhwa, 2012.
3. Vikas Vashishth.; "Law and practice of intellectual property in India"

References:

1. William Stallings; "Cryptography and Network Security: Principles and Practices", Fifth Edition, Prentice Hall Publication Inc., 2007.
2. Harish Chander; "Cyber Laws and IT Protection", PHI Learning Pvt. Ltd, 2012
3. Shon Harris, "All in One CISSP, Exam Guide Sixth Edition", McGraw Hill, 2013.

Cyber Crime and Cyber Laws	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CS-EAE	CS-EAE-3	CS-421T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the threats in networks and security concepts.
2.	Apply authentication applications in different networks.
3.	Understand security services for email.
4.	Awareness of firewall and it applications

Course Outcomes (CO)

CO 1	Understands the different elements of cybercrime and how to deal with such issues with clarity
CO 2	Analysis of various legal provisions of cyber-crimes and the mechanism of their enforcement.
CO 3	To Know the essential legal provisions of internet-governance.
CO 4	To understand the Prevention of Cyber Crimes.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1	-	-	-	-	1	1	-	1
CO 2	3	3	2	1	-	-	-	-	1	1	-	1
CO 3	3	2	1	2	2	-	-	-	1	1	-	2
CO 4	3	3	1	1	2	-	-	-	1	1	-	1

UNIT-I

Cyber Crime- Overview, Internal and External Attacks, Attack Vectors. Cybercrimes against Individuals – E-mail spoofing and online frauds, Phishing and its forms, Spamming, Cyber-defamation, Cyberstalking, Cyber Bullying and harassment, Computer Sabotage, Pornographic offenses, Password Sniffing. Keyloggers and Screenloggers.

UNIT-II

Cybercrime against organization – Unauthorized access of computer, Password Sniffing, Denial-of-service (DOS) attack, Backdoors and Malwares and its types, E-mail Bombing, Salami Attack, Software Piracy, Industrial Espionage, Intruder attacks. Security policies violations, Crimes related to Social Media, ATM, Online and Banking Frauds. Intellectual Property Frauds.

UNIT-III

The World Wide Web, Web Centric Business, e-Business Architecture, Models of e-Business, e-Commerce, Threats to virtual world. IT Act 2000 - Objectives, Applicability, Non-applicability, Definitions, Amendments and Limitations. Cyber Crimes- Cyber Squatting, Cyber Espionage, Cyber Warfare, Cyber Terrorism, Cyber Defamation.

UNIT - IV

Digital Signature, E-Signature, Electronic Records, Electronic Evidence and Electronic Governance. Controller, Certifying Authority and Cyber Appellate Tribunal. (Rules announced under the Act), Network and Network Security, Access and Unauthorized Access,.

Textbook(s):

1. Nina Godbole and Sunit Belapore; "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publications, 2011.
2. Karnika Seth; "Computers, Internet and New Technology Laws", Lexis Nexis Buttersworth Wadhwa, 2012.
3. Vikas Vashishth. "Law and practice of intellectual property in India"

References:

1. William Stallings; "Cryptography and Network Security: Principles and Practices", Fifth Edition, Prentice Hall Publication Inc., 2007.
2. Harish Chander; "Cyber Laws and IT Protection", PHI Learning Pvt. Ltd, 2012
3. Shon Harris, "All in One CISSP, Exam Guide Sixth Edition", McGraw Hill, 2013.

Cyber Crime and Cyber Laws Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CS-EAE	CS-EAE-3	CS-421P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Cyber Crime and Cyber Laws) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Checklist for reporting cyber crime at Cyber crime Police Station.
2. Checklist for reporting cyber crime online.
3. Reporting phishing emails.
4. Demonstration of email phishing attack and preventive measures.
5. Basic checklist, privacy and security settings for popular Social media platforms.
6. Reporting and redressal mechanism for violations and misuse of Social media platforms.
7. Do’s and Don’ts for posting content on Social media platforms.
8. Registering complaints on a Social media platform.
9. List out security controls for mobile phone and implement technical security controls in the personal mobile phone.
10. Log into computer system as an administrator and check the security policies in the system.

Cyber Security and Forensics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-CS	7	PC	PC	CS-423T
EAE	7	ICB-EAE	ICB-EAE-3	CS-423T
EAE	7	CS-EAE	CS-EAE-4	CS-423T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Understand the threats in networks and security concepts.
2.	To Apply authentication applications in different networks.
3.	To correctly define and cite appropriate instances for the application of computer forensics Correctly collect and analyze computer forensic evidence
4.	Identify the essential and up-to-date concepts, algorithms, protocols, tools, and methodology of Computer Forensics

Course Outcomes (CO)

CO 1	Understand the foundations of Cyber security and threat landscape
CO 2	Analyze governance, regulatory, legal, economic, environmental, social and ethical contexts of cyber security
CO 3	Understand the concept of Cyber security and issues and challenges associated with it.
CO 4	Understand the cyber crimes, their nature, legal remedies and as to how report the crimes through available platforms and procedures

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1	-	-	-	-	-	1	1	1
CO 2	3	3	2	2	-	-	-	-	-	1	1	1
CO 3	3	2	1	2	2	-	-	-	-	2	1	2
CO 4	3	3	1	1	2	-	-	-	-	1	1	1

UNIT-I

Introduction to Incident Response Process Computer Security Incident, Goals of Incident response, Who is involved in Incident response, Incidence Response Methodology, Preincident preparation, Detection of Incidents, Initial response, Formulate a response strategy, Investigate the incident, Reporting and Resolution.

UNIT-II

Preparing for Incidence Response : preparing Individual Hosts, Recording of Cryptographic Checksum of critical files, enabling secure Audit Logging, Building Up your Hosts Defense, Preparing a Network : Installing Firewalls and IDS, User access control Lists, Establishing Appropriate Policies and procedures, creating a response tool Kit, Establishing an Incident Response Team, Incident handling After Detection of an Incident.

UNIT-III

Fundamentals of Computer Forensics, Computer Forensics Technology, Live data collection from Windows systems, Live data Collection from Unix systems, Data Acquisition of digital evidence from electronic media, Evidence collection and preservation, Network Forensics, Email Investigations, Mobile device forensics, Computer Forensics Analysis and Validation, Macro Threats,

UNIT - IV

Data analysis Techniques : Preparation for Forensic Analysis, Restoring a forensics Duplicate, Recovering deleted files on Windows systems, recovering Unallocated Space, Free Space and Slack space, Writing forensic Reports, Report Writing Guidelines.

Textbook(s):
1. K Mandla, C. Prosise , Matt Pepe, “ Incident Response and Computer Forensics”, 2nd Edition, 2003, TMH
2. John R. Vacca, “Computer Forensics”, 2nd Edition, 2004, Firewall Media.

References:
1. Chad Steel, “Windows Forensics”, 1 st Edition, 2006, Wiley India,
2. R M Slade, “ Software Forensics”, 1 st Edition, 2004, TMH
3. Majid Yar, “Cybercrime and Society”, 1 st Edition, 2006, Sage Publications.

Cyber Security and Forensics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-CS	7	PC	PC	CS-423P
EAE	7	ICB-EAE	ICB-EAE-3	CS-423P
EAE	7	CS-EAE	CS-EAE-4	CS-423P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Cyber Security and Forensics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Creating a Forensic Image using FTK Imager/Encase Imager
2. Perform data acquisition using USB Write Blocker and FTK Imager
3. Forensics Case Study : Solve the Case study (image file) provide in lab using Encase

   Investigator or Autopsy
4. Capturing and analyzing network packets using Wireshark Recovering and Inspecting deleted files
   - Check for Deleted Files
   - Recover the Deleted Files
   - Analyzing and inspecting the recovered files
5. Installation and configuration of Computer Host Firewall.
6. Demonstration of email phishing attack and preventive measures.
7. Installation and configuration of computer Anti-virus.
8. Do’s and Don’ts for posting content on Social media platforms
9. Wi-Fi security management in computer and mobile
10. Setting and configuring two factor authentications in the Mobile phone.

Cyber Security for Industrial Automation	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-5	ICE-419T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the knowledge of internet along with the changing trends in the cyber technologies.
2.	Understand the various security threats and vulnerabilities of the cyber world keeping in line with the industrial trends.
3.	Understand how web technology works, how web server capability is used in industry, and the security problems engendered by such use
4.	Locate web technologies where they can be used securely for industrial automation.

Course Outcomes (CO)

CO 1	Understand concept of security mechanisms, standards and state-of–the-art capabilities.
CO 2	Identify and solve different cyber security threats.653
CO 3	Develop and maintain new tools and technologies to enhance the security of applications in industrial automation.
CO 4	Design new systems and infrastructure level security solutions.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	-	-	-	-	2	-	2	2	2	3
CO 2	3	3	2	3	-	-	3	-	2	3	3	3
CO 3	3	3	2	3	-	-	3	-	2	3	3	3
CO 4	3	3	3	3	-	-	3	-	3	3	3	3

Unit I

Information System Security Technology- Types and classes of attack, Policies, Standards, Guidelines and procedures, Malicious code and attacks, Firewalls, Cryptography, Attacks against cryptosystems. Industrial Automation Culture versus Information Technology (IT) Paradigms- Considerations in adapting IT security methods to industrial automation, Threats, IT and industrial automation.

Unit II

Risk Management for Industrial Automation- Risk management, ANSI/ISA-62443-2-1 (99.02.01)-2009 cyber security, Risk analysis, Addressing risk, NIST SP 800-39 Integrated enterprise risk management, Threats.

Unit III

Industrial Automation Trends, Approaches, and Issues- Automation trends, Formal methods used to quantify and standardize, Important concepts and applications -Information security continuous monitoring (ISCM) strategy, The Smart Grid Maturity Model (SGMM), Future smart grid issues and automation security issues.

Unit IV

Emerging Approaches to Industrial Automation Security- Internet of Things, Open platform communications unified architecture, Security and privacy, Big data analytics and the industrial Internet of Things, The National Institute of Standards Technology (NIST) Cyber-Physical Systems (CPS) Framework

Textbooks:

1. Ronald L. Krutz, "Industrial Automation and Control System Security Principles: Protecting the Critical Infrastructure", 2nd Edition, International Society of Automation, 2017.
2. David J. Teumim, "Industrial Network Security, Second Edition", International Society of Automation, 2010.

References:

1. Lawrence M. Thompson and Tim Shaw, "Industrial Data Communications", Fifth Edition, International Society of Automation, 2015.
2. Dick Caro, "Automation Network Selection: A Reference Manual", 3rd Edition, Paperback, International Society of Automation, 2016.

Cyber Security for Industrial Automation Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-5	ICE-419P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Cyber Security for Industrial Automation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Implement following substitution and transportation techniques concepts i)Caesar Chiperb ii) Rail fence row and column transformation
2. Implement the following Attack: a) Dictionary Attack b) Brute Force Attack.
3. Perform an Experiment to Sniff Traffic using ARP Poisoning.
4. Demonstrate intrusion detection system using any tool (snort or any other s/w)
5. Demonstrate how to provide secure data storage, secure data transmission and for creating digital signatures.
6. Installation of rootkits and study about the variety of options.
7. Network enumeration through port scanning, SYN flooding
8. Find vulnerabilities of target system through Nessus vulnerability Scanner
9. Perform anonymity through e-mail spoofing and bombing using PHP. Subsequently detect these attacks through analyzing the e-mail header.
10. Generating password hashes using Open SSL

Data Analytics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	MLDA-EAE	MLDA-EAE-2A	DA-338T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To develop the fundamental concepts such as data analysis, data pre-processing
2.	To learn about the various data modelling techniques
3.	To learn three different mining techniques.
4.	Exposure to Data Analytics with R

Course Outcomes (CO)

CO 1	Discuss various concepts of data analytics
CO 2	Apply classification and regression techniques
CO 3	Explain and apply mining techniques on streaming data
CO 4	Describe the concept of R programming and implement analytics on Big data using R.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	-	3	-	2	-	-	-	-	-	-	-
CO 2	1	-	3	-	-	2	-	-	3	1	-	-
CO 3	1	-	2	-	-	2	-	-	-	-	-	-
CO 4	1	-	3	-	-	3	1	-	2	-	-	-

UNIT-I

Introduction to Data Analytics: Sources and nature of data, classification of data (structured, semi-structured, unstructured), characteristics of data, introduction to Big Data platform, need of data analytics, evolution of analytic scalability, analytic process and tools, analysis vs reporting, modern data analytic tools, applications of data analytics. Data Analytics Lifecycle: Need, key roles for successful analytic projects, various phases of data analytics lifecycle – discovery, data preparation, model planning, model building, communicating results, and operationalization.

UNIT-II

Data Analysis: Regression modeling, multivariate analysis, Bayesian modeling, inference and Bayesian networks, support vector and kernel methods, analysis of time series: linear systems analysis & nonlinear dynamics, rule induction, neural networks: learning and generalisation, competitive learning, principal component analysis and neural networks.

UNIT-III

Mining Data Streams: Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, Real-time Analytics Platform (RTAP) applications, Case studies – real time sentiment analysis, stock market predictions.

UNIT – IV

Frame Works and Visualization: MapReduce, Hadoop, Pig, Hive, HBase, MapR, Sharding, NoSQL Databases, S3, Hadoop Distributed File Systems, Visualization: visual data analysis techniques, interaction techniques, systems and applications. Introduction to R - R graphical user interfaces, data import and export, attribute and data types, descriptive statistics, exploratory data analysis, visualization before analysis, analytics for unstructured data.

Textbook(s):

1. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier.
2. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer

References:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley.
2. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big Data Analytics", EMC Education Series, John Wiley

Data Analytics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	MLDA-EAE	MLDA-EAE-2A	DA-338P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Data Analytics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) using in R.
2. To perform data import/export (.CSV, .XLS, .TXT) operations using data frames in R
3. To get the input matrix from user and perform Matrix addition, subtraction, multiplication, inverse transpose and division operations using vector concept in R
4. To perform statistical operations (Mean, Median, Mode and Standard deviation) using R
5. To perform data pre-processing operations i) Handling Missing data ii) Min-Max normalization
6. To perform dimensionality reduction operation using PCA for Houses Data Set.
7. To perform Simple Linear Regression with R..
8. To perform K-Means clustering operation and visualize for iris data set
9. Write R script to diagnose any disease using KNN classification and plot the results.
10. To perform market basket analysis using Association Rules (Apriori).

Data Communication and Networking	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	5	PC	PC	ECC-311

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To build an understanding of the fundamental concepts of data communication.
2.	To familiarize the student with the basic taxonomy of data link layer.
3.	To understand and implements the network routing, IP addressing, subnetting.
4.	To enumerate the functions of transport layer and application layer.

Course Outcomes (CO)

CO 1	Understand basic concepts of data communications.
CO 2	Understand and explain various functions of data link layerr.
CO 3	Understand and implements the network routing, IP addressing, subnetting.
CO 4	Enumerate the functions of transport layer and application layer.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1	3	1	-	-	-	-	-	3
CO 2	3	2	1	1	3	1	-	-	-	-	-	3
CO 3	3	2	1	1	3	1	-	-	-	-	-	3
CO 4	3	2	1	1	3	1	-	-	-	-	-	3

UNIT- I

Data Communications : Components, protocols and standards, Network and Protocol Architecture, Reference Model ISO-OSI, TCP/IP-Overview ,topology, transmission mode, digital signals, digital to digital encoding, digital data transmission, DTE-DCE interface, interface standards, modems, cable modem, transmission media- guided and unguided, transmission impairment, Performance, wavelength and Shannon capacity. Review of Error Detection and Correction codes.

Switching: Circuit switching (space-division, time division and space-time division), packet switching (virtual circuit and Datagram approach), message switching.

UNIT- II

Data Link Layer: Design issues, Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, Point-to –Point Access: PPP Point –to- Point Protocol, PPP Stack

Medium Access Sub layer: Channel allocation problem, Controlled Access, Channelization, multiple access protocols, IEEE standard 802.3 & 802.11 for LANS and WLAN, high-speed LANs, Token ring, FDDI based LAN, Network Devices-repeaters, hubs, switches bridges.

UNIT- III

Network Layer: Design issues, Routing algorithms, Congestion control algorithms,
Host to Host Delivery: Internetworking, addressing and routing, IP addressing (class full & Classless), Subnet, Network Layer Protocols: ARP, IPV4, ICMP, IPV6 ad ICMPV6.

UNIT- IV

Transport Layer: Process to Process Delivery: UDP; TCP, congestion control and Quality of service.
Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP), file transfer (FTP), HTTP and WWW.

Text Books:

1. A. S. Tannenbum, D. Wetherall, "Computer Networks", Prentice Hall, Pearson, 5th Ed
2. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, 4th Ed

Reference Books:

1. Fred Halsall, "Computer Networks", Addison – Wesley Pub. Co. 1996.
2. Larry L, Peterson and Bruce S. Davie, "Computer Networks: A system Approach", Elsevier, 4th Ed
3. Tomasi, "Introduction To Data Communications & Networking", Pearson 7th impression 2011
4. William Stallings, "Data and Computer Communications", Prentice Hall, Imprint of Pearson, 9th Ed.
5. Zheng , "Network for Computer Scientists & Engineers", Oxford University Press
6. Data Communications and Networking: White, Cengage Learning

Data Communication and Networking Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	5	PC	PC	ECC-359

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Data Communication and Networking) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Computer Network laboratory
   Introduction to Discrete Event Simulation
   Discrete Event Simulation Tools - ns2/ns3, Omnet++
2. Using Free Open Source Software tools for network simulation – I Preliminary usage of the tool ns3
   Simulate telnet and ftp between N sources - N sinks (N = 1, 2, 3). Evaluate the effect of increasing data rate on congestion.
3. Using Free Open Source Software tools for network simulation - II
   Advanced usage of the tool ns3
   Simulating the effect of queueing disciplines on network performance - Random Early Detection/Weighted RED / Adaptive RED (This can be used as a lead up to DiffServ / IntServ later).
4. Using Free Open Source Software tools for network simulation - III
   Advanced usage of the tool ns3 Simulate http, ftp and DBMS access in networks
5. Using Free Open Source Software tools for network simulation - IV
   Advanced usage of the tool ns3
   Effect of VLAN on network performance - multiple VLANs and single router.
6. Using Free Open Source Software tools for network simulation - IV
   Advanced usage of the tool ns3
   Effect of VLAN on network performance - multiple VLANs with separate
   multiple routers.
7. Using Free Open Source Software tools for network simulation - V
   Advanced usage of the tool ns3
   Simulating the effect of DiffServ / IntServ in routers on throughput enhancement.
8. Using Free Open Source Software tools for network simulation - VI
   Advanced usage of the tool ns3
   Simulating the performance of wireless networks
9. Case Study I : Evaluating the effect of Network Components on Network Performance
   To Design and Implement LAN With Various Topologies and To Evaluate Network Performance Parameters for DBMS etc)
10. Case Study II : Evaluating the effect of Network Components on Network Performance
    To Design and Implement LAN Using Switch/Hub/Router As Interconnecting Devices For Two Different LANs and To Evaluate Network Performance Parameters.
11. Mini project - one experiment to be styled as a project of duration 1 month (the last month)

Data Pre-processing and Post Processing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	6	PC	PC	DS-344T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Build an understanding of the fundamental concepts of data science and to make them understand the importance of data collection and pre-processing tasks.
2.	Familiarize the student with various exploratory data analytics techniques.
3.	Introduce the student to model development and evaluation techniques.
4.	Will be able to learn model evaluation and generalization error techniques.

Course Outcomes (CO)

CO 1	Understand the fundamental concepts of data science and to make them understand the importance of data collection and pre-processing tasks.
CO 2	Explain various exploratory data analytics techniques.
CO 3	Understand of various model development and evaluation techniques.
CO 4	Apply mechanism for model evaluation and generalizing error techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	3	-	-	-	3	2	3	3
CO 2	3	3	2	2	2	-	-	-	3	3	2	3
CO 3	3	3	2	3	3	-	-	-	3	3	3	3
CO 4	3	3	2	3	3	-	-	-	3	3	3	3

UNIT-I

Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.
Data Collection and Data Pre-Processing Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.

UNIT-II

Exploratory Data Analytics Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map – Correlation Statistics – ANOVA.

UNIT-III

Model Development Simple and Multiple Regression – Model Evaluation using Visualization – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Measures for In-sample Evaluation – Prediction and Decision Making.

UNIT – IV

Model Evaluation Generalization Error – Out-of-Sample Evaluation Metrics – Cross Validation – Overfitting – Under Fitting and Model Selection – Prediction by using Ridge Regression – Testing Multiple Parameters by using Grid Search

Textbook(s):

1. Daniel T. Larose; Chantal D. Larose, "Data Preprocessing," in Discovering Knowledge in Data: An Introduction to Data Mining, Wiley, 2014, pp.16-50, doi: 10.1002/9781118874059.ch2.

References:

1. Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2015
2. Machine Learning and Big Data: Concepts, Algorithms, Tools, and Applications Uma N. Dulhare, Khaleel Ahmad, Khairol Amali Bin Ahmad First published: 15 July 2020

Data Pre-processing and Post Processing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	6	PC	PC	DS-344P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Data Pre-processing and Post Processing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Stats models and Pandas packages.
2. Working with NumPy arrays
3. Working with Pandas data frames
4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
5. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
    a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
    b. Bivariate analysis: Linear and logistic regression modelling
    c. Multiple Regression analysis
    d. Also compare the results of the above analysis for the two data sets.
6. Perform following pre-processing techniques on loan prediction dataset
    a. Feature Scaling
    b. Feature Standardization
    c. Label Encoding
    d. One Hot Encoding
7. Apply and explore various plotting functions on UCI data sets.
    a. Normal curves
    b. Density and contour plots
    c. Correlation and scatter plots
    d. Histograms
    e. Three-dimensional plotting
8. Perform following visualizations using matplotlib: Bar Graph, Pie Chart, Box Plot, Histogram, Line Chart and Subplots, Scatter Plot.

Data Science	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	7	PCE	PCE-4	CIE-405T
MAE	7	OAE-MAE	OAE-1	MAO-417T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the students about the knowledge and overview of R or Octave statistical package, data transformation and merging, data visualization and illustration of techniques through R or Octave.
2.	To understand statistical techniques like regression analysis and structural equation modelling.
3.	To promote deeper understanding of forecasting, time series data analysis and auto regression models.
4.	To provide overview of support vector machine, linear discriminant analysis and clustering techniques.

Course Outcomes (CO)

CO 1	Develop relevant programming abilities.
CO 2	Demonstrate proficiency with statistical analysis of data.
CO 3	Develop the ability to build and assess data-based models.
CO 4	Execute statistical analyses with professional statistical software.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	-	2	-	-	-	-	-	2
CO 2	3	2	2	3	-	3	-	-	-	-	-	2
CO 3	2	2	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	2	3	-	3	-	-	--	-	-	2

UNIT- I

Overview of R or Octave statistical package.
Introduction to R, Variables, Comments, Data Types, Strings, Operators, If-Else, Loops, Functions, Vectors, Lists, Arrays, Data Frames
Data Pre-processing, Data Scales, Similarity and Dissimilarity measures, sampling and quantization of data, filtering, Data transformation and merging, Data visualization, PCA, Correlation, Chi-Square test. Illustration of These techniques through R, or Octave.

UNIT- II

Regression Analysis, linear, generalized, regularized regression, Cross-validation, Training and Testing data set, Overview of nonlinear regression, Overview of Ridge regression, Latent variables, Structure Equation modelling. Illustration of These techniques through R, or Octave.

UNIT- III

Forecasting, time series data analysis, Stationarity, Seasonality, recurrent models, autoregressive models. Illustration of These techniques through R, or Octave.

UNIT- IV

Classification, Linear discriminant analysis, overview of support vector machine, Decision trees, Clustering, Clustering techniques. Illustration of These techniques through R, or Octave.

Text Books:

1. Runkler, Thomas A., “Data Analytics: Models and Algorithms for Intelligent Data Analysis”, Springer, 2012.
2. Friedman, Jerome, Trevor Hastie, and Robert Tibshirani, “The elements of statistical learning”. Vol. 1. New York: Springer Series in Statistics, 2001.

References Books:

1. Zuur, Alain, Elena N. Ieno, and Erik Meesters. “A Beginner's Guide to R”. Springer, 2009.
2. Hansen, Jesper Schmidt, “GNU Octave: Beginner's Guide: Become a Proficient Octave, User by Learning this High-level Scientific Numerical Tool from the Ground Up”, Packt Publishing Ltd, 2011.

Data Science Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	7	PCE	PCE-4	CIE-405P
MAE	7	OAE-MAE	OAE-1	MAO-417P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Data Science) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Installation of R, basic syntax of R.
2. Describing data, viewing and manipulating data using R.
3. To plot the probability distribution curve through R software.
4. To perform chi square test on various data sets.
5. To use Python as a programming tool for the analysis of data structures.
6. To perform various operations such as data storage, analysis and visualization through R software.
7. To perform descriptive statistics analysis and data visualization in python.
8. To perform Principal Component Analysis on datasets using R software.
9. To perform linear regression on datasets using R software.
10. To perform Data Aggregation and GroupWise Operations.
11. To edit and execute programs involving Flow Controls.
12. To edit and execute programs involving functions.

Data Science using R	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	7	PC	PC	DS-427T
EAE	7	DS-EAE	DS-EAE-3	DS-427T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	The fundamental knowledge on basics of data science and R programming.
2.	The programs in R language for understanding and visualization of data using statistical functions and plots.
3.	The fundamentals of how to obtain, store, explore, and model data efficiently.
4.	The fundamentals of probability and statistics for data science.

Course Outcomes (CO)

CO 1	Understand basics of data science and R programming.
CO 2	Understand and visualize data using statistical functions and plots.
CO 3	Explain how to obtain, store, explore, and model data efficiently.
CO 4	Apply probability and statistics for data science.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	2	-	3	2	-	1	-	-	-	-	-
CO 2	-	-	-	3	2	-	2	-	-	-	-	-
CO 3	-	-	-	2	2	-	2	-	-	-	-	-
CO 4	-	1	-	3	2	-	3	2	2	-	-	-

UNIT-I

Structured versus unstructured data, Quantitative and qualitative data, The four levels of data: Nominal level, Ordinal level, Interval level, and Ratio level, The five steps of Data Science: Ask an interesting question, obtain the data, explore the data, model the data, communicate and visualize the results, Explore the data.

UNIT-II

How to run R, R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes, R Programming Structures, Control Statements, Loops, - Looping Over Nonvector Sets,- If-Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Functions are Objects, Recursion.

UNIT-III

Mathematics: Vectors and matrices, Arithmetic symbols, Graphs, Logarithms/exponents, Set theory, Linear algebra. Probability: Basic definitions, Probability, Bayesian versus Frequentist, Compound events, Conditional Probability, The rules of probability, Collectively exhaustive events, Bayes theorem, Random variables

UNIT - IV

Statistics: Obtaining data, Sampling data, Measuring Statistics, The Empirical rule, Point estimates, Sampling distributions, Confidence intervals, Hypothesis tests

Textbook(s):
1. Sinan Ozdemir, "Principles of Data Science", Packt.
2. Norman Matloff, "The Art of R Programming", Cengage Learning.

References:
1. G. Jay Kerns, "Introduction to Probability and Statistics Using R", First Edition.
2. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 1st Edition, 2014

Data Science using R Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	7	PC	PC	DS-427P
EAE	7	DS-EAE	DS-EAE-3	DS-427P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Data Science using R) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Installation of R, basic syntax of R.
2. Describing data, viewing and manipulating data using R.
3. Visualizing data- tables, charts, plots using R.
4. Implementing binomial distribution and plotting density and distribution function.
5. Implementation probability distribution
6. Exploratory data analysis- range, mean, variance, median, standard deviation.
7. Implementation densities of random numbers- distribution in R, making histogram.
8. Correlations- making of scatter plots, use of scatter plots to investigate relationship between two variables.
9. Statistical function in R-Statistical inference, contingency tables, chi-square goodness of fit

10 Implement linear and logistics regression in R.

Data Structures and Algorithms	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	CSE-OAE	CSE-OAE-2A	OCSE-310T
OAE	7	SD-OAE	SD-OAE-3A	OSD-445T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce basics of Data structures (Arrays, strings, linked list etc.) and concepts of Stacks, Queues
2.	To understand the concepts of and Trees, heaps and related operations and their implementation
3.	To introduce various Sorting and searching Algorithms and Hashing
4.	To understand sets and the concept of Graphs and their applications.

Course Outcomes (CO)

CO 1	Understand data structures like Arrays Stack,Queues,Linked lists and ability to choose the efficient data structures for given problem
CO 2	Construct Binary Search trees ,Heap trees and AVL trees and learn about sparse matrix
CO 3	Apply sorting and searching techniques efficiently and learn about Hashing and its types
CO 4	Apply graph theory and its concepts in various applications and able to differentiate between trees and graphs

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	3	2	3	2	1	2	3	2	1
CO 2	2	3	1	2	3	3	2	1	2	2	1	3
CO 3	1	2	3	3	2	1	1	2	3	3	2	1
CO 4	2	3	1	2	3	1	2	3	1	3	2	1

UNIT-I

Overview of data structure, Basics of Algorithm Analysis including Running Time Calculations, Abstract Data Types, Arrays, Arrays and Pointers, Multidimensional Array, String processing, General Lists and List ADT, List manipulations, Single, double and circular lists. Stacks and Stack ADT, Stack Manipulation, Prefix, infix and postfix expressions, recursion. Queues and Queue ADT, Queue manipulation.

UNIT – II

Trees, Properties of Trees, Binary trees, Binary Tree traversal, Tree manipulation algorithms, Expression trees and their usage, binary search trees, Heaps and their implementation, Priority Queues

UNIT-III

Sparse Matrix Representation (Array and Link List representation), polynomials and polynomial arithmetic. Sorting: Selection Sort, Insertion Sort, Bubble Sort, Quick Sort, Merge Sort, Heap Sort;
Searching: List Search, Sequential Search, Binary Search, Hashing Methods, Collision Resolution in Hashing.

UNIT – IV

Overview of algorithm design approaches – Divide and Conquer, Greedy, Dynamic Programming.
Graphs, Graph representation, Graph Traversals (DFS and BFS) and their implementations using divide and conquer approach. Minimum Spanning Tree algorithms – Prim's algorithm using Greedy approach and Kruskal's algorithm, Shortest Path Algorithms – Dijkastra's, Bellman Ford's, Floyd Warshall's algorithm (implement using dynamic programming approach).

Textbook(s):

1. Richard Gilberg , Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C, 2nd Edition, Cengage Learning, 2004
2. E. Horowitz, S. Sahni, S. Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Ed, Silicon Press, 2007.
3. T.H. Cormen, C.E. Leiserson, R.L. Rivest, Clifford Stein, Introduction to Algorithms, 3rd Ed., PHI

References:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson, 1996
2. Robert Kruse, "Data Structures and Program Design in C", 2nd Edition, Pearson, 1990
3. Seymour Lipschutz, "Data Structures with C (Schaum's Outline Series)", McGrawhill, 2017
4. A. M. Tenenbaum, "Data structures using C". Pearson Education, 1st Edition 2003.
5. Weiss M.A., "Data structures and algorithm analysis in C++", Pearson Education, 2014.

Data Structures and Algorithms Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	CSE-OAE	CSE-OAE-2A	OCSE-310P
OAE	7	SD-OAE	SD-OAE-3A	OSD-445P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Data Structures and Algorithms) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Implement sparse matrix using array. Description of program: a. Read a 2D array from the user. b. Store it in the sparse matrix form, use array of structures. c. Print the final array.
2. Create a linked list with nodes having information about a student and perform a. Insert a new node at specified position. b. Delete of a node with the roll number of student specified. c. Reversal of that linked list.
3. Create doubly linked list with nodes having information about an employee and perform Insertion at front of doubly linked list and perform deletion at end of that doubly linked list.
4. Create circular linked list having information about a college and perform Insertion at front perform Deletion at end.
5. Implement two stacks in a using single array.
6. Create a stack and perform Push, Pop, Peek and Traverse operations on the stack using Linked list.
7. Create a Linear Queue using Linked List and implement different operations such as Insert, Delete, and Display the queue elements.
8. Implement Experiment-2 using liked list.
9. Create a Binary Tree and perform Tree traversals (Preorder, Postorder, Inorder) using the concept of recursion.
10. Implement insertion, deletion and traversals (inorder, preorder and postorder) on binary search tree with the information in the tree about the details of an automobile (type, company, year of make).
11. Implement Selection Sort, Bubble Sort, Insertion sort, Merge sort, Quick sort, and Heap Sort using array as a data structure.
12. Perform Linear Search and Binary Search on an array. Description of programs: a. Read an array of type integer. b. Input element from user for searching. c. Search the element by passing the array to a function and then returning the position of the element from the function else return -1 if the element is not found. d. Display the position where the element has been found.
13. Implement the searching using hashing method.
14. Create a graph and perform DFS and BFS traversals.

Data Visualization	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	MLDA-EAE	MLDA-EAE-2B	DS-340T
CST/ITE	7	PCE	PCE-5	CIE-423T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the key techniques and theory behind data visualization
2.	To use effectively the various visualization structures (like tables, spatial data, tree and network etc.)
3.	To evaluate information visualization systems and other forms of visual presentation for their effectiveness
4.	To design and build data visualization systems with box plots, heat maps etc.

Course Outcomes (CO)

CO 1	Understand the key techniques and theory behind data visualization
CO 2	Use effectively the various visualization structures (like tables, spatial data, tree and network etc.)
CO 3	Evaluate information visualization systems and other forms of visual presentation for their effectiveness
CO 4	Design and build data visualization systems with box plots, heat maps etc.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	-	-	1	2	-	-	3
CO 2	3	3	3	3	3	-	-	1	2	-	-	3
CO 3	3	3	3	3	3	-	-	1	2	-	-	3
CO 4	3	3	3	3	3	-	-	1	2	-	-	3

UNIT-I

Value of Visualization – What is Visualization and Why do it: External representation – Interactivity – Difficulty in Validation. Data Abstraction: Dataset types – Attribute types – Semantics. Task Abstraction – Analyze, Produce, Search, Query. Four levels of validation – Validation approaches – Validation examples. Marks and Channels

UNIT-II

Rules of thumb – Arrange tables: Categorical regions – Spatial axis orientation – Spatial layout density. Arrange spatial data: Geometry – Scalar fields – Vector fields – Tensor fields. Arrange networks and trees: Connections, Matrix views – Containment. Map color: Color theory, Color maps and other channels.

UNIT-III

Manipulate view: Change view over time – Select elements – Changing viewpoint – Reducing attributes. Facet into multiple views: Juxtapose and Coordinate views – Partition into views – Static and Dynamic layers – Reduce items and attributes: Filter – Aggregate. Focus and context: Elide – Superimpose – Distort – Case studies.

UNIT – IV

Applied Visualizations: Box plot - Density Plot - Area Chart - Heat map - Tree map - Graph Networks

Textbook(s):

1. Tamara Munzner, Visualization Analysis and Design, A K Peters Visualization Series, CRC Press, 2014.
2. Scott Murray, Interactive Data Visualization for the Web, O'Reilly, 2013.

References:

1. Alberto Cairo, The Functional Art: An Introduction to Information Graphics and Visualization, New Riders, 2012
2. Nathan Yau, Visualize This: The FlowingData Guide to Design, Visualization and Statistics, John Wiley & Sons, 2011.

Data Visualization Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	MLDA-EAE	MLDA-EAE-2B	DS-340P
CST/ITE	7	PCE	PCE-5	CIE-423P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Data Visualization) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Loading and Distinguishing Dependent and Independent parameters
2. Exploring Data Visualization tools
3. Drawing Charts
4. Drawing Graphs
5. Data mapping
6. Creating Scatter Plot maps
7. Using BNF Notations
8. Working with REGEX
9. Visualize Network Data
10. Understanding Data Visualization frameworks

Data Warehousing and Data Mining	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/CST	7	PCE	PCE-5	CIE-425T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the need of data warehousing for data analysis
2.	To understand and apply OLAP operations
3.	To identify the need of various data mining techniques.
4.	To apply various data mining techniques.

Course Outcomes (CO)

CO 1	Able to understand ETL Process.
CO 2	Able to understand and apply OLAP operations for data analysis.
CO 3	Able to apply supervised learning based data mining techniques.
CO 4	Able to apply unsupervised learning based data mining techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT-I

Introduction to Data Warehousing: Overview, Difference between Database System and Data Warehouse, The Compelling Need for data warehousing, Data warehouse – The building Blocks: Defining Features, data warehouses and data marts, overview of the components, Three tier architecture, Metadata in the data warehouse.

Data pre-processing: Data cleaning, Data transformation ETL Process. ETL tools.

Defining the business requirements: Dimensional analysis, information packages – a new concept, requirements gathering methods, requirements definition: scope and content.

UNIT-II

Principles of Dimensional Modelling: Objectives, From Requirements to data design, Multi-Dimensional Data Model, Schemas: the STAR schema, the Snowflake schema, fact constellation schema.

OLAP in the Data Warehouse: Demand for Online Analytical Processing, limitations of other analysis methods-OLAP is the answer, OLAP definitions and rules, OLAP characteristics, major features and functions, hyper

cubes.
OLAP Operations: Drill-down and roll-up, slice-and-dice , pivot or rotation, OLAP models, overview of variations, the MOLAP model, the ROLAP model, the DOLAP model, ROLAP versus MOLAP, OLAP implementation considerations. Query and Reporting, Executive Information Systems (EIS), Data Warehouse and Business Strategy.

UNIT-III

Data Mining Basics: What is Data Mining, Data Mining Defined, The knowledge discovery process (KDD Process), Data Mining Applications- The Business Context of Data Mining, Data Mining for Process Improvement, Data Mining as a Research Tool, Data Mining for Marketing, Benefits of data mining,
Major Data Mining Techniques: Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, KNN Algorithm.

UNIT - IV

Cluster detection, K- means Algorithm, Outlier Analysis, memory-based reasoning, link analysis, Mining Association Rules in Large Databases: Association Rule Mining, genetic algorithms, neural networks.
Data mining tools.

Textbook(s):
1. Paul Raj Poonia, “Fundamentals of Data Warehousing”, John Wiley & Sons, 2004
2. Kamber and Han, “Data Mining Concepts and Techniques”, Hart Court India P. Ltd. Elsevier, 2nd Ed, 2001

References:
1. W. H. Inmon, “Building the operational data store”, 2nd Ed., John Wiley, 1999.
2. Pang- Ning Tan, Michael Steinbach, Viach, Vipin Kumar, Introduction to Data Mining, Pearson
3. Shmueli, “Data Mining for Business Intelligence : Concepts, Techniques and Applications in Microsoft Excel with XLMiner”, Wiley Publications

Data Warehousing and Data Mining Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/CST	7	PCE	PCE-5	CIE-425P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Data Warehousing and Data Mining) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of ETL process and its tools.
2. Program of Data warehouse cleansing to input names from users (inconsistent) and format them.
3. Program of Data warehouse cleansing to remove redundancy in data.
4. Introduction to WEKA tool.
5. Implementation of Classification technique on ARFF files using WEKA.
6. Implementation of Clustering technique on ARFF files using WEKA.
7. Implementation of Association Rule technique on ARFF files using WEKA.
8. Implementation of Visualization technique on ARFF files using WEKA.
9. Perform Data Similarity Measure (Euclidean, Manhattan Distance).
10. Perform Apriori algorithm to mine frequent item-sets.
11. Develop different clustering algorithms like K-Means, KMedoids Algorithm, Partitioning Algorithm and Hierarchical
12. Apply Validity Measures to evaluate the quality of Data

Database Modelling and Design	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	6	PCE	PCE-1	CIE-316

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the database design life cycle and design conceptual model of database system.
2.	To design logical model of database system.
3.	To physically implement the database.
4.	To understand the need of database tuning and security.

Course Outcomes (CO)

CO 1	Able to understand the database design life cycle and design conceptual model of database system.
CO 2	Able to design logical model of database system.
CO 3	Able to physically implement the database.
CO 4	Able to perform database tuning.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT-I

Introduction: Overview of database systems architecture and components, database design life cycle
Conceptual data modelling: ER Modeling, EER Modeling, Modeling complex relationships, Design issues in ER & EER modeling

UNIT-II

Logical data modelling: Overview of relational data model, Integrity constraints, Mapping ER Model to a logical schema, Mapping EER Model to a logical schema, Mapping of higher degree relationships, Mapping of Aggregation, Mapping complex ER Model Constructs to a logical schema
Normalization: Introduction, Anomalies, Normal forms – 1NF, 2NF, 3NF, BCNF, 4NF & 5NF

UNIT-III

Database implementation and physical database design: Database creation using SQL, SQL commands – DDL &

DML; Views; Advanced data manipulation using SQL
Database Programming: Cursor, Exception Handling, Procedures, Functions, Packages, Triggers

UNIT - IV

Database tuning and maintenance: Introduction, Clustering and indexing, guidelines for index selection, de-normalization, database tuning
Database security: Introduction, Access control DCL Commands, views

Textbook(s):

1. Database Modelling and Database Design. Narayan S. Umanath and Richard W. Scamell. Cengage Learning, 2nd Edition.
2. Database Management Systems. Raghu Ramakrishnana and Johannes Gehrke, Mc Graw Hill, 3rd Edition.

References:

1. Database Modelling and Design. Toby Teorey, Sam Lightstone, Tom Nadeau and H. V. Jagadish. Morgan Kaufmann Publishers, 5th Edition
2. Elmasri, Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education, India.
3. Database System Concepts, Silberschatz, Korth, McGraw hill, V edition.

Deep Learning for Image Processing and Computer Vision	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IPCV-EAE	IPCV-EAE-5A	IPCV-459T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic knowledge about deep learning, computer vision and image processing.
2.	To impart knowledge about linear regression and basic concepts of decision functions.
3.	To impart knowledge about deep learning algorithms like Feed Forward and Convolutional Neural Networks.
4.	To impart knowledge about Recurrent Neural Networks, Generative Modelling, Image Classification and Data Labeling use Deep Learning.

Course Outcomes (CO)

CO 1	Understand concepts of deep learning, computer vision and image processing.
CO 2	Understand linear regression and basic concepts of decision functions.
CO 3	Implement Feed Forward and Convolutional Neural Networks.
CO 4	Implement advanced deep learning techniques for image related applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	2	1	1	-	2	1	-	3
CO 2	3	3	3	3	2	1	1	-	2	1	-	3
CO 3	3	3	3	3	2	1	1	-	2	1	-	3
CO 4	3	3	3	3	2	1	1	-	2	1	-	3

UNIT I

Introduction to Deep Learning, Computer Vision and Image Processing, Image Formation Concepts. Geometric Transformations, Image Transforms, Image Filtering, Colour Image Processing, Image Segmentation Texture Descriptors, Colour Features, Edges/Boundaries. Object Boundary and Shape Representations.

UNIT II

Linear Regression, Basic Concepts of Decision Functions, Elementary Statistical Decision Theory, Parameter Estimation, Clustering for Knowledge Representation, Dimension Reduction, Artificial Neural Network for Classification.

UNIT III

Feed Forward Neural Networks, Introduction to CNNs, Optimization for training Deep neural networks, Deep Neural Network, Tricks for Improving the Learning.

UNIT IV

Introduction to DL packages/ Important architectures , Visualizing CNNs , Recurrent Neural Networks, Generative Modelling using Deep networks, Deep Reinforcement Learning, Image Classification and Data Labelling using Deep Learning.

Textbook(s):

1. Mahmoud Hassaballah (Edit.), Ali Ismail Awad (Edit.) : Deep Learning in Computer Vision: Principles and Applications, CRC Press, 2020
2. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing‘, Pearson, Third Edition, 2010.
3. Rajalingappaa Shanmugamani: Deep Learning for Computer Vision: Expert techniques to train advanced neural networks using TensorFlow and Keras, Packt Publishing Limited, 2018

References:

1. Bernd Jahne: Digital Image Processing, 5th Ed., Springer, 2002.
2. William K Pratt: Digital Image Processing: Piks Inside, John Wiley & Sons, 2001.
3. Deep Learning: Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 2016

Deep Learning for Image Processing and Computer Vision Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IPCV-EAE	IPCV-EAE-5A	IPCV-459P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Deep Learning for Image Processing and Computer Vision) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Python programming fundamentals.
2. Illustration of list, tuple and dictionary in Python.
3. Illustration of exception handling and debugging concepts in python
4. Introduction and application of Panda and Numpy libraries in image analysis
5. Introduction and application of Open CV, PIL (Python Image Library) and other relevant libraries in image processing.
6. To learn and understand Tensor Flow.
7. To learn to make a Deep Learning model in Keras for an image related application.
8. To learn to apply Convolutional Neural Networks (CNNs) for an image related application.
9. To learn to apply Recurrent Neural Networks (RNNs) for an image related application.
10. To learn to apply Multilayer Perceptrons (MLPs) for an image related application.

Design and Analysis of Algorithm

L	P	C
4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-311

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Introduce various designing techniques and methods for algorithms
2.	Performance analysis of Algorithms using asymptotic and empirical approaches
3.	Demonstrate a familiarity with major algorithms and data structures.
4.	To give clear idea on algorithmic design paradigms like Divide-and-Conquer, Dynamic Programming, Greedy, Branch & Bound, Back tracking and string matching and network flow. .

Course Outcomes (CO)

CO 1	Analyse asymptotic runtime complexity of algorithms including formulating recurrence relations and divide and conquer designing method.
CO 2	Describe the greedy paradigm and apply Greedy strategy for solving various problems.
CO 3	Apply dynamic programming and Branch & Bound approach to solve suitable problems
CO 4	Understand the concept of NP problems and string matching algorithm and various flow & sorting networks

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	1	1	1	2	2	2	2	1	1	1
CO 2	2	2	3	1	2	3	1	2	3	1	2	2
CO 3	2	2	1	1	2	3	3	2	1	3	1	2
CO 4	3	2	2	3	2	1	3	2	1	1	2	3

UNIT-I

Asymptotic notations for time and space complexity, Methods for solving Recurrence relations, Brief Review of Graphs, Sets and disjoint sets, union, sorting and searching algorithms and their analysis in terms of space and time complexity.

Divide and Conquer: General method, binary search, merge sort, Quick sort, selection sort, Strassen's matrix multiplication algorithms and analysis of algorithms for these problems.

UNIT-II

Greedy Method: General method, knapsack problem, Huffman Codes, job sequencing with deadlines, minimum spanning trees, single souce paths and analysis of these problems.

Back Tracking: General method, 8 queen's problem, graph colouring, Hamiltonian cycles, and analysis of these problems.

UNIT-III

Dynamic Programming: Ingredients of Dynamic Programming. Matrix Chain Multiplication, Longest common subsequence and optimal binary search trees problems, 0-1 knapsack problem, Traveling salesperson problem, Floyd Warshall algorithm.
Branch and Bound: Method, O/I knapsack and traveling salesperson problem

UNIT - IV

String Matching: The naïve String Matching algorithm, The Rabin-Karp Algorithm, String Matching with finite automata, The Knuth-Morris Pratt algorithm.
Computational Complexity: Basic Concepts, Polynomial vs Non-Polynomial Complexity, NP- hard & NP-complete classes. Approximation Algorithms
Flow and Sorting Network:, Ford- Fulkerson method, Maximum bipartite matching, Sorting Networks, Comparison network, Zero- one principle, Bitonic sorting network, merging network

Textbook(s):
1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, Clifford Stein, Introduction to Algorithms, 3rd Ed., PHI, 2013.
2. Udit Aggarwal, Algorithm Design and Analysis, Dhanpat Rai and Co.

References:
1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Computer Algorithms/C++, Second Edition, Universities Press.
2. Jon Klenberg, Eva Tardos, Algorithm Design, Pearson Publications,2014.
3. A. V. Aho, J. E. Hopcroft, J. D. Ullman, The Design and Analysis of Computer Algorithms, Pearson, 2013.
4. Richard Neapolitan, Foundations of Algorithms, Fifth Edition, Jones & Bartlett Learning
5. Sara Base, Introduction to Design & analysis,Pearson

Design and Analysis of Algorithm Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-359

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Design and Analysis of Algorithm) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To implement following algorithm using array as a data structure and analyse its time complexity.
    a) Merge sort
    b) Quick sort
    c) Bubble sort
    d) Selection sort
    e) Heap sort
2. To implement Linear search and Binary search and analyse its time complexity.
3. To implement Huffman Coding and analyse its time complexity.
4. To implement Minimum Spanning Tree and analyse its time complexity.
5. To implement Dijkstra‘s algorithm and analyse its time complexity.
6. To implement Bellman Ford algorithm and analyse its time complexity.
7. Implement N Queen's problem using Back Tracking.
8. To implement Matrix Multiplication and analyse its time complexity.
9. To implement Longest Common Subsequence problem and analyse its time complexity.
10. To implement naïve String Matching algorithm, Rabin Karp algorithm and Knuth Morris Pratt algorithm and analyse its time complexity.
11. To implement Sorting Network.

Design of Experiments	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-5	MEE-417T
MAE	7	OAE-MAE	OAE-1	MAO-419T

Marking Scheme:
Teachers Continuous Evaluation: 25 marks
Term end Theory Examinations: 75 marks

Instructions for paper setter:

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To explain theory of probability and statistics with regards to this course.
2.	To explain experimental design for more than two factors and interpretation of models.
3.	To impart knowledge about parameter design, tolerance design and reliability improvement.
4.	To explain experimental design using Taguchi's orthogonal arrays.

Course Outcomes (CO)

CO 1	Apply statistics for experimental design.
CO 2	Analyse the factorial design of experiments.
CO 3	Explain methods to improve the reliability through experiments.
CO 4	Design experiments using Taguchi's Orthogonal Arrays.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	3	2	3	-	-	-	-	-	2
CO 2	3	3	2	3	2	3	-	-	-	-	-	2
CO 3	3	2	2	3	2	3	-	-	-	-	-	2
CO 4	3	3	2	2	2	3	-	-	--	-	-	2

UNIT-I

Introduction: Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments.
Basic Statistical Concepts: Concepts of random variable, probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of confidence level. Statistical Distributions: Normal, Log Normal & Weibull distributions. Hypothesis testing, Probability plots, choice of sample size. Illustration through Numerical examples.

UNIT-II

Experimental Design: Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs. Illustration through Numerical examples.

Analysis and Interpretation Methods: Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples.

UNIT-III

Quality By Experimental Design: Quality, Western and Taguchi's quality philosophy, elements of cost, Noise factors causes of variation. Quadratic loss function & variations of quadratic loss function. Robust Design: Steps in Robust Design: Parameter design and Tolerance Design. Reliability Improvement through experiments, Illustration through Numerical examples.

UNIT - IV

Experiment Design Using Taguchi's Orthogonal Arrays: Types of Orthogonal Arrays, selection of standard orthogonal arrays, Linear graphs and Interaction assignment, Dummy level Technique, Compound factor method, Modification of linear graphs. Illustration through Numerical examples.

Textbook(s):

1. Montgomery, D.C., "Design and Analysis of Experiments", 5 Ed., John Wiley and Sons Inc., New York.
2. D. Cox and N. Reid, "The Theory of the Design of Experiments", CRC Press, 2000.

References:

1. George. E. P. Box, J. Stuart Hunter, William G. Hunter, "Statistics for Experimenters: Design, Innovation, and Discovery", 2nd Edition, Wiley.
2. K. Hinkelmann and O. Kempthorne, "Design and Analysis of Experiments, Wiley.

Design of Experiments Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-5	MEE-417P
MAE	7	OAE-MAE	OAE-1	MAO-419P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Design of Experiments) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Installation and demonstration of MINITAB software
2. Installation and demonstration of DESIGN EXPERT software.
3. To determine whether a factor, or a collection of factors, has an effect on the response.
4. To determine whether factors interact in their effect on the response.
5. To model the behaviour of the response as a function of the factors.
6. To carry out the ANOVA on the experimental data.
7. To make a Mathematical model from experimental data.
8. To check the reliability of experimental data.
9. To perform the experimental design using Taguchi’s orthogonal arrays.

Design of Mechanical Assemblies	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-5	MEE-421T
MAE	7	OAE-MAE	OAE-1	MAO-421T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the working of a gear box used in automobiles and design entire assembly.
2.	To conceptualise the assemblage design needs for entire parts involved in force, motion and power transfer from fuel combustion in engine to wheels.
3.	To study the whole assembly of governor and crane hooks.
4.	To critically analyze the design procedure for double shoe brake assembly for hoisting mechanism.

Course Outcomes (CO)

CO 1	Design analysis of power & torque transmission through gear box of an automobile causing speed variations.
CO 2	Analyze the effect of transmissions in various mechanical drives of an internal combustion engine.
CO 3	Evaluate and justify the assemblage systems for speed control mechanisms and crane hooks.
CO 4	Justify the design needs for double shoe brake assembly for hoisting mechanism.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	-	-	-	1	1	2	3
CO 2	3	3	3	3	3	-	-	-	2	1	2	3
CO 3	3	3	3	3	1	-	-	-	1	1	2	3
CO 4	3	3	3	2	2	-	-	-	2	1	2	3

UNIT-I

Introduction: Need for Mechanical assemblies, part alignments, efficiency and reliability.
Gear box- geometric progression, standard step ratio; layout diagram of gears, Types of gear boxes - sliding mesh gear box, constant mesh gear box, Synchromesh gear box and Epicyclic gear box. Design of multi-seed gear box for machine tool applications; Detailed design of constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

UNIT-II

Engine part assembly design for an Internal Combustion engine: Separate design analysis of Piston, Connecting rod, Crankshaft and Flywheel. Calorific value of fuel, brake power, mechanical efficiency. Design of drive shafts, propeller shafts, entire drive transmission ratio, efficiency, power losses at various stages. Wheel power, velocity ratio, vehicle velocity, air resistance, power calculations for entire automobile movement. Design of Flywheel, Rim dimensions.

UNIT-III

Mechanical Assemblage of Governors: Need of governor assembly, Types - Watt, Porter, Proell, Hartnell, Hartung, Pickering, spring controlled gravity e governors. Governor height, controlling force diagrams, Equilibrium speed, effort & power of governor. Parts of governor assembly. Design of levers and springs. Complete assembly design analysis of Hartnell Governor. Numerical Problems.

Assembly design of Crane Hooks: Bending stresses in curved structures, stresses in critical sections, Hook design procedure. Complete assembly design of hook with side plates, cross-piece, thrust bearing, standard bolts selection. Numerical Problems.

UNIT - IV

Double Shoe brake assembly for hoisting mechanism: Necessity for braking mechanism,Single and Double shoe brake analysis, hoisting mechanism concept, Standard drum sizes, friction materials for braking applications, heat dissipation characteristics, Bell crank lever design, design of closed coiled helical spring. Detailed design procedure of double shoe brake assembly for hoisting mechanism including design of levers, springs and side plates. Numerical Problems.

Textbook(s):

1. Maleeve Hartman and O.P.Grover, “Machine Design”, CBS Publishers& Distributors Pvt. Ltd. Sixth Ed (2015).
2. Jindal U.C., “Machine Design: Design of Transmission System”, Dorling Kindersley, 2010.

References:

1. Mahadevan, “Design Data Book”, CBS Publishers & Distributors.
2. J.E. Shigley& C.R. Mischke, "Mechanical Engineering Design”, Tata McGraw Hill Co. Inc.
3. Shigley J.E. and Vicker J.J, Theory of Machines and Mechanisms, McGraw Hill, 1981.
4. P.C. Sharma and D.K Aggarwal., “Machine Design”, S.K. Kataria& Sons.
5. Juvinal R C, Marshek K M, “Fundamentals of Machine Component Design”, Wiley India.
6. Norton R. l. “Machine Design” Pearson.
7. Singh V.P., “Theory of Machines” Dhanpat Rai & Co.(Pvt.) Ltd. (2005).

Design of Mechanical Assemblies Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-5	MEE-421P
MAE	7	OAE-MAE	OAE-1	MAO-421P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Design of Mechanical Assemblies) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To design a two stage gear reducer assembly (Differential) with input and output shafts on opposite sides and at right angles to transmit a given propellor shaft power equally to two wheel axles.
2. To design a constant mesh gear box assembly for a heavy commercial vehicle, including complete design parameters of all gears, shaft diameters and bearing selection.
3. To design a Piston, Cylinder and Connecting rod assembly for an Internal combustion engine from give data.
4. To design a complete assembly of Hartnell governor including bell crank lever, spring design from given data set.
5. To design a complete assembly for a hook of a crane for lifting/lowering given load along with the design of side plates, cross-piece, bolts and thrust bearings selection.
6. To design a double shoe brake for a hoisting mechanism using standard drum sizes and friction materials and check for heat dissipation.
7. To design Hartnell Governor with complete assembly.
8. To design a closed coil helical spring.

Design of Mechanical Drives	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-5	MEE-415T
MAE	7	OAE-MAE	OAE-1	MAO-423T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand relative application suitability of various flexible drives over medium distances i.e. belt drives and chain drives.
2.	To conceptualise the design needs for short distance non flexible toothed element drives for industrial applications.
3.	To study the means of transporting power over long distances through wire ropes.
4.	To critically analyze the design procedure for cams, brakes & clutches.

Course Outcomes (CO)

CO 1	Design analysis of transmission drives through flexible machine elements over medium distances.
CO 2	Analyze the effect of changing speeds on varied power transmission mechanical drives with toothed elements over short distance between shafts.
CO 3	Evaluate, Design, select and suitably justify systems for transmission at long distances.
CO 4	Justify the design needs for power drives through Cams and mechanisms for stoppage, engagement/disengagement of parts with relative motion in vehicles.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	-	-	1	1	1	2	3
CO 2	3	3	2	3	2	1	-	-	2	1	2	3
CO 3	3	3	2	3	1	-	1	-	1	1	2	3
CO 4	3	3	3	3	3	1	-	1	2	1	2	3

UNIT-I

Mechanical Drives: Introduction, need of transmission, Classification of various mechanical drives, Comparative analysis and Choice of transmission drives based on centre distance, velocity, velocity ratio, efficiency, weight, cost.

Flexible Drives for medium distances: Design of Flat belt drives and pulleys, Belt constructions, open & crossed belts, belt lengths, belt materials, belt tensions, belt stresses in one revolution, Flat belt selection from manufacturer's catalogue, Pulley crowning. Numerical belt drive design problems

Design and selection of A-E Type V-belt drives from manufacturer's catalogue based on power ratings and calculation if number of belts.

Chain drives: Need for chain drives, roller chains, Polygonal effect, Power ratings, sprocket wheels, silent or inverted chains, design procedure for roller chain drives.

.

UNIT-II

Short distance non flexible geared drives: Introduction, Classification of gears based on centre distances, position and alignment of shaft axes, efficiency, characteristics, Materials, Theory of gearing and forces on gears.

Design of industrial gear drives:

Spur gears: Design based on tooth strength Lewis equation, Dynamic & Wear loads, gear tooth failures.

Design of **Helical Gears** based on modified Lewis Equation. Virtual teeth, herringbone gears, Dynamic and wear loads. Use in gearbox.

Design of **Bevel Gears**. Terminology and force analysis, Dynamic and wear loads. Spiral bevel gears.

Design of **Worm & Worm Wheel** Gears, Efficiency, Worm gear- merits & demerits, Thermal considerations for checking for heat dissipation suitability, estimating the size of worm gear pair.

UNIT-III

Large distance transmission drives: Introduction to hoisting machinery.

Wire ropes: Classification &Types, regular lay and lang lay wire ropes, Industrial applications of wire ropes, stresses in hoisting rope, Design procedure of Wire Ropes, designation of wire ropes, rope sheaves and drums, Numerical problems.

Design of Crane Hooks. Stresses at critical sections. Bending stresses in curved beams of circular, triangular, trapezoidal sections. Numerical problems.

UNIT - IV

Cam design: types, pressure angle and undercutting base circle determination, forces and surface stresses.
Clutches: Design of plate clutches, axial clutches, cone clutches, Centrifugal clutches, Use in automobiles.
Brakes: Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Textbook(s):

1. V.B. Bhandari, “Design of Machine elements”, Tata McGraw Hill Education Private Ltd. Third Edition (2012).
2. Jindal U.C., “Machine Design: Design of Transmission System”, Dorling Kindersley, 2010.

References:

1. Mahadevan, “Design Data Book”, CBS Publishers & Distributors .
2. J.E. Shigley& C.R. Mischke, "Mechanical Engineering Design”, Tata McGraw Hill Co. Inc.
3. Shigley J.E. and Vicker J.J, Theory of Machines and Mechanisms, McGraw Hill, 1981.
4. P.C. Sharma and D.K Aggarwal., “Machine Design”, S.K. Kataria& Sons.
5. Juvinal R C, Marshek K M, “Fundamentals of Machine component Design”, Wiley India.
6. Maleeve Hartman and O.P.Grover, “Machine Design”, CBS Publishers& Distributors Pvt. Ltd. Sixth Ed (2015).

Design of Mechanical Drives Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-5	MEE-415P
MAE	7	OAE-MAE	OAE-1	MAO-423P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Design of Mechanical Drives) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To design a suitable Flat belt or V-belt drive for given power transmission, speeds and velocity ratio. Other necessary data may be suitably selected from Design Data Handbook.
2. To design and select a suitable Chain drive for given power transmission, speeds, velocity ratio, center distance and service conditions using Design Data Handbook and manufacturer’s catalogue.
3. To design a worm gear drive for transmitting a power from worm wheel to worm gear, selecting suitable materials from handbook. Also find efficiency and check heat dissipation capacity of the drive.
4. To design a gear box for a heavy commercial vehicle - Selection of type of gearbox and calculation of no. of teeth, PCDs, module, center distances of all gears and gear ratios within ±2% error.
5. Identification and design of a most heavily stressed gear and selection of material for all gears and shafts of the same gear box.
6. To find the diameters of input, output & countershaft as per ASTM recommendations, finding support reactions and selecting suitable bearings using catalogues.
7. To design a wire rope for a lift to be used for lifting a given load in a building over given height.
8. To design a hook of a crane for hoisting a given load along with side plates, Centre plates, bolts and thrust bearings selection.
9. To design a double shoe brake for a hoisting mechanism using standard drum sizes and friction materials and check for heat dissipation.

Design of Sensors and Transducers	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-5	ICE-415T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce thermal, mechanical sensors
2.	To introduce signal conditioning devices required for sensors
3.	To introduce design of instrumentation amplifier
4.	To introduce design of signal conditioning circuit of thermal sensors

Course Outcomes (CO)

CO 1	Ability to understand operating principle of different sensors
CO 2	Ability to apply analog and digital signal conditioning techniques
CO 3	Ability to analyze signal conditioning devices
CO 4	Ability to design signal conditioning circuit

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	-	-	-	2	2	2	-	-	3
CO 2	3	2	-	-	-	-	2	2	2	-	-	3
CO 3	3	3	2	-	-	-	2	2	2	-	-	3
CO 4	3	2	3	-	-	-	3	3	3	-	-	3

UNIT I

Thermal and Electrical Sensors: Thermistors, Thermocouples, Semiconductor Resistance versus Temperature, Design of temperature indicator using IC sensors, Hall effect sensor, CT, PT, Practical designing of a capacitor measurement circuit, Ratio transformer technique, Differential capacitor measurement.

UNIT II

Mechanical Sensors: Pressure sensors- differential pressure transmitter, Flow sensors - Head type flow meters, Variable area type, Turbine, Electromagnetic, Ultrasonic, Displacement - LVDT, Practical design of 4-20 mA current transmitter for resistance sensors and LVDT sensor, Level Sensor- Ultrasonic, Capacitive, Radioactive type, laser type transducers and their calibration.

UNIT III

Sensor signal conditioning devices: Basics of instrumentation amplifiers, use of instrumentation amplifiers in measurement, design of instrumentation amplifier, Errors due to resistance drift, effects of Op amp offset voltage drift, offset current drift. Error budgeting, Design of signal conditioning circuit: Thermocouple, RTD, Thermistor, load cell, potentiometric sensors, capacitive level sensor, LVDT, optical sensors (LDR, photodiode, photo transistor, photocell)

UNIT IV

Design of Instrumentation amplifier and design of signal conditioning circuit: Introduction, signal level and bias changes, linearization, conversion, filtering and impedance matching, concept of loading, divider circuits, bridge circuits, lead compensation, excitation techniques (constant power, current, bridge), filters(low pass, high pass), Boolean algebra, converters (comparators, DAC, ADC), Readout/meter.

Textbooks:

1. D.Patranabis,"Principle of Industrial Instrumentation" Tata McGraw Hill.
2. B.C Nakra and K.K Choudhari, "Instrumentation Measurements and Analysis", Tata McGraw Hill Education

References:

1. D.V.S. Murty, "Instrumentation & Measurement principles", PHI New Delhi
2. E.O. Doebelin,"Measurement Systems", McGraw Hill.
3. B.G. Liptak, "Process Measurement & Analysis", chilton book company
4. Andrew parr, "Industrial control handbook", 3rd ed. Newnes Industrial press.

Design of Sensors and Transducers Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-5	ICE-415P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Design of Sensors and Transducers) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Calibration of Rotameter
2. Measurement of flow using DP cell
3. Level measurement using capacitive/resistive method.
4. Measurement of viscocity and density.
5. Deign and implementation of temperature indicator using thermocouple with cold junction temperature technique.
6. Design and implementation of temperature indicator using RTD.
7. Design and implementation of signal conditioning circuit for weighing machine using load cell
8. Design and implementation of signal conditioning circuit for liquid level indicator using electromechanical system.
9. Design and implementation of digital control logic for process using electronic hardware/software.
10. Design and implementation of through beam/reflected beam type optical proximity sensors.

Design of Smart Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-IoT	7	PC	PC	IOT-443T
EAE	7	IOT-EAE	IOT-EAE-4	IOT-443T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To make students understand the concept the design of smart systems.
2.	To make students aware of CPS systems, Pervasive Computing
3.	To make students understand the concepts of distributed systems, sensors, NFCs, RFID etc
4.	To explain the ethical considerations while developing the smart systems

Course Outcomes (CO)

CO 1	Able to describe the importance of smart systems.
CO 2	Able to conceptualize real world situations to develop the smart systems.
CO 3	Able to understand the underlying architectures of smart systems
CO 4	Interpret and explain the impact of smart systems , ethical, legal, social and environmental implications

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	3	2	1	-	-	2	2	-	1	-	-
CO 2	2	3	-	2	-	-	-	2	-	-	-	-
CO 3	3	2	2	2	-	-	2	1	-	2	-	-
CO 4	2	2	3	1	-	-	-	2	-	-	-	-

UNIT-I

Introduction to Smart Systems: Smart Systems and System Environment, Components of Smart Systems, Applications, and challenges of Smart Systems. Advantages and disadvantages of smart systems, models of smart systems, Augmented Intelligent Smart Systems, Product Service Systems, Explain IoT in developing smart systems.

UNIT-II

Smartness and Pervasive Computing: Pervasive computing, Problems and applications of Pervasive computing. Infrastructure of pervasive computing – UbiCloud , Sensors , Distributed Networks/Systems, mobile computing , Cloud computing, Methods and tools for developing smart systems, NFCs, RFID and their purpose, Blockchain, AI and machine learning and its use in developing smart systems, Integration of Big Data with Smart Systems.

UNIT-III

Cyber Physical Systems and Security of Smart Systems: CPS, Architecture, Applications, and classification of CPS, Operational and Information Technology Security, differences, and purposes, uses and challenges, Cyber Physical Systems risk management, purpose, security concerns and elements of CPS, Industry 4.0 concepts-Horizontal and vertical integration

UNIT - IV

Applications: Smart homes, smart appliances, smart things, healthcare applications, smart spaces. Ethical, sustainability and economic impacts, privacy, and security concerns. Application standard of implementing smart systems. Metrics to measure the performance of Smart Systems and improvement

Textbook(s):

1. Handbook of Industry 4.0 and smart systems, D. Pascual, P.Daponate and A.Kumar
2. Big Data : Using SMART Big Data, Analytics and Metrics to Make Better Decisions and Improve Performance, B.Marr

References:

1. Cyber Physical Systems security : Analysis , challenges and solutions
2. Framework for cyber Physical Systems : Vol1

Design of Smart Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-IoT	7	PC	PC	IOT-443P
EAE	7	IOT-EAE	IOT-EAE-4	IOT-443P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Design of Smart Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Equipments: Code Composer Studio Version 6, MSP430 based launch pads, Wi-Fi booster pack.

1. Introduction to MSP430 launch pad and Programming Environment.
2. Read input from switch and Automatic control/flash LED (soft-ware delay).
3. Interrupts programming example using GPIO.
4. Configure watchdog timer in watchdog mode & interval mode.
5. Configure timer block for signal generation (with given frequency)
6. Read Temperature of MSP430 with the help of ADC. 16
7. Test various Power Down modes in MSP430.
8. PWM Generator 23
9. Use Comparator to compare the signal threshold level 25
10. Speed Control of DC Motor 26
11. Master slave communication between MSPs using SPI 30
12. Networking MSPs using Wi

Design Patterns	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OSD-449T
OAE	7	SD-OAE	SD-OAE-4A	OSD-449T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the concept of Design patterns and its importance.
2.	Understand the behavioral knowledge of the problem and solutions.
3.	Relate the Creational, Structural , behavioral Design patterns.
4.	Apply the suitable design patterns to refine the basic design for given context.

Course Outcomes (CO)

CO 1	Identify the appropriate design patterns to solve object oriented design problems.
CO 2	Develop design solutions using creational patterns.
CO 3	Apply structural patterns to solve design problems.
CO 4	Construct design solutions by using behavioral patterns.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT-I

Introduction: What Is a Design Pattern?, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

UNIT-II

A Case Study: Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation.

UNIT-III

Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton.

Structural Patterns: Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy

UNIT - IV

Behavioral Patterns: Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, Strategy, Template Method, Visitor.
Conclusion: What to Expect from Design Patterns, The Pattern Community.

Textbook(s):
1. Design Patterns By Erich Gamma, Pearson Education
2. Design Patterns Explained By Alan Shalloway,Pearson Education..
3. Meta Patterns designed by Wolf gang , Pearson.

References:
1. Head First Design Patterns By Eric Freeman-Oreilly-spd
2. JAVA Enterprise Design Patterns Vol-III By Mark Grand ,Wiley DreamTech.
3. Pattern‟s in JAVA Vol-I By Mark Grand ,Wiley DreamTech.
4. Pattern‟s in JAVA Vol-II By Mark Grand ,Wiley DreamTech.

Design Patterns Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OSD-449P
OAE	7	SD-OAE	SD-OAE-4A	OSD-449P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Design Patterns) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. The Strategy pattern
2. The Observer Pattern
3. The Decorator Pattern
4. The Simple Factory Pattern
5. The Factory Methods
6. The Abstract Factory Patterns
7. The Singleton Pattern
8. The Command Pattern.
9. The Adapter and Facade Patterns.
10. The Template Method Pattern
11. The Iterator and Composite Patterns.
12. The State Pattern.
13. The Proxy Pattern.
14. Compound Patterns.

Digital Control System	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-5	ICE-421T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the basic concept of Digital control system.
2.	To apply the knowledge of control theory for discrete-time models in various engineering applications
3.	To do the stability analysis of discrete-time system.
4.	To design discrete-time controllers for hybrid systems.

Course Outcomes (CO)

CO 1	Ability to define, understand and explain the concept of Digital control system.
CO 2	Ability to apply the knowledge of control theory for discrete-time models in various engineering applications.
CO 3	Ability to analyze discrete time control systems with different methods of stability in Z domain.
CO 4	Ability to design discrete time controller using DSPs and Microcontrollers

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	-	-	3	-	3	-	-	-	-	3
CO 2	3	2	-	2	3	3	-	3	3	-	-	3
CO 3	3	3	-	2	3	-	2	3	-	-	-	3
CO 4	3	2	3	3	3	3	-	3	3	3	-	3

UNIT I

Introduction to Discrete Time Control Systems: Introduction, Digital control systems, Sampling Process and its Mathematical Analysis, Quantization, Data Acquisition, Mathematical Description of the Ideal Sampling Process-The Ideal Sampler, Construction of Sampled Signals, Data Reconstruction by Polynomial Extrapolation, Z-Transforms, Important properties and theorems of the Z-transform,Inverse Z-Transformation, z transform method for solving Difference Equations, The Limitations ofZ-Transform Method, Modified z transform.

UNIT II

Z-plane Analysis of Discrete-Time control systems: Introduction, Impulse sampling and Data Hold circuits, Block Diagram Analysis and Transfer Functions of Closed Loop Sampled Data Systems, Signal FlowGraphs of Sampled Data Systems, The pulse transfer function, Pulse transfer function of a digital PID controller, Realization of digital controllers and filters.

UNIT III

Design of Discrete –Time control system by Conventional Methods: System characteristic equation, Time response, Mapping S-plane into Z-plane, Steady state accuracy, Stability Techniques, Bi-linear transformation, Routh Hurwitz Criterion, Jury stability test, Root locus, Nyquist criterion, Bode diagram, interpretation of frequency response, Closed loop frequency response, State-Space Representations of Discrete-time system, Solving Discrete-time State –space Equations, Pulse Transfer function matrix, Discretization of continuous- time state–space equations

UNIT IV

Digital Controller Design: Introduction to controller design, Control system specification, Compensation, Implementation of digital control systems using DSPs and Microcontrollers, Large-scale industrial applications usingPLCs and SCADA, Introduction to Discrete-event systems and Hybrid Systems

Textbooks:
1. K. Ogata, “Discrete Time Control System”, Prentice Hall International.
2. B.C. Kuo, “Digital Control Systems”, Oxford, 2007

References:
1. Charles L.Phillips & H.Troy Nagle, “Digital Control system Analysis and Design” PHI
2. G. F. Franklin, J. D. Powell and M. L. Workman, Digital Control of Dynamic Systems, Pearson, 3rd Ed, 2000.
3. V.I. George, C.P. Kurian, “Digital Control Systems” Cenage Learning 2012.
4. M. Gopal, “Digital Control & Sate Variable Methods”, TMH
5. Kavita Singh, Rashmi Vashisth, “Digital Control Systems”, Galgotia Publications, 2013.

Digital Control System Lab

L	P	C
	2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-5	ICE-421P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Digital Control System) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Obtain the inverse Z –transform of the following:

   $X(z) = \frac{z^2+2z}{z^2-2z+1}$and $f(z) = \frac{z(z+1)}{(z-1)^3}$

2. For the LTI systems described by the following difference equations generate its impulse response and unit step response:

   (a) $\mathrm{Y(n) = \ x(n) + 2x(n-1)}$

   (b) $Y(n) = 0.9y(n-1)\ + x(n)$ also find the analytical expression.

   (c) $Y(n) - 0.3695y(n-1)\ + 0.1958y(n-2)\ =\ 0.2066x(n) + 0.4131x(n-1)\ + 0.2066x(n-2)$

3. For the discrete-time transfer function

   $$H(z) = \frac{0.25^3 - 0.6273z^2 + 0.5153z - 0.1367}{Z^3 - 2.811z^2 + 2.652z - 0.8395}$$

   obtain the following

   (a) Transfer function to polo-zero conversion

   (b) Draw the polo-zero plot

   (c) Polo-zero to transfer function

   (d) Find the partial fraction expression of the transfer function

   (e) r, p, k to transfer function

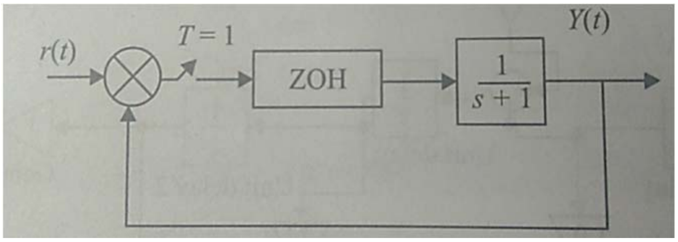
   (f) Root locus and stability analysis

4. Find the ZOH equivalent transfer function of $\frac{10}{5s+1}$. Obtained with the sampling period Ts=0.5sec.

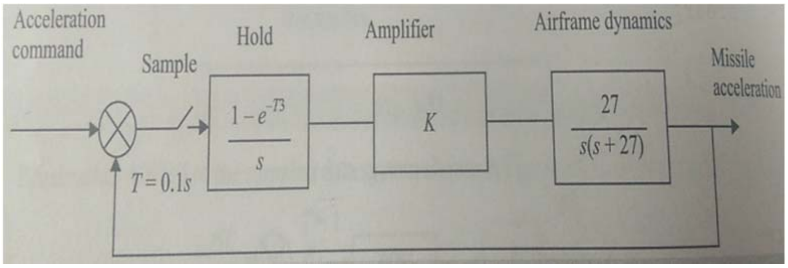
5. Obtain the six different realizations of the pulse transfer function.

   $$\frac{y(z)}{u(z)} = \frac{z+3}{z^3+9z^2+24z+20}$$

6. For the sampled data system shown in fig. below, find the response to step input.



7. Find the gain for stability.



8. Determine whether the system is observable and state controllable.

$$x = \begin{bmatrix} -2 & -1 & -3 \\ 0 & -2 & 1 \\ -7 & -8 & -9 \end{bmatrix} X + \begin{bmatrix} 2 \\ 1 \\ 2 \end{bmatrix} u;\ y = [4 \quad 6 \quad 8]x$$

9. Obtain bilinear transformation for

   (a) $z^3 - 1.3z^2 + 0.08z + 0.24 = 0$analyze the stability.

   (b) Obtain the root locus and analyse the stability.

10. Find the pulse transfer function of the given continuous-time system given below

    $A = [0 \quad 0; \quad 1 \quad -0.1]; [B = [0.1 \quad 0]; C = [0 \quad 1]; D = [0]$, For sampling time $T_s = 0.2\ s$.

Digital Image Processing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-1	ECE-308T
CSE-in-EA	6	OAE-CSE-EA	OAE-1	IPCV-334T
EAE	6	IPCV-EAE	IPCV-EAE-1A	IPCV-334T
EE/EEE	7	PCE	PCE-4	EEE-413T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic knowledge of image fundamentals.
2.	To impart the knowledge of simple image enhancement techniques in Spatial and Frequency domain.
3.	To impart the knowledge of image compression and image segmentation techniques
4.	To impart the knowledge of image representation and recognition techniques

Course Outcomes (CO)

CO 1	Understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and basic neighbour operations.
CO 2	Understand the techniques of smoothing, sharpening and enhancement.
CO 3	Understand the concept of image compression and image segmentation techniques
CO 4	Explain basic concepts of image representation and recognition techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Introduction and Digital Image Fundamentals: The origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamentals Steps in Image Processing, Elements of Digital Image Processing Systems, Image Sampling and Quantization, Some basic relationships like Neighbours, Connectivity, Distance Measures between pixels, Linear and Non Linear Operations

UNIT II

Image Enhancement in the Spatial Domain: Some basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods.

Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III

Image Compression: Coding, Interpixel and Psychovisual Redundancy, Image Compression models, Elements of Information Theory, Error free comparison, Lossy compression, Image compression standards.
Image Segmentation: Detection of Discontinuities, Edge linking and boundary detection, Thresholding, Region Oriented Segmentation, Motion basedsegmentation.

UNIT IV

Image Representation and Description: Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description, Introduction to Morphology, Some basic Morphological Algorithms.
Object Recognition: Patterns and Pattern Classes, Decision - Theoretic Methods, Structural Methods.

Textbook(s):
1. Rafael C. Gonzalez, Richard E. Woods, ‗Digital Image Processing', Pearson, Third Edition, 2010.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

References:
1. Bernd Jahne, "Digital Image Processing", 5th Ed., Springer, 2002.
2. William K Pratt, "Digital Image Processing: Piks Inside", John Wiley & Sons, 2001.

Digital Image Processing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-1	ECE-308P
CSE-in-EA	6	OAE-CSE-EA	OAE-1	IPCV-334P
EAE	6	IPCV-EAE	IPCV-EAE-1A	IPCV-334P
EE/EEE	7	PCE	PCE-4	EEE-413P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Digital Image Processing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write Program to read any image, resize it to 256 × 256. Apply a square mask so that only middle part of the image is visible.
2. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization.
3. Write and execute program for geometric transformation of image (a) Translation (b) Scaling (c) Rotation (d) Shrinking (e) Zooming
4. Prepare any two images of size 256 × 256 in paint. Save it in JPEG format 256 gray levels. Perform logical NOR, NAND operations between two images. Write program and paste your results
5. To Implement smoothing or averaging filter in spatial domain
6. Program of sharpen image using gradient mask.
7. To implement sharpening in frequency domain using High pass filtering
8. Program for DCT/IDCT computation
9. To add salt and pepper noise in the image and apply image restoration technique using Wiener filter and median filter
10. Write and execute programs for image frequency domain filtering (a) Apply FFT on given image (b) Perform low pass and high pass filtering in frequency domain (c) Apply IFFT to reconstruct image
11. Edge Detection using Sobel, Prewitt and Roberts Operators
12. To create a program to eliminate the high frequency components of an image
13. Write a program for image compression
14. To fill the region of interest for the image
15. Morphological Operations on Binary Images: erosion and dilation

Digital Logic and Computer Design	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE/ECE	3	PC	PC	ECC-207
OAE	6	CSE-OAE	CSE-OAE-1B	OCSE-308
OAE	7	ECE-OAE	ECE-OAE-3A	OECE-415

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce basic concepts of Boolean Algebra and Combinational Logic
2.	To introduce various sequential circuits, designing with examples
3.	To relate combination circuit design and sequential circuit design with respect to the design of a computer system
4.	To introduce machine learning, computer arithmetic, modes of data transfer with respect to I/O and Memory organization of a computer

Course Outcomes (CO)

CO 1	Ability to understand Boolean Algebra and Design Combinational Circuit.
CO 2	Ability to understand and Design Sequential Circuits.
CO 3	Ability to understand Design of a basic computer.
CO 4	Ability to understand Input-Output and Memory Organization of a Computer.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	-	-	-	3	2	2	3
CO 2	3	2	3	2	2	-	-	-	3	2	2	3
CO 3	3	2	3	3	2	-	-	-	3	2	2	3
CO 4	3	3	3	3	3	-	-	-	3	2	2	3

UNIT – I

Boolean Algebra and Combinational Logic: Review of number systems , signed, unsigned, fixed point, floating point numbers, Binary Codes, Boolean algebra – basic postulates, theorems , Simplification of Boolean function using Karnaugh map and Quine-McCluskey method – Implementations of combinational logic functions using gates, Adders, Subtractors, Magnitude comparator, encoder and decoders, multiplexers, code converters , parity generator/checker, implementation of combinational circuits using multiplexers.

UNIT – II

Sequential Circuits: General model of sequential circuits, Flip-flops, latches , level triggering, edge triggering, master slave configuration , concept of state diagram , state table, state reduction procedures , Design of synchronous sequential circuits , up/down and modulus counters , shift registers, Ring counter , Johnson counter , timing diagram , serial adder , sequence detector, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Memory Unit, Random Access Memory

UNIT – III

Basic Computer organization: Stored Program, Organization, Computer registers, bus system, instruction set completeness, instruction cycle, Register Transfer Language, Arithmetic, Logic and Shift Micro-operations, Instruction Codes, Design of a simple computer, Design of Arithmetic Logic unit, shifter, Design of a simple hardwired control unit, Programming the basic computer, Machine language instructions, assembly language, Microprogrammed control, Horizontal and Vertical Microprogramming, Central Processing Unit, instruction sets and formats, addressing modes, data paths, RISC and CISC characteristics.

UNIT – IV

Computer Arithmetic, addition, subtraction, multiplication and division algorithms, Input-Output Organization, Modes of data transfer, Interrupt cycle, direct memory access, Input-Output processor, Memory Organization, Memory Hierarchy, Associative Memory, Cache Memory, Internal and external Memory, Virtual Memory.

Text Book(s)

1. M. Morris Mano, “Digital Logic and Computer Design”, Pearson Education, 2016
2. M. Morris Mano, Rajib Mall “Computer System Architecture”, 3rd Edition Pearson Education, 2017

References:

1. Leach, D. P., Albert P. Malvino, “Digital Principles and Applications”, McGraw Hill, 8th Edition , 2014
2. Jain, R.P. ,”Modern Digital Electronics”, McGraw Hill Education, 4th Edition , 2010
3. Floyd, Thomas L. , “Digital Fundamentals” Pearson Education, 11th Edition, 2017
4. M. Rafiquzzaman, “Fundamentals of Digital Logic and Microcomputer Design”, Wiley, 5th Ed., 2005.

Digital Signal and Image Processing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	IPCV-EAE	IPCV-EAE-1B	IPCV-356T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the concept of DT Signal and DT Systems along with Classifying and analysing discrete-time signals and systems.
2.	To impart the Digital Signal Transform techniques DFT and FFT
3.	To impart the basics of image processing and Representation of Digital Image
4.	To impart the knowledge to Use the enhancement techniques for digital Image Processing

Course Outcomes (CO)

CO 1	To understand the basicconcept of DT Signal and DT Systems along with Classifying and analysing discrete-time signals and systems.
CO 2	To Acquire a clear idea of Digital Signal Transform techniques DFT and FFT
CO 3	To understand the basics of image processing and Representation of Digital Image.
CO 4	To understand the Use of the enhancement techniques for Digital Image Processing

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Review of Discrete Time Fourier Transform, Z- transform and Discrete Fourier Transform, Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs, concept of circular convolution, computation of circular convolution by graphical and matrix form, relationship between linear convolution and circular convolution, computation of linear convolution from circular convolution, , linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Save and Overlap-Add methods

Efficient computation of the DFT: Complexity analysis of direct computation of DFT, Concept of Fast Fourier transformation, Radix-2 computation of FFT using decimation-in-time and decimation-in-frequency algorithms, signal flow graphs, Butterflies, computations of FFT in one place using both algorithms, bit-reversal process, examples for DIT & DIF FFT Butterfly computations.

UNIT II

Design & structure of FIR filters: Basic concepts of IIR and FIR filters, Gibbs Phenomenon, Design of Linear-phase FIR filters using windows- Rectangular, Hamming, Hanning, Bartlett windows, Design of FIR filters using frequency sampling method. Structure for FIR Systems: Direct form, Cascade form and Lattice structures.
Design & Structure of IIR filters: Concept of IIR digital filter, analog to digital domain transformation, procedure to design Butterworth and Chebyshev digital IIR filters. Direct, Cascade, Parallel , Signal Flow graph and transposed structure, Lattice structures, Lattice and Lattice-Ladder Structures, Schur - Cohn stability Test for IIR filters.

UNIT III

Digital Image Fundamentals-Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization. Representation of Digital Image, Connectivity. Image File Formats: BMP, TIFF and JPEG.
Image Enhancement in Spatial domain-Gray Level Transformations, Zero Memory Point Operations, Histogram Processing and Histogram equalization, Neighbourhood Processing, Spatial Filtering, Smoothing and Sharpening Filters, Median Filter.

UNIT IV

Image Compression: Coding, Interpixel and Psychovisual Redundancy, Image Compression models, Elements of Information Theory, Error free comparison, Lossy compression, Image compression standards.
Image Segmentation: Detection of Discontinuities, Edge linking and boundary detection, Thresholding, Region Oriented Segmentation, Motion basedsegmentation.

Textbook(s):
1. John G. Proakis, Dimitris and G.Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications 4th Edition 2007, Pearson Education.
2. Rafel C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education Asia, 3rd Ed, 2009,
3. Oppenheim & Schafer, Digital Signal Processing, PHI-latest edition

Reference Books:
1. R.Babu ,Digital Signal Processing , Scitech Publication
2. S. K. Mitra, Digital Signal Processing, TMH edition 2006
3. Bernd Jahne, “Digital Image Processing”, 5th Ed., Springer,2002.
4. William K Pratt, “Digital Image Processing: Piks Inside”, John Wiley & Sons, 2001.

Digital Signal and Image Processing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	IPCV-EAE	IPCV-EAE-1B	IPCV-356P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Digital Signal and Image Processing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Generation of basic signals sine, cosine, ramp, step, impulse and exponential in continuous and discrete domains using user-defined functions.
2. Write a MATLAB program to find convolution (linear/circular) and correlation of two discrete signals.
3. Perform linear convolution using circular convolution and vice versa.
4. Write a MATLAB program to
5. Find 8-point DFT, its magnitude and phase plot and inverse DFT.
6. Find 16-point DFT, its magnitude and phase plot and inverse DFT.
7. Perform the following properties of DFT: a. Circular shift of a sequence b. Circular fold of a sequence.
8. Write Program to read any image, resize it to 256 × 256. Apply a square mask so that only middle part of the image is visible.
9. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization.
10. Write and execute program for geometric transformation of image (a) Translation (b) Scaling (c) Rotation (d) Shrinking (e) Zooming
11. Prepare any two images of size 256 × 256 in paint. Save it in JPEG format 256 gray levels. Perform logical NOR, NAND operations between two images. Write program and paste your results
12. To Implement smoothing or averaging filter in spatial domain

Digital Signal Processing	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE/ICE	5	PC	PC	ECC-303

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic knowledge of DFT, its properties, FFT and its applications.
2.	To impart the knowledge of designing and realization of FIR filters.
3.	To impart the knowledge of designing and realization of IIR filters.
4.	To impart the knowledge of quantization errors in Digital Signal Processing and the concept of Multirate signal processing.

Course Outcomes (CO)

CO 1	To understand the basic concept of DFT and FFT.
CO 2	To Acquire a clear idea of FIR filter designing techniques and realization methods.
CO 3	To understand the IIR filter designing techniques and realization methods and the stability.
CO 4	To understand the quantization errors in Digital Signal Processing and the concept of Multirate signal processing.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Review of Discrete Time Fourier Transform, Z- transform and Discrete Fourier Transform, Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs, concept of circular convolution, computation of circular convolution by graphical and matrix form, relationship between linear convolution and circular convolution, computation of linear convolution from circular convolution, , linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Save and Overlap-Add methods

Efficient computation of the DFT: Complexity analysis of direct computation of DFT, Concept of Fast Fourier transformation, Radix-2 computation of FFT using decimation-in-time and decimation-in-frequency algorithms, signal flow graphs, Butterflies, computations of FFT in one place using both algorithms, bit-reversal process, examples for DIT & DIF FFT Butterfly computations

UNIT II

Design & structure of FIR filters: Characteristics of practical frequency-selective filters, Basic concepts of IIR and FIR filters, Gibbs Phenomenon, Symmetric and Anti-symmetric FIR filters, Design of Linear-phase FIR filters using windows- Rectangular, Hamming, Hanning, Bartlett windows, FIR differentiator, FIR Hilbert Transformer. Design of FIR filters using frequency sampling method. Structure for FIR Systems: Direct form, Cascade form and Lattice structures.

UNIT III

Design & Structure of IIR filters: Concept of IIR digital filter, recursive and non-recursive system analog to digital domain transformation- Approximation of derivatives ,impulse invariant method and bilinear transformation and their properties, limitations of bilinear transformation, frequency warping and prewarping, methods to find out the order of IIR filter, mapping of poles and zeroes of filter in analog domain, computation of filter transfer function in analog domain, digital filter realization techniques, procedure to design Butterworth and Chebyshev digital IIR filters. Direct, Cascade, Parallel , Signal Flow graph and transposed structure, Lattice structures, Lattice and Lattice-Ladder Structures, Schur - Cohn stability Test for IIR filters

UNIT IV

Quantization Errors in Digital Signal Processing: Fixed point and floating point representation of numbers, Errors resulting from Rounding and Truncation, Digital Quantization of filter coefficients, Round-off effects in digital filters, Dead Band Effects.

Multirate Digital Signal Processing: Decimation, Interpolation, Sampling rate conversion by a rational factor; Frequency domain characterization of Interpolator and Decimator; Polyphase decomposition, Applications of Multirate signal processing.

Textbook(s):

1. Oppenheim & Schafer, Digital Signal Processing, PHI-latest edition.
2. Proakis and Manolakis, Digital Signal Processing, PHI Publication

Reference Books:

1. S. K. Mitra, Digital Signal Processing, TMH edition2006
2. Johny. R. Johnson, Introduction to Digital Signal Processing, PHI, Latest edition
3. R.Babu, Digital Signal Processing, Scitech Publication.

Digital Signal Processing Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE/ICE	5	PC	PC	ECC-351

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Digital Signal Processing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write Program to compute N point DFT of a given sequence and to plot magnitude and phase spectrum.
2. To implement Parseval theorem of DFT
3. To implement Time shifting and time reversal property of DFT
4. To find linear convolution of two given sequences.
5. To find circular convolution of two given sequences
6. To perform linear convolution from circular convolution and vice versa
7. To design LP FIR filter using windowing techniques
8. To design HP FIR filter using windowing techniques
9. To design LP IIR Butterworth filter for given specifications
10. To design LP IIR Chebyshev type-1 filter for given specifications
11. To verify the decimation of a given sequence
12. To verify the interpolation of a given sequence

Digital Systems Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EEE	6	PCE	PCE-3	EEE-338T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn the basics of VHDL hardware
2.	To apply combinational logic circuits using VHDL
3.	To apply synchronous circuit using VHDL
4.	To apply asynchronous circuit using VHDL

Course Outcomes (CO)

CO 1	Understand the VHDL as a programming language
CO 2	Design combination logic circuit using VHDL
CO 3	Design sequential synchronous circuit using VHDL
CO 4	Design asynchronous circuit using VHDL

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	-	-	2	3	-	3	1
CO 2	1	2	2	2	-	3	-	2	-	-	-	-
CO 3	2	1	3	1	2	-	-	-	-	-	-	-
CO 4	1	1	2	2	-	-	-	-	-	-	-	-

UNIT I

Introduction to VHDL, design units, data objects, signal drivers, inertial and transport delays, delta delay, VHDL data types, concurrent and sequential statements. Subprograms – Functions, Procedures, attributes, generio, generate, package, IEEE standard logic library, file I/O, test bench, component declaration, instantiation, configuration.

UNIT II

Combinational logic circuit design and VHDL implementation of following circuits –first adder, Subtractor, decoder, encoder, multiplexer, ALU, barrel shifter, 4X4 key board encoder, multiplier, divider, Hamming code encoder and correction circuits.

UNIT III

Synchronous sequential circuits design – finite state machines, Mealy and Moore, state assignments, design and VHDL implementation of FSMs, Linear feedback shift register (Pseudorandom and CRC).

UNIT IV

Asynchronous sequential circuit design – primitive flow table, concept of race, critical race and hazards, design issues like metastability, synchronizers, clock skew and timing considerations
Introduction to place & route process, Introduction to ROM, PLA, PAL, Architecture of CPLD (Xilinx/Altera).

Text Books:
1. Douglas Perry ,"VHDL" 4th Edition, TMH
2. Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with VHDL design", TMH.

Reference Books:
1. Charles. H.Roth ,"Digital System Design using VHDL", PWS (1998)
2. John F. Wakerley ,"Digital Design Principles And Practices" ,Pearson Education
3. Navabi Z , "VHDL-Analysis & Modelling of Digital Systems",McGraw Hill.
4. William I. Fletcher, "An Engineering Approach To Digital Design", Prentice Hall
5. Bhasker, "A VHDL Primer", Prentice Hall 1995.

Digital Systems Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EEE	6	PCE	PCE-3	EEE-338P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Digital Systems Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Design all gates using VHDL.
2. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
   i) half adder
   ii) full adder
3. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
   i) multiplexer
   ii) demultiplexer
4. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
   i) decoder
   ii) encoder
5. Write a VHDL program for a comparator and check the wave forms and the hardware generated
6. Write a VHDL program for a code converter and check the wave forms and the hardware generated
7. Write a VHDL program for a FLIP-FLOP and check the wave forms and the hardware generated
8. Write a VHDL program for a counter and check the wave forms and the hardware generated
9. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
   i) ALU
   ii) shift register
10. Write a VHDL program for a seven segment display interface and check the waveforms and the hardware generated.

Disaster Management	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	6	PCE	PCE-3	CEE-322

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide a general concept in the dimensions of disasters caused by nature beyond the human control
2.	To familiarize the student about the disasters and environmental hazards induced by human activities
3.	To aware about disaster preparedness, response and recovery.
4.	To know about the latest technology in mitigation of disasters

Course Outcomes (CO)

CO 1	Understand the knowledge of the significance of disaster management,
CO 2	Analyse the occurrences, reasons and mechanism of various types of disaster
CO 3	Understand the preventive measures as Civil Engineer with latest codal provisions
CO 4	Apply the latest technology in mitigation of disasters

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	1	2	2	3	-	-	-	-	-	-
CO 2	3	3	1	2	1	3	-	-	-	-	-	-
CO 3	2	2	3	2	2	2	-	-	-	-	-	-
CO 4	2	2	3	1	1	2	-	-	-	-	-	-

UNIT-I

Introduction: Disaster, Emergency, Hazard, Mitigation, Disaster Prevention,
Geological based disasters: Earthquake, Tsunamis, Landslides and avalanches: Definition, causes and structure; past lesson learnt and measures taken; their Characteristic features, Impact and prevention, Atlas (BMTRPC); structural and non-structural measures.
Man-made Disaster: Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures (Building and Bridge), War & Terrorism etc. Causes, effects and practical examples for all disasters.

UNIT-II

Hydro-meteorological based disasters: Disaster Management Act 2005, Role of NDMA, NDRF, NIDM, Tropical Cyclones, Floods, droughts, mechanism, causes, role of Indian Meteorological Department, Central Water

Commission, structure and their impacts, classifications, vulnerability. Desertification Zones, causes and impacts of desertification, Characteristics, Vulnerability to India and Step to combat desertification, Forest Fires; Causes of Forest Fires; Impact of Forest Fires, Prevention.

UNIT-III

Disaster Preparedness and Response Preparedness: Disaster Preparedness: Concept and Nature, Disaster Preparedness Plan, Prediction, Early Warnings and Safety Measures of Disaster, Role of Information, Education, Communication, and Training, Role of Government, International and NGO Bodies, Role of IT in Disaster Preparedness, Role of Engineers on Disaster Management

Response: Introduction to Disaster Response, Response Plan, Communication, Participation, and Activation of Emergency Preparedness Plan, Search, Rescue, Evacuation and Logistic Management, Role of Government, International and NGO Bodies.

UNIT – IV

Rehabilitation, Reconstruction and Recovery: Reconstruction and Rehabilitation as a Means of Development, Damage Assessment, Post Disaster effects and Remedial Measures, Creation of Long-term Job Opportunities and Livelihood Options, Disaster Resistant House Construction, Sanitation and Hygiene, Education and Awareness, Dealing with Victims' Psychology, Long-term Counter Disaster Planning, Role of Educational Institute

Textbook(s):

1. J. P. Singhal Disaster Management Laxmi Publications
2. Dr. Mrinalini Pandey Disaster Management Wiley India Pvt. Ltd.

References:

1. Savindra Singh and Jeetendra Singh, Disaster Management, Pravalika Publications, Allahabad
2. Nidhi GaubaDhawan and Ambrina Sardar Khan, Disaster Management and Preparedness, CBS Publishers & Distribution
3. Selected Resources Published by the National Disaster Management Institute of Home Affairs, Govt. of India, New Delhi.

Discrete Control Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-2	EEE-326T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Acquire working knowledge of discrete system science related mathematics
2.	Use of techniques, tools and skills to identify, formulate and solve discrete control problems
3.	Design of discrete control systems and implementation of different techniques to analyse response
4.	Develop designs skills using state space model, design Lyapunov criterion and pole placement

Course Outcomes (CO)

CO 1	Understand the concept of discrete system and apply of z transform for its representation
CO 2	Realization of digital controller and digital filters
CO 3	Analyse stability in discrete time using z transform and Pulse transform
CO 4	Stability and performance analysis of discrete control systems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1	1	1	1	1	1	1	1	1
CO 2	3	3	3	2	2	1	1	1	1	1	1	2
CO 3	3	3	3	2	3	1	1	1	1	1	1	3
CO 4	3	3	3	3	3	1	1	1	1	1	1	3

UNIT I

Introduction to Discrete Time Control Systems: Digital control Systems, Quantizing and Quantization errors, data acquisition, conversion and distribution systems.
The Z Transform-Z transforms of elementary functions, Properties and theorems of z transform, Inverse Z transform, z transform for solving difference equations.

UNIT II

Z plane Analysis of Discrete Time Control Systems: Impulse sampling and data hold, Obtaining Z transform by convolution Integral method, Reconstructing original signals from sampled signals, Pulse transfer function, Realization of digital controllers and digital filters.

UNIT III

Design of Discrete- Time Control Systems by Conventional Methods : Mapping between the s plane and the Z plane, stability analysis of closed loop systems in z plane, transient and steady state response analysis, design based on root locus and frequency response methods.

UNIT IV

State Space Analysis: State space representations of Discrete time systems, Pulse transfer function matrix, Discretrization of continous time state space equations, Liapunov stability analysis. Pole Placement and Obseverer Design: Controllabity, Observability, Design via pole placement.

Textbooks:

1. Discrete - Time Control Systems by Katsuhiko Ogata, PHI, 2nd Ed, 2005

References:

1. Advanced Discrete Time control: Designs and Applications by J X Xu & K. Abidi, Springer
2. Discrete Time Control system design with Applications by CA Rabbath and Nelecheiva, Springer

Discrete Control Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-2	EEE-326P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Discrete Control Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of open loop and closed loop time/ frequency responses of first/second order LTI system
2. Conversion of transfer functions to state model of LTI system and vice versa
3. Determine State Space Model of a given system and determine its controllability and observability.
4. Analysis of Zero order hold and first order hold circuits.
5. Conversion of transfer functions to state model of discrete time system.
6. To determine state transition matrix of a given system.
7. Study of saturation and dead zone non-linearity using describing function technique of a relay control system.
8. To draw phase trajectory of a given non-linear system.
9. Experiments based on PLC applications e.g. Lift control models, pick and place module etc.
10. Study of operation of a stepper motor interface with microprocessor.

Distributed Systems and Cloud Computing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	7	PCE	PCE-4	CIE-407T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	This course provides an insight into Distributed systems.
2.	The course Discusses important paradigms in distributed systems
3.	The course helps the students to understand process synchronization
4.	The course tells about basics of cloud computing and cloud migration

Course Outcomes (CO)

CO 1	Select appropriate distributed system and inter process communication method
CO 2	Understand various process synchronization problems in distributed systems
CO 3	Create distributed file systems using Hadoop
CO 4	Choose appropriate cloud migration approach for the organization

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	3	-	1	-	-		1		-	1
CO 2	3	3	3	3	1	-	-		1	-	-	1
CO 3	2	-	3	2	3	-	-	-	1	-	-	1
CO 4	2	2	-	-	-	2	2	-	-	-	-	2

UNIT-I

Introduction to Distributed Systems: Characteristics of Distributed Systems-Introduction, Examples of Distributed systems (Client server, peer to peer, grid and cloud computing), Advantages of distributed systems, System models -Introduction, Architectural and Fundamental models, Networking and Internetworking, Interposes Communication (message passing and shared memory), Distributed objects and Remote Method Invocation, RPC, Events and notifications, Case study-Java RMI.

UNIT-II

Synchronization: Time and Global States-Introduction, Logical Clocks, Synchronizing physical clocks events and Process states, Synchronizing physical clocks, logical time and logical clocks, global states, distributed debugging, Coordination and Agreement: Distributed mutual exclusion, Elections, Multicast communication, consensus and related problems.

UNIT-III

Distributed File Systems: Introduction – File Models – File accessing, sharing and caching – File Replication – Atomic transactions Case Study HADOOP. : Resource and process management – Task assignment approach – Load balancing approach – Load sharing approach

UNIT – IV

Cloud Computing, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service, Hardware as a service, platform as a Service, Software as a service, Challenges and Risks. Migrating into a Cloud:-Introduction, Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud

Textbook(s):

1. Distributed Systems Concepts and Design, G Coulouris, J Dollimore and T Kindberg, Fourth Edition, Pearson
2. R. Buyya, CLOUD COMPUTING Principles and Paradigms, Willey
3. Distributed Systems, S.Ghosh, Chapman & Hall/CRC, Taylor & Francis Group, 2010.

References:

1. Distributed Systems – Principles and Paradigms, A.S. Tanenbaum and M.V. Steen, Pearson Education.
2. Distributed Computing, Principles, Algorithms and Systems, Ajay D. Kshemakalyani and Mukesh Singhal, Cambridge, rp 2010.
3. Gerard Tel, “Introduction to Distributed algorithms”, Cambridge University Press, USA, 2000.

Distributed Systems and Cloud Computing Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	7	PCE	PCE-4	CIE-407P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Distributed Systems and Cloud Computing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a Program in Java to implement RPC
2. Implement the concept of Remote Method Invocation in Java.
3. Write a java program to implement Lamport’s Logical clock
4. Implement mutual exclusion service using Lamport’s Mutual Exclusion Algorithm
5. Install Hadoop on Windows
6. Run a simple application on single node Hadoop Cluster
7. Install Google App Engine and develop a simple web application.
8. Launch Web application using Google App Engine
9. Install Virtualbox / VMware Workstation with different flavours of linux on windows.
10. Simulate a cloud scenario using CloudSim and run a scheduling algorithm

E-Commerce and M-Commerce	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	6	PCE	PCE-2	CIE-336

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge about the fundamentals and advancements in the fields of Electronic Commerce (E-Commerce) with the aim of enabling the students to explore the possibilities of practical applications and research aspects in the field of integrating business with Information Technology.
2.	To impart knowledge of Electronic Payment Systems, Electronic Data Interchange, online selling techniques, and Internet tools.
3.	To understand the concept of Supply chain management, E-procurement, and Customer relationship management.
4.	To impart knowledge about the fundamentals and advancements in the fields of Mobile Commerce (M-Commerce) with the aim of enabling the students to explore the possibilities of practical applications and research aspects in the field of integrating business with Information Technology.

Course Outcomes (CO)

CO 1	Ability to have in-depth knowledge in the fields of Electronic Commerce (E-Commerce)
CO 2	Ablility to understand Electronic Payment Systems, Electronic Data Interchange, online selling techniques, and Internet tools.
CO 3	Ability to understand the concept of Supply chain management, E-procurement, and Customer relationship management.
CO 4	Ability to have an understanding of Mobile Commerce (M-Commerce)

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	2	2	3	3
CO 2	3	2	2	2	3	-	-	-	2	2	3	3
CO 3	3	2	2	2	3	-	-	-	2	2	3	3
CO 4	3	2	2	2	3	-	-	-	2	2	3	3

UNIT-I

Introduction and Concepts: Networks and commercial transactions – Internet and other novelties; networks and electronic transactions today, Model for commercial transactions; Internet environment – internet advantage, worlds wide web and other internet sales venues; Online commerce solutions.

Security Technologies: Insecurity Internet; A brief introduction to Cryptography; Public key solution; Key distribution and certification; prominent cryptographic applications.

Electronic Payment Methods: Updating traditional transactions; secure online transaction models; Online commercial environments; digital currencies and payment systems; Offline secure processing; private data networks.

UNIT-II

Protocols for Public Transport of Private Information: Security protocols; secure protocols; Secure hypertext transfer protocols; Secure sockets layers; Integrating security protocols into the web; Non technical provide. Electronic Commerce Providers: On-line Commerce options: Company profiles.
Electronic Payment Systems: Digital payment systems; First virtual internet payment system; cyber cash model. On-line Commerce Environments: Servers and commercial environments; Netscape product line; Netscape commerce server; Microsoft internet explorer and servers; open market.
Digital Currencies: Optional process of Digicash, Ecash Trail; Using Ecash; Smart cards, Electronic Data Interchange; Its basics; EDI versus Internet and EDI over Internet.
Strategies, Techniques and Tools: Internet Strategies: Internet Techniques, Shopping techniques and online selling techniques; Internet tools.

UNIT-III

Supply chain management: Introduction, What is supply chain management? Focus on the value chain, Option for restructuring the supply chain, Using e-business to restructure the supply chain, Supply chain management implementation.
E-procurement: Introduction, What is e-procurement?, Drivers of e-procurement, Focus on estimating e-procurement cost savings, Risks and impacts of e-procurement, Implementing e-procurement, Focus on electronics B2B marketplaces, The future of e-procurement?
Customer relationship management: Introduction, What is e-CRM?, conversion marketing, the online buying process, customer acquisition management, focus on marketing communications for customer acquisition, customer retention management focus on excelling in e-commerce service quality, customer extension Analysis and design: Introduction, process modeling, Data modeling, Design for e-business, Focus on user – centered site design, Focus on security design for e-business.
Implementation and maintenance: Introduction, Alternatives for acquiring e-business systems, Development of web-based content and services, focus on developing dynamic web content, testing, Changeover, Content management and maintenance, focus on measuring and improving performance of e- business systems.

UNIT – IV

Introduction to M-commerce: Emerging applications, different players in m-commerce, M-commerce life cycle Mobile financial services, mobile entertainment services, and proactive service management. Management of mobile commerce services, Content development and distribution to hand-held devices, content caching, pricing of mobile commerce services; emerging issues in mobile commerce: The role of emerging wireless LANs and 3G/4G wireless networks, personalized content management, implementation challenges in m-commerce, futuristic m-commerce services.

Textbook(s):

1. Ravi Kalakota, Andrew B. Whinston, “Frontiers of E-Commerce”, 1st Edition, Sept. 1996, Addison Wesley
2. Dave Chaffey, “E-Business and E-Commerce Management”, 3rd Edition, 2009, Pearson Education.

References:

1. Henry Chan, Raymod Lee and etl., “E-Commerce Fundamental and Applications”, 1st Edition, Wiley, 2001
2. Brian Mennecke and Troy Strader, “Mobile Commerce: Technology, Theory and Applications”, Idea Group, 2003.
3. Nansi Shi, “Mobile Commerce Applications”, IGI Global, 2004.
4. Gary P. Schneider, “Electronic Commerce”, Tenth Edition, May 2012, CENGAGE Learning India
5. K. K. Bajaj, D. Nag “E-Commerce”, 2nd Edition, Sept. 2005, McGraw Hill Education.
6. P. T. Joseph, “E-Commerce an Indian Perspective”, 4th Edition, July 2013, PHI Publication.
7. Bhaskar Bharat, “Electronic Commerce - Technology and Application”, 4th Edition, May 2013, McGraw Hill.

Economics and Policies of e-Mobility	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	EV-EAE	EV-EAE-4	EV-415

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of Indian and global scenario of E- Mobility.
2.	To impart the knowledge of Dynamics testing of Vehicles.
3.	To impart the knowledge of vehicle component testing.
4.	To impart the knowledge of the static testing of vehicles.

Course Outcomes (CO)

CO 1	To understand the Indian and global scenario of E- Mobility.
CO 2	To provide the knowledge of Dynamics testing of Vehicles.
CO 3	To understand the vehicle component testing
CO 4	To analyze and understand the knowledge of the static testing of vehicles.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Indian and Global Scenario: Technology Scenario - Market Scenario - Policies and Regulations - Payback and commercial model - Polices in India – opportunities
Introduction: Specification & Classification of Vehicles (including M, N and O layout) - Homologation & its Types - Regulations overview (EEC, ECE, FMVSS, AIS, CMVR) - Type approval Scheme.

UNIT II

Dynamics Testing of Vehicle: Speedo-meter Calibration, Range Test, Maximum Speed, Acceleration Test, Coast-down test, Brakes Performance ABS Test, Broadband / Narrowband EMI Test, Electric vehicle, RangeTest.

UNIT III

Vehicle Component Testing: Horn Testing - Safety Glasses Test - Windscreen laminated and toughened safety glass - Rear View Mirror Test - Hydraulic Brakes Hoses Fuel Tank Test - Metallic & Plastic - Hinges and Latches

Test, Tyre & Wheel Rim Test - Bumper Impact Test - Side Door Intrusion - Crash test with dummies - Demist test - Defrost Test.

UNIT IV

STATIC TESTING OF VEHICLE: CMVR physical verification - Tyre Tread Depth Test - Vehicle Weightment - Horn installation - Rear view mirror installation - External Projection - tell-tale - Wheel Guard - Arrangement of Foot Controls for M1 Vehicle - Angle & Dimensions Measurement of Vehicle - The Requirement of Temporary Cabin For Drive away - Chassis.

Textbook(s):
1. “Vehicle Inspection Handbook”, Indian Association of Motor Vehicle Administrators

References:
1. Proceedings- Automotive Testing & Certification held on 20th to 24th July 2010 at ARAI PUNE
2. Bosch Automotive Handbook, Robert Bosch, 7th Edition, 2007

Economics for Engineers	L	P	C
	2		2

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
All	5	HS/MS	HS	HS-301

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To explain the basic micro and macro economics concepts.
2.	To analyze the theories of production, cost, profit and break even analysis.
3.	To evaluate the different market structures and their implications for thebehavior of the firm.
4.	To apply the basics of national income accounting and business cycles toIndian economy.

Course Outcomes (CO)

CO 1	Analyze the theories of demand, supply, elasticity and consumer choicein the market.
CO 2	Analyze the theories of production, cost, profit and break even analysis.
CO 3	Evaluate the different market structures and their implications for thebehavior of the firm.
CO 4	Apply the basics of national income accounting and business cycles toIndian economy.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	2	1	2	1	-	1	-	1	1	3	1
CO 2	1	2	1	2	1	-	1	-	1	1	3	1
CO 3	1	2	1	2	1	-	1	-	1	1	3	1
CO 4	1	2	1	2	1	-	1	-	1	1	3	1

UNIT-I

Introduction: Economics Definition, Basic economic problems, Resource constraints and welfare maximization. Microand Macro economics. Production Possibility Curve.Circular flow of economic activities.

Basics of Demand, Supply and Equilibrium: Demand side and supply side of the market. Factors affecting demand & supply. Elasticity of demand & supply – price, income and cross-price elasticity. Market equilibrium price.

UNIT-II

Theory of Consumer Choice: heory of Utility and consumer’s equilibrium.Indifference Curve analysis, Budget Constraints, Consumer Equilibrium.

Demand forecasting: Regression Technique, Time-series, Smoothing Techniques: Exponential, Moving AveragesMethod

UNIT-III

Cost Theory and Analysis: Nature and types of cost, Cost functions- short run and long run, Economies and diseconomies of scale
Market Structure: Market structure and degree of competitionPerfect competition, Monopoly, Monopolistic competition, Oligopoly

UNIT - IV

National Income Accounting: Overview of Macroeconomics, Basic concepts of NationalIncome Accounting
Macro Economics Issues: Introduction to Business Cycle, Inflation-causes,consequences and remedies: Monetary and Fiscal policy.

Textbook(s):
1. H.C. Petersen, W.C. Lewis, Managerial Economics, 4th ed., Pearson Education 2001.

References:
1. S.K. Misra& V. K. Puri, Indian Economy, 38th ed., Himalaya Publishing House, 2020.
2. D.N. Dwivedi, Managerial Economics, 8th Edition, Vikas Publishing house
3. D. Salvatore, Managerial Economics in a Global Economy, 8th ed., Oxford University Press, 2015.
4. S. Damodaran, Managerial Economics, 2 nd ed., Oxford University Press, 2010.
5. M. Hirschey, Managerial Economics, 12th ed., Cengage India, 2013.
6. P.A. Samuelson, W.D. Nordhaus, S. Nordhaus,Economics,18th ed., Tata Mc-Graw Hill, 2006.

EHVAC and HVDC Transmission	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	PS-EAE	PS-EAE-2	PS-322T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To teach about the basic concepts of EHV AC transmission and understand its need
2.	Description of voltage control methods for EHV AC transmission System
3.	Description of the concepts of HVDC Transmission over AC Transmission
4.	To teach the concepts of the control of HVDC Converters and system

Course Outcomes (CO)

CO 1	Understand the trends in EHV AC Transmission
CO 2	Analyse compensated devices for voltage control
CO 3	Understand the advantages of DC transmission over AC transmission
CO 4	Analyze Line Commutated Converters and Voltage Source Converters in HVDC Transmission

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	2	2	2	2	1	2	2	1	1	1
CO 2	1	1	2	2	2	2	1	2	1	2	1	1
CO 3	1	2	2	2	1	3	2	1	1	2	1	3
CO 4	2	2	3	2	2	2	1	1	1	1	2	2

UNIT-I

EHV AC Transmission System: Necessity advantages of EHV AC transmission lines, EHV AC transmission lines analysis – nominal and equivalent circuits; Problems related with long lines: corona loss, audible noise generation and characteristic corona pulses, RI effect, ferro-resonance, and principles of half wave transmission.

UNIT-II

Reactive Power Management in EHV AC System: Reactive power management of power system, reactive power problems associated with EHV AC systems; reactive power devices – operation and control, series and shunt compensation of EHV AC system, different equipment and scheme details with analysis, application of FACTS Technology, extra high voltage testing: Characteristics and generation of impulse voltage, generation of high AC and DC voltages, measurement of high voltage by sphere gaps and potential dividers.

UNIT-III

HVDC Transmission: Introduction, historical developments, comparison of AC and DC Transmission(Economics, Technical Performance and Reliability); types of HVDC systems, components of HVDC systems and their ratings, construction and characteristics; Applications of DC transmission; power converter circuits associated with HVDC systems, design aspects of 12- pulse converters, simple design problems of HVDC systems.

UNIT – IV

Control of HVDC Converters and System: Types of DC link, principle of DC link control, converter controls characteristics, firing angle control, current and excitation angle control, power control, starting and stopping of DC link, harmonic filters – HVDC current and voltage filters, different types of filters, fundamental aspects of HVDC circuit breaking, MTDC systems: types, control and application.

Textbook(s):
1. S.Rao, EHV AC & HVDC Transmission Engineering & Practice, Khanna Publishers.
2. K.R Padiyar HVDC power Transmission System, New Age Publication.

References:
1. R.D. Begamudre, Extra high Voltage AC transmission Engineering, Wiley Eastern.
2. Naidu, Kamaraju, High Voltage Engineering, 5th ed., TMH Publishing.
3. Kamakshaiah, Kamaraju, HVDC Transmission, McGraw-Hill Publication.
4. Nagsarkar, Sukhija, Power System Analysis, Oxford Publication.

EHVAC and HVDC Transmission Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	PS-EAE	PS-EAE-2	PS-322P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (EHVAC and HVDC Transmission) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of various HVDC transmission system components and their applications.
2. Study of AC/DC side voltage and current waveform of six pulse converter system under variable RL load using simulation.
3. Study the methods of measurement of EHVAC.
4. Study of AC/DC side voltage and current waveform of twelve pulse converter system under variable RL Load using simulation.
5. Study of various types of Multi terminal HVDC transmission system.
6. Study of DC link control in VSC based HVDC transmission system.
7. Study of reactive power control in HVDC transmission system.
8. Study of various passive filters used in LCC based HVDC transmission system.
9. Study of some simulation practice based on HVDC power and voltage stability system
10. Operation of VSC for power factor correction at AC side of HVDC using sinusoidal PWM.

Note: The above practical list is based on model. However, Hands on MATLAB/SCILAB simulation based models related to the course contents can be carried out.

Elastic & Plastic Behaviour of Materials	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-3	MEE-338T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about different types metal forming processes.
2.	To understand theory of plastic deformation.
3.	To understand the mechanics of various deformation processes and problems associated with them.
4.	To understand the importance of lubrication.

Course Outcomes (CO)

CO 1	Classify various forming process.
CO 2	Analyze theory of stress strain.
CO 3	Identify and analyze various methods bulk metal forming processes.
CO 4	Explain the importance of lubrication in metal deformation processes.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Stress-Strain relations in Elastic and plastic Deformations, True stress and true strain, true stress-strain curves, selection of stress-strain curves for cold and hot working, yield of Isotropic plastic material.

UNIT-II

Von Mises' hypothesis of yielding, Tresca's hypothesis of yielding, graphical representation of yield criteria, plastic incompressibility, Idealized stress strain relations in plastic deformations, Poisson's ratio for plastic deformation flow rule, application of theory of plasticity for solving metal forming Problems using Slab method, Upper and lower Bound methods, Slip line field theory.

UNIT-III

Technology and analysis of important metal forming processes- Forging, Roiling, Extrusion. Wiredrawing, Sheet Metal forming processes like Deep drawing, Stretch forming, Bending, defects in various metal forming processes like rolling, forging, extrusion, wiredrawing and deep drawing and their causes and remedial measures.

UNIT – IV

Lubrication in metal forming processes, principles and mechanism of lubrications, hydrodynamic and their film lubrication, boundary and extreme pressure lubricants, solid Lubricants, lubricants used for rolling and cold drawing, forging. Effects of temperature and strain rate in metal working, friction in Hot and Cold working.

Textbook(s):

1. Ghosh A. and Mallik A. K., "Manufacturing Science", East -West Press, New Delhi, 1998.
2. Juneja B. L., “Fundamentals of Metal Forming Processes”, New Age International Publishers, 2010.

References Books:

1. Dieter G. E., "Mechanical Metallurgy", McGraw Hill, 1988.
2. Rao P.N., "Manufacturing Technology", Tata McGraw Hill, 1990.
3. Wangoner Robert H. and Jean-Loup Chenot, "Fundamentals of Metal Forming”, John Wiley & Sons, 1997.
4. Beddoes J. and Bibby M. J., "Principles of Metal Manufacturing Processes", Viva Books, 2000.
5. Sharma P. C., "Production Engineering", S. Chand & Co., New Delhi, 2003
6. Hosford William F. and Caddell R. M., "Metal Forming Mechanics and Metallurgy", Prentice Hall, 1993.
7. Mielnik Edward M., "Metal Working Science and Engineering", McGraw Hill, 1991.

Elastic & Plastic Behaviour of Materials Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-3	MEE-338P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Elastic and Plastic Behaviour of Materials) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Forming Process
2. To study of Yield Condition
3. To Study of Slip lines, Upper bound and lower bound.
4. To study and analysis of Forging Process
5. To study and analysis of Rolling Process
6. To study Extrusion & Drawing process
7. To study and analysis of Sheet metal forming process
8. To study and analysis of deep drawing process

Electric Drives	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-3	EEE-340T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To describe dynamics of electric drives and selection of motors
2.	To study the characteristics of DC motor drives
3.	To discuss operations and characteristics of induction motor drives
4.	To demonstrate working of special machines used in electrical drives

Course Outcomes (CO)

CO 1	To develop the capability to choose a suitable motor in drives
CO 2	To acquire knowledge of DC series and DC shunt motor operations
CO 3	To design frequency controlled converters used in induction motor drives
CO 4	To demonstrate working of special machines used in electrical drives.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	3	2	2	3	3	2	2	2	2	3
CO 2	3	1	3	2	2	2	3	3	3	2	1	2
CO 3	3	3	3	2	3	2	3	2	2	3	3	2
CO 4	3	3	3	3	3	2	3	3	3	3	3	3

UNIT- I

Dynamics of Electric Drives: Types of loads, quadrant diagram of speed time characteristics, Basic and modified characteristics of dc and ac motors, equalization of load, steady state stability, calculation of time and energy loss, control of electric drives, modes of operation, speed control and drive classifications, closed loop control of drives, selection of motor power rating, class of duty, thermal considerations.

UNIT- II

DC Motor Drives: DC motor speed control, Methods of armature control, field weakening, semiconductor controlled drives, starting, braking, transient analysis, controlled rectifier fed dc drives, chopper controlled dc drives.

UNIT- III

Induction Motor Drives: Three phase induction motor starting, braking, transient analysis, speed control from stator and rotor sides, stator voltage control, variable frequency control from voltage sources and current sources, static rotor resistance control, slip power recovery, static Scherbius and static Kramer drive.

UNIT-IV

Drives with Special Machine: Introduction to permanent magnet machines, thermal properties of PM, concept of BLDC motor, 120° and 180° operation, rotor position detection, open loop voltage control, closed loop current control, high speed single pulse operation, permanent magnet synchronous machines, rotor position detection and synchronization, sinusoidal PWM excitation, closed and open loop control, PMSG and its application to wind energy, stepper motor, current and voltage control, drive circuits, SRM drive, modelingand analysis of SRM, different configurations of converters, closed and open loop operation, high speed operation with angle of advance.

Text Books:

1. G K Dubey, "Principle of Electrical Drives",Narosa Publishing House
2. VedamSubrahmanyam, "Electrical Drives", Tata McGraw-Hill

References Books:

1. R Krishnan, "Electrical Motor Drives" PHI Publications.
2. Ned Mohan, "Electrical Machines And Drives" Wiley India Publication
3. Bimal K Bose, "Modern Power Electronics and AC Drives", PHI Publications.
4. De, Sen, "Electric Drives", PHI Publications.
5. Bimal K Bose, "Power Electronics and Variable Frequency Drives" Wiley India Publication

Electric Drives Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-3	EEE-340P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Electric Drives) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Load equalization by flywheel for intermittent duty loads.
2. Comparison of various braking methods and their range of braking for induction motor.
3. Open loop AC voltage Control of single phase capacitor run induction motor.
4. Verification of linear relationship between duty cycle vs speed in open loop step down chopper controlled DC motor drive.
5. Single phase thyristorised full converter fed closed loop speed control of DC motor drive.
6. Closed loop speed control of 4 quadrant DC motor drive.
7. Closed Loop constant v/f speed control of Induction motor drive.
8. Closed Loop speed control through static rotor resistance controlled slip ring Induction motor.
9. Closed loop speed control of BLDC motor drive.
10. Closed Loop speed control of SRM drive.

Electric Vehicle Powertrain and Motor Design	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
EAE	6	EV-EAE	EV-EAE-1	EV-308T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic knowledge of EV technologies.
2.	To impart the knowledge of different storage technologies.
3.	To impart the knowledge of Electric Machines and Drives in EVs.
4.	To impart the knowledge of converters and controllers used in EVs.

Course Outcomes (CO)

CO 1	To understand the different EV technologies.
CO 2	To provide the solution of energy storage in EVs.
CO 3	To understand the Electric machines and Drives in EVs.
CO 4	To understand the different converters and controllers in EVs.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Introduction to EVs, Comparison with Internal combustion Engine : Technology, Comparison with Internal combustion Engine: Benefits and Challenges Components of Electric Vehicle, Electric Vehicle Powertrain block diagram,

UNIT II

Battery Energy StorageBatteries in Electric and Hybrid Vehicles: Battery Basics, Battery Parameters, Electrochemical Cell Fundamentals. Battery Modeling: Electric Circuit ModelsBasic Battery Model, Run-Time Battery Model, Impedance-Based Model, First Principle Model, Empirical Models: Range Prediction with Constant Current Discharge, Range Prediction with Power Density Approach. Traction Batteries, Battery Pack Management

UNIT III

Electric Machines and Drives in EVs: Principle of Induction Motors,Speed Control of Induction Machine, Variable Frequency, Variable Voltage Control of Induction Motors, Field-Oriented Control of Induction Machine, Basic Principle and Operation of PM Motors, Design and Sizing of Traction Motors. Speed Rating of the Traction Motor, Determination of the Inner Power, Thermal Analysis and Modeling of Traction Motors.

UNIT IV

Introduction to Power Electronic Switches, DC/DC Converters, Buck Converter, Boost Converter, Buck-Boost Converter, EV Powertrain Converters: Powertrain Boost Converter, Traction Inverter:Power Device Selection, Busbar and Packaging, DC Bus Filtering, Gate Drive Design, Controller and Sensors,Thermal Design. High- to Low-Voltage DC/DC Converter, On-Board Battery Charger, Cell-Balancing Converters

Textbook(s):

1. Iqbal Husain , “Electric and Hybrid VehiclesDesign Fundamentals”, CRC Press
2. John G. Hayes, “Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid,Electric and Fuel Cell Vehicles”, Wiley
3. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley, 2003

Reference Books:

1. Mehrdad Ehsani, “Modern Electric,Hybrid Electric, andFuel Cell Vehicles” CRC Press
2. Electric and Hybrid Vehicles Technologies, Modeling and Control: A Mechatronic Approach By Amir Khajepour, Saber Fallah, AvestaGoodarzi, Wiley

Electric Vehicle Powertrain and Motor Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	EV-EAE	EV-EAE-1	EV-308P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Electric Vehicle Powertrain and Motor Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1 Battery testing

2 Alternator testing.

3 Starter motor testing

4 Diagnosis of ignition system.

5 Diagnosis of automotive electrical wiring.

6 Fault finding of relay & fuses in car using Off Board Diagnostics Systems (OBDS).

7 Relay & fuse Fault diagnostic of a car using OBDS

8 Powertrain Design- Continuously Variable Transmission (CVT) and Belt Drive

9 Powertrain Design- Using Planetary Gear Sets

10 Powertrain Design- Using CVT and a Bevel Gearbox

11 Driving Cycle Simulation

Electrical and Electronics Measuring Instruments	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	5	PC	PC	EEC-305

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Introduce how to measure power and energy
2.	Understand working and applications of potentiometers and bridges
3.	Knowledge to use printers and recorders
4.	Selection of proper type and specification of transducers

Course Outcomes (CO)

CO 1	Identify and classify various types of instruments for power and energy measurement
CO 2	Develop the knowledge of working and applications of potentiometers and bridges
CO 3	Ability to apply proper recorder and printer in measurement
CO 4	Describe working principle selection criteria and application of various transducers in measurement system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	3	2	3	3	2	2	1	1	1	1	3
CO 2	3	3	2	3	3	2	2	1	1	1	1	3
CO 3	3	3	3	3	3	2	2	1	1	1	1	3
CO 4	3	3	3	3	3	2	2	1	1	1	1	3

UNIT I

Power and Energy Measurement

Instrument transformers:, CT and PT, Ratio and phase angle errors.

Measurement of Power: Single phase and three phase dynamometer wattmeter, LPF and UPF, expression for deflecting and control torques. Type of P.F. Meters, dynamometer and moving iron type, Frequency meters, Resonance type and Weston type, synchoroscopes.

Measurement of Energy: single phase and three phase induction type energy meter, driving and braking torques, errors and compensations, testing by phantom loading, trivector meter, maximum demand meters.

UNIT II

Potentiometers and Bridges: Basics of DC potentiometers, laboratory type potentiometer, multi range potentiometer, applications of DC potentiometers, AC potentiometer; polar and coordinate type,, Drydale polar potentiometer, Gall Trinsley potentiometer, applications of AC potentiometer, Bridges for measuring

low, medium and high resistance; Carey Foster's bridge, Kelvin's double bridge, Mega ohm bridge, Megger.
A.C. Bridges: Measurement of inductance and capacitance, Maxwell's bridge, Hay's bridge, Anderson's bridge, Owen's bridge, Heaviside Bridge and its modifications, Desauty bridge. Wien's bridge, Schering Bridge..

UNIT III

Display Devices and Recorders: Introduction of various display devices, LCD, LED and plasma display, CRO & its applications, measurement of frequency (lissajous patterns), sampling oscilloscope, DSO. Recorders: requirement of recording data, selection of recorder for a particular application, analog, graphic, strip chart, galvanometeric, circular chart, XY, digital recorders, single point and multipoint recorders.
Printers: Types of Printers, Drum type printer, dot matrix type printer, Ink-jet and Laser jet printers

UNIT IV

Transducers: Introductionon and Classification of Transducers. Primary and secondary sensing elements, Basic Working principle and applications of resistive, inductive and capacitive transducers. Working principle and applications of. LVDT, RTD, Thermistor, piezoresistors, strain gauze, angular velocity transducers, opto electronic transducers, inverse tranducers

Textbook(s):

1. D. Patranabis, "Sensors and Transducers", PHI Learning Pvt. Ltd., 2nd edition
2. D V S Murty, "Transducers and Instrumentation", PHI Learning Pvt. Ltd.
3. E. W. Golding and F. C. Widdis - Electrical Measurements and measuring Instruments, Wheeler Publishing, 5th Ed..
4. A. K. Sahwney - Electrical & Electronic Measurement & Instrumention, Dhanpat Rai & Co., 2000

Reference Books:

1. Buckingham and Price - Principles of Electrical Measurements, Prentice Hall, 1970
2. Reissland, M. U. - Electrical Measurements: Fundamentals, Concepts, Applications New Age.
3. W. D. Cooper, "Modern Electronic Instrumentation & Measurement Technique" PHI, 1998

Electrical and Electronics Measuring Instruments Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	5	PC	PC	EEC-353

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Electrical and Electronics Measuring Instruments) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Testing of single phase and three phase electromechanical and electronic energy meters.
2. Measurement of three phase power by two watt meters using instrument transformer.
3. Study and demonstration of Trivector Meter.
4. Calibration of D.C. and A.C. potentiometers.
5. Measurement of low resistance using Kelvin’s double bridge.
6. Measurement of inductance using Maxwell’s bridge/ Hay’s bridge/ Anderson’s bridge/ Owen’s bridge.
7. Study and use of different types of Recorders / Printers.
8. Study of different types of transducers.
9. Study of LVDT and RTD.

Electrical Power Generation Systems	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	6	PCE	PCE-1	EEE-358
EEE	6	PCE	PCE-3	EEE-354

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Study the effect of renewable energy resources and thermal power plant
2.	Explore Gas turbine Power plant and hydro electric methods used in power system
3.	Deep knowledge of various components of substations.
4.	Design of various new technologies to optimize the economic operations

Course Outcomes (CO)

CO 1	Understand the economics of power generation.
CO 2	Understand Gas turbine Power plant and hydroelectric methods used in power system
CO 3	Have a deep knowledge of various components of substations.
CO 4	Apply various new technologies to optimize the economic operations

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	-	-	-	1	-	-	-	1	2
CO 2	3	2	2	-	2	2	2	-	-	-	1	2
CO 3	3	2	2	-	-	2	1	-	-	1	2	2
CO 4	3	-	2	-	-	-	3	-	-	-	3	2

UNIT I

Different form of energy sources: Fossils fuels, Nuclear energy and Hydro power
Renewable Energy Sources: Introduction to Solar energy, geo-thermal energy, tidal energy, wind energy, bio-gas energy and M.H.D. Power generation.
Thermal Power Plant: Location and Site selection, general layout and working of plant, boilers, economizers, super heaters, draft equipments, fuel and ash handling plants.

UNIT II

Gas Turbine Power Plant: Lay out, Working and components of gas turbine power plant, combined gas and steam turbine plant.
Hydro Electric Plant: Location and site selection, general layout and operation of plant, Types of Hydro Turbines and their characteristics – Impulse and reaction type (Pelton Wheel, Francis and Kaplan turbines), speed governing system.

Diesel Power Plant: Layout and components of plant auxiliary equipments.

UNIT III

Nuclear Power Plant: Location and site selection, general layout and operation of plant, brief description of reactors, moderators and reflectors.
Substation Layout: Types of substations, typical layout and constructional details of pole mounted, Indoor, Outdoor sub-stations, hybrid gas insulated sub stations, bus bar arrangements, application of substation equipment like transformer , circuit breaker, isolator, metering equipments and protecting equipment , substation grounding.

UNIT IV

Economic Operation Of Power System: Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling Economic Dispatch including transmission losses – approximate penalty factor, iterative technique for solution of economic dispatch with losses; Derivation of transmission loss formula. Cost analysis and economics of power generation.

Textbooks:

1. M. V. Deshpande, “Elements of Electric Power Station Design”, Wheeler Publishing Co.
2. B. G. A. Skrotzki& W. A. Vopat, “Power Station Engineering and Economy”, Tata McGraw Hill. 5th Ed. 2013
3. Harish.C.Rai, “Power Plant Engineering”, I.K. International Publishers.

References:

1. S. L. Uppal, “Electrical Power”, Khanna Publishers. 13th edition 2003
2. M. L. Soni, P. V. Gupta and U. S. Bhatnagar, “A Course in Electrical Power”, Dhanpat Rai & Sons, 1st Ed 2005
3. B. R. Gupta, “Generation of Electrical Energy”, S. Chand & Co. Ltd.
4. C.L. Wadhwa, “Generation distribution and utilization of Electrical Energy”, New Age International Publishers, 3rd Ed, 2017

Electricity Distribution Schemes and Policies	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	7	PCE	PCE-4	EEE-403

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To model and characterise the transmission and distribution systems
2.	To design transmission and distribution systems
3.	Analysis of Distribution systems based on economic considerations
4.	To understand Coordination of protective devices

Course Outcomes (CO)

CO 1	Ability to model and characterise the transmission and distribution systems
CO 2	Ability to design transmission and distribution systems
CO 3	Ability to analyse distribution systems based on economic considerations
CO 4	Ability to understand Coordination of protective devices

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	3	2	2	2	1	1	-	2	1	2	2
CO 2	2	3	2	2	2	1	1	-	2	1	2	2
CO 3	2	2	2	2	2	1	1	-	2	1	2	2
CO 4	2	2	2	2	2	1	1	-	2	1	2	2

UNIT- I

Introduction to sub-transmission and distribution system; classification of loads – residential, commercial, agricultural, industrial and their characteristics; distribution system planning – short-term, mid-term, long-term, load modeling and characteristics; definition of demand factor, utilization factor, load factor, plant factor, diversity factor, loss factor; computer applications to distribution system automation; tariff.

UNIT- II

Distribution feeders, transformers and sub-stations; primary feeders – voltage level, radial and loop types, uniformly distributed and non-uniformly distributed load; design considerations for secondary system – voltage level, location of substation, rating, service area with primary feeders, optimal location; existing system improvement.

UNIT- III

System analysis – voltage drop and power loss calculation; methods of solution for radial networks, three-phase balanced primary lines, non-three-phase primary lines; loss reduction, voltage regulation, voltage control and improvement, issues in quality of service – voltage sag, swell and flicker; application of capacitors to distribution system – effect of series and shunt capacitors, power factor correction, economic justification for capacitor with cost-benefit analysis aiming at most economic power factor, optimum location of capacitor.

UNIT-IV

Distribution sub-station bus schemes, description, and comparison of switching schemes; types of common faults and procedure for system fault calculation; protection – objectives, over current protection devices – fuses, automatic circuit re-closers, automatic line sectionalizing, coordination of protective devices – fuse to fuse, fuse to circuit breaker, re-closer to circuit breaker.

Textbooks:

1. Turan Gonen, "Electric Power Distribution System Engineering", McGraw Hill, 3rd Ed, 2014
2. Dale R. Patrick, "Electrical Distribution System", 2nd Edition, 2021, River Publications

References:

1. James A. Momoh, "Electric Power Distribution Automation, Protection and Control", CRC Press
2. A. S. Pabla, "Electric Power Distribution", Tata McGraw Hill, 7th Ed, 2019

Electricity Generation, Transmission and Utilization	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	PS-EAE	PS-EAE-1	PS-320T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concepts of various methods of generation of power.
2.	To explain the features of energy transmission system and transmission line structure.
3.	To acquire Knowledge of traction system and its speed time curve.
4.	To study illumination concepts and designing

Course Outcomes (CO)

CO 1	Understand the process of power generation.
CO 2	Explain the standard electric power transmission methods.
CO 3	understand the speed time curves for traction.
CO 4	Understand the design illumination scheme for class rooms, workshops and factories.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	3	2	1	1	1	2	2	2	2
CO 2	3	3	2	3	2	1	1	1	2	2	2	2
CO 3	3	3	3	3	2	1	1	1	2	2	2	2
CO 4	3	3	3	3	2	2	1	1	2	2	2	2

UNIT I

Electric Power Generation: Different forms of energy sources: Fossils fuels, Nuclear energy and Hydro power. Thermal Power Plant: Location and Site selection, general layout and working of plant, boilers, economizers, super heaters, fuel and ash handling plants. Gas Turbine Power Plant: Lay out, Working and components of gas turbine power plant, combined gas and steam turbine plant. Hydro Electric Power Plant: Location and site selection, general layout and operation of plant, Types of Hydro Turbines and their characteristics – Impulse and reaction type (Pelton Wheel, Francis and Kaplan turbines. Diesel Power Plant: Layout and components of plant auxiliary equipment. Nuclear Power Plant: Location and site selection, general layout and operation of plant, brief description of reactors, moderators and reflectors.

UNIT II

Transmission: AC transmission and distribution system – Schematic layout diagram, standard transmission and distribution voltages, advantages and limitations of high voltage transmission, various systems for power transmission and distribution, transmission through overhead and underground system, comparison of HVDC and HVAC system. Overhead transmission lines: Main components of overhead transmission lines, classification of transmission lines based on the distance, Line constants -resistance, inductance and capacitance. Short transmission line- Equivalent circuit, vector diagram, equations for receiving end voltage, efficiency, voltage regulation and power factor. Underground transmission lines: Classification of UG cables, types of cables, general construction of a single core UG cable, construction of 3 core XLPE cables, essential properties required for insulating material of UG cables, methods of laying UG cables.

UNIT III

Electric Traction: Advantages of electric traction, requirements of an ideal traction system, different system of electric traction; comparison between D.C. and A.C. systems of railway electrification; speed – time curves, different types of traction motors and their characteristics; parallel operation of traction motors. Starting and speed control of 3 phase induction motors, electric braking, advantages and disadvantages of regenerative braking. Calculation of energy returned during regeneration.

UNIT IV

Illumination: Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light, discharge lamps, mercury vapour and sodium vapour lamps- their characteristic and applications, performance comparison between tungsten filament lamps, fluorescent tubes, CFL and LED lights, basic principles of light control, types and design of lighting schemes and flood lighting.

Textbook(s):

1. C.L. Wadhwa, “Generation, Distribution and Utilization of Electrical Energy” New Age International Publications.
2. Pratap. H., “Art and Science of Utilization of Electrical Energy”, Dhanpat Rai & Sons.

References:

1. G. C. Garg, “Utilisation of Electric power and electric traction”, Khanna Publishers, New Delhi.
2. R K Rajput, “Utilisation of Electrical Power”, Laxmi Publications Pvt. Ltd, New Delhi.
3. A. Pabla, “Electric Power Distribution”, McGraw Hill.

Electricity Generation, Transmission and Utilization Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	PS-EAE	PS-EAE-1	PS-320P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Electricity Generation, Transmission and Utilization) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To plot polar curves for various lamps.
2. Design of lighting schemes for house / commercial complex / industry / street light / flood light with the help of designing software ‘CALCULUX’.
3. To control the speed of various traction motors.
4. To verify illumination laws.
5. To study of charging method of batteries and calculation of their life cycle.
6. To conduct performance comparison of MV lamps, SV lamps, filament lamps, CFL & LED lights.
7. Characteristics of welding transformer.
8. Demonstration of large size cut model of different types of batteries.
9. Study of charging and discharging of battery under MATLAB/SIMULINK.
10. To dissect the power cable into its distinguished parts and selection of the appropriate cable size for the given load.
11. To study major substation equipment and make a one-line diagram.
12. To improve power factor of distribution load.

Electronic Devices and Circuits	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	ECE-OAE	ECE-OAE-2	OECE-314T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of Electronics, associated semiconductor devices and application areas and also to understand the movement of charge carriers in semiconductors
2.	To impart the knowledge of PN junction diode, special diodes and the circuits using these diodes for various applications.
3.	To impart the knowledge of various semiconductor transistors.
4.	To impart the knowledge of circuits with different transistor configurations. Also, to understand the basics of digital electronics, Boolean algebra and minimization techniques to analyse circuits using logic gates.

Course Outcomes (CO)

CO 1	Define the concepts of Electronics, associated semiconductor devices and application areas. Demonstrate the movement of charge carriers in semiconductors
CO 2	Summarize various properties of a PN junction diode. Design and analyses special diodes and the circuits using these diodes for various applications.
CO 3	Classify the concepts of various semiconductor transistors.
CO 4	Design and analyse various circuits with different transistor configurations. Illustrate the basics of digital electronics, Boolean algebra and minimization techniques to analyse circuits using logic gates.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	2	3	3	2	3	3	2	3	2	3
CO 2	3	2	3	3	2	1	2	2	1	1	3	1
CO 3	3	2	2	2	2	1	1	2	2	2	2	1
CO 4	3	3	3	2	3	2	1	2	3	2	3	2

UNIT I

Evaluation Of Electronics: Introduction & Application Of Electronics, Energy Band Theory Of Crystals, Energy Band Structures In Metals, Semiconductors And Insulators, Theory of Semiconductors: Classification Of Semiconductors, Conductivity Of Semiconductors, Carrier Concentration In Intrinsic & Extrinsic Semiconductors, Properties Of Intrinsic And Extrinsic Semiconductors, Variation In Semiconductors Parameters With Temperature, Fermi-Dirac Function, Fermi Level In A Semiconductor Having Impurities, Band Structure Of Open-Circuited P-N Junction, Drift And Diffusion Currents, Carrier Life Time (Elementary Treatment Only)

UNIT II

Theory of p-n junction Diode: Ideal diode, Diode Current Equation, AC & DC Resistance, Transition and Diffusion Capacitance, (Elementary treatment only), Effect of Temperature on p-n Junction Diode, Switching Characteristics, Piecewise Linear Model
Special Diodes: Zener Diode, Tunnel Diode, Photodiode, Light Emitting Diodes, Schottky Barrier Diode
Applications of Diodes: Half-Wave Diode Rectifier, Full-Wave Rectifier, Clippers and Clampers (Elementary treatment only).

UNIT III

Bipolar junction transistor: Introduction of transistor, construction, transistor operations, BJT characteristics, load line, operating point, leakage currents, saturation and cut off mode of operations, Eber-moll 's model.

UNIT IV

Application of BJT: CB, CE, CC configurations, hybrid model for transistor at low frequencies, Introduction to FETs and MOSFETs.
Fundamentals of digital electronics: Digital and analog signals, number systems, Boolean algebra, logic gates with simple applications, karnaugh maps.

Textbook(s):
1. S. Salivahanan, N. Suresh Kr. & A. Vallavaraj, Electronic Devices & Circuit, Tata McGraw Hill, 2008
2. Millman, Halkias and Jit, Electronic devices and circuits McGraw Hill
3. Boylestad & Nashelsky, Electronic Devices & Circuits, Pearson Education, 10TH Edition.

Reference Books:
1. Sedra & Smith, Micro Electronic Circuits Oxford University Press, VI Edition
2. Robert T. Paynter, Introducing Electronic Devices & Circuits, Pearson Education, VII Edition, 2006
3. Vincent Del Toro, Electrical Engineering Fundamentals, Prentice Hall of India

Electronic Devices and Circuits Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	ECE-OAE	ECE-OAE-2	OECE-314P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Electronic Devices and Circuits) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to CRO, Function Generator& Bread Board & to generate different types of waveforms with the help of Function Generator & to calculate their frequency.
2. Identification & testing of Active & passive components.
3. To plot V-I characteristics of a semiconductor diode.
4. To Study the Reverse characteristics of Zener diode.
5. To Study the Rectifier circuit: a) Half Wave Rectifier b) Centre Tapped Rectifier c) Bridge Rectifier.
6. To Study the output waveforms of different Filter Circuits of Rectifier.
7. To Plot Input & Output characteristics CB transistor.
8. To Plot Input & Output characteristics of CE transistor.
9. Realization of basic gates.
10. Implementation of Boolean functions (two or three variables).
11. Few experiments mentioned above to be performed on P-spice.
12. To develop a working model of any electronic circuit.

Electronic Measurements	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-1	ECE-320T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide an exposure to performance characteristics of Electronic measurements.
2.	To impart the knowledge about the working and use of different measuring instruments.
3.	To impart the detailed knowledge about cathode ray oscilloscope and its various types.
4.	To provide understanding about various signal analyzers and transducers along with Data Acquisition System.

Course Outcomes (CO)

CO 1	Identify and analyze different performance characteristics of measuring in detail.
CO 2	Analyze/Illustrate the working of various basic meters such as voltmeter and ammeter.
CO 3	Implement the working of different types of oscilloscopes with their applications.
CO 4	Explain different types of signal analyzers and transducers along with Data Acquisition System.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	-	2	1	1	2	2	2	2
CO 2	3	3	3	3	1	2	2	-	2	2	-	3
CO 3	3	3	1	3	2	2	-	-	1	1	1	2
CO 4	1	1	1	3	2	2	-	-	1	2	-	2

UNIT I

Performance Characteristics of Instruments: Static Characteristics, Dynamic Characteristics.
Errors in Measurement: Types of Static Errors, Gross Errors, Systematic Errors, Random Errors, Sources of Errors.
Basic Meter Movement: Moving Coil and Moving Iron type of instruments.
Display Devices: Digital display system and indicators, Classification of displays, Light Emitting Diodes (LED), Liquid Crystal Display (LCD).
Printers: Classification of Printers, Drum Printer, Dot-Matrix, ink-jet & Laser-jet Printers.
Electrical Standards & Calibration.

UNIT II

DC Ammeter, Multi range ammeters, Extending of ammeter ranges, RF Ammeter, Effect of frequency on calibration. DC Voltmeter, Multi range voltmeter, extending Voltmeter ranges, Transistor Voltmeter, Chopper type DC amplifier Voltmeter (Micro-voltmeter), Solid-State Voltmeter, AC Voltmeter using rectifiers, True RMS Voltmeter.

Digital Metering: Dual slope integrating type DVM (Voltage to Time conversion), Integrating type DVM (Voltage to Frequency Conversion), Resolution and sensitivity of digital meters, General specifications of a DVM, Digital Multimeters, Digital frequency meter, Digital measurement of time, Universal counter, Electronic counter, Digital tachometer, Digital pH meter, Digital phase meter, Digital capacitance meter.

UNIT III

Basic Principle, CRT features, Block diagram of oscilloscope, single/dual beam CRO, dual trace oscilloscope, (VHF) sampling oscilloscope, storage oscilloscope (For VLF Signal). Measurement of phase and frequency by Lissajous figures method. Oscilloscope as a Bridge Null detector, standard specifications of a single beam CRO, probes for CRO, Digital Storage Oscilloscope (DSO), Fiber Optic CRT recording oscilloscope.

UNIT IV

Fixed / Variable Frequency AF Oscillator, Signal Generator, Function Generator, (sine, square and triangular wave generator), Frequency selective and Heterodyne Wave Analyzer. Digital Data Recording, Potentiometric Recorder (Multipoint), Digital Memory Waveform Recorder (DWR),

Introduction to transducers, Data Acquisition System: Introduction, Objective of a DAS, Single Channel Data Acquisition System, Multi-Channel DAS.

Textbook(s):

1. A. K. Shawney - Electrical & Electronic Measurement & Instruments, Dhanpat Rai & Sons Publication
2. H.S. Kalsi, “Electronic Instrumentation” Tata McGraw-Hill.

References:

1. W. D. Cooper, “Modern Electronics Instrumentation & Measurement Techniques” PHI, 1998.
2. E. W. Gloding and F. C. Widdis - Electrical Measurements and measuring Instruments, Wheeler Publishing, fifth Edition.
3. Reissland, M. U. “Electrical Measurements: Fundamentals, Concepts, Applications”, New Age International (P) Limited, Publishers.

Electronic Measurements Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-1	ECE-320P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Electronic Measurements) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study and demonstration of different types of display devices.
2. Measurement of resistance, voltage and current using digital multimeter / clamp meter.
3. Calibration of Ammeter and Voltmeter.
4. Measurement of resistance, inductance and capacitance using digital RLC meter.
5. Measurement of frequency and time period using digital frequency meter.
6. Study and demonstration of universal frequency counter.
7. Study and measurement of voltage, frequency and phase difference of a.c. quantities using C.R.O.
8. Measurement of inductance and capacitance using C.R.O.
9. Study and measurement of quantities using D.S.O.
10. Study of function generator.
11. Study and use of different types of transducers (Temperature, Pressure, Optical Transducers).
12. Study of different types of recorders /Printers.
13. Study and use different types of ADC and DAC.

Embedded Linux	L	P	C
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	IOT-EAE	IOT-EAE-2A	ES-328T
EAE	6	ICB-EAE	ICB-EAE-2A	ES-328T
EAE	7	ES-EAE	ES-EAE-5A	ES-407T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	This course provides an insight into Architecture of Embedded Linux
2.	The course helps the students to understand Hardware Abstraction Layer and BSP
3.	The course helps the students to understand the basics of device drivers
4.	The course tells about basics of Real Time Operating Systems

Course Outcomes (CO)

CO 1	Understand architecture of Embedded Linux
CO 2	Configure Board Support Package and HAL with proper memory management
CO 3	Design Device drivers for various type of devices
CO 4	Port Application Developed for embedded systems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	3	-	1	-	-		1		-	1
CO 2	3	3	3	3	1	-	-		1	-	-	1
CO 3	2	-	3	2	3	-	-	-	1	-	-	1
CO 4	2	2	-	-	-	2	2	-	-	-	-	2

UNIT-I

Introduction to Embedded Linux: Introduction to Embedded Systems, Real time Operating Systems, Embedded Linux, Embedded Linux Distributions, Architecture of Embedded Linux, Linux Kernel, Architecture of Linux Boot Sequence, GNU Cross Platform Tool chain.

UNIT-II

Board Support Package & HAL: Inserting BSP during build process, Boot Loader, Memory Map, PCI Subsystem, Interrupt Management, , UART, Timers, and Power Management.
Storage: Flash Map, MTD—Memory Technology Device, MTD Architecture, Flash- Mapping Drivers, MTD Block and Character devices, Embedded File systems, Optimizing Storage Space.

UNIT-III

Device Drivers: Basics of Device drivers, Ethernet Driver, Linux Serial Driver, I2C subsystem on Linux, USB, Watchdog Timer, and Kernel Modules.

UNIT – IV

Porting Applications: Architectural Comparison, Application Porting Road Map, Programming with Pthreads, Operating System Porting Layer (OSPL), Kernel API Driver.

Textbook(s):

1. Embedded Linux System Design and Development, P. Raghavan, Amol Lad, Sriram Neelakandan, 2006, Auerbach Publications

References:

1. Karim Yaghmour, Jon Masters, Gillad Ben Yossef, Philippe Gerum, “Building embedded Linux systems”, O'Reilly, 2008.
2. Christopher Hallinan, “Embedded Linux Primer: A practical real world approach”, Prentice Hall, 2007.
3. Craig Hollabaugh, “Embedded Linux: Hardware, software and Interfacing”, Pearson Education, 2002.
4. Doug Abbott, “Linux for embedded and real time applications”, Elsevier Science, 2003.

Embedded Linux Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	IOT-EAE	IOT-EAE-2A	ES-328P
EAE	6	ICB-EAE	ICB-EAE-2A	ES-328P
EAE	7	ES-EAE	ES-EAE-5A	ES-407P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Embedded Linux) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a multi-threaded program using pthread
2. Write a program to use fork( ) system call to create a child process.
3. Write a program to show CPU scheduling using fork ( ).
4. Write a program to implement semaphore using pthread library.
5. Install & configure busy box
6. Run busy box and check Version.
7. Execute important Busybox commands.
8. Build a minimal RootFS using busy box
9. create symlinks to busybox for a command
10. Use HttpD server on busy box

Embedded System Architecture and Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-344T
CSE-in-EA	6	OAE-CSE-EA	OAE-1	ES-306T
EAE	6	ES-EAE	ES-EAE-2B	ES-306T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn the architectural design of Embedded system.
2.	To understand the communication protocols in respect to advanced processors.
3.	Develop real time applications based on embedded systems.
4.	Apply embedded device based processing on RTOS.

Course Outcomes (CO)

CO 1	Ability to understand the architecture and features of microcontrollers 8051 and PIC.
CO 2	Ability to understand and apply the concepts of ARM processors and understand various Bus structures in programming.
CO 3	Ability to understand the concept of embedded software, RTOS and apply it in Embedded Programming.
CO 4	Ability to apply the knowledge of embedded operating systems to understand Mutli-Tasking, Scheduling and RTOS linux kernel.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	-	-	-	-	-	-	-	2	-	1
CO 2	2	1	-	-	-	-	-	-	-	2	-	2
CO 3	2	1	1	2	2	2	2	-	-	2	-	1
CO 4	-	1	1	2	2	2	2	-	-	2	-	1

UNIT I

Overview of Embedded Systems: Characteristics of Embedded Systems. Comparison of Embedded Systems with general purpose processors. General architecture and functioning of micro controllers. 8051 microcontrollers. PIC Microcontrollers: Architecture, Registers, memory interfacing, interrupts, Instructions, programming and peripherals.

UNIT II

ARM Processors: Comparison of ARM architecture with PIC micro controller, ARM 7 Data Path, Registers, Memory Organization, Instruction set, Programming, Exception programming, Interrupt Handling, Thumb mode Architecture. Bus structure: Time multiplexing, serial, parallel communication bus structure. Bus arbitration, DMA, PCI, AMBA, I2C and SPI Buses.

UNIT III

Embedded Software, Concept of Real Time Systems, Software Quality Measurement, and Compilers for Embedded System.

UNIT IV

RTOS: Embedded Operating Systems, Multi-Tasking, Multi-Threading, Real-time Operating Systems, RTLinux introduction, RTOS kernel, Real-Time Scheduling.

Textbook(s):

1. Design with PIC Microcontrollers, John B. Peatman, Pearson Education Asia, 2002.
2. ARM System Developer’s Guide: Designing and Optimizing System Software, Andrew N. Sloss, Dominic Symes, Chris Wright, Morgan Kaufman Publication, 2004.
3. Computers as components: Principles of Embedded Computing System Design, Wayne Wolf, Morgan Kaufman Publication, 2000.

References:

1. The Design of Small-Scale embedded systems, Tim Wilmshurst, Palgrave 2003.
2. Embedded System Design, Mar wedel, Peter , Kluwer Publishers , 2004.

Embedded System Architecture and Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-344P
CSE-in-EA	6	OAE-CSE-EA	OAE-1	ES-306P
EAE	6	ES-EAE	ES-EAE-2B	ES-306P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Embedded System Architecture and Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to load three numbers into Accumulator and send them to port 1. (Keil)
2. Write an 8051 C program to send hex values for ASCII characters of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D and E to port P1.
3. Write a program to configure watchdog timer in watchdog mode & interval mode.
4. Write an 8051 C program to get a byte of data form P1, wait ½ second (i.e., 500 ms) and then send it to P2.
5. Write an 8051 C Program to send the two messages “first name” and “last name” to the serial port. If SW = 0, send first name else if SW = 1, send last name. Set the baud rate at 9600, 8-bit data, and 1 stop bit.
6. Learn how to use Embest IDE for ARM and ARM Software Emulator.
7. Program to interface Stepper Motor to rotate the motor in clockwise and anticlockwise Directions.
8. Write a program to change ARM state mode by using MRS/MMSR instruction.
9. Write a random number generation function using assembly language.
10. Use assembly and C language to read/write words, half-words, bytes, half bytes from/to RAM.
11. Write programs that implement an interrupt service routine.
12. Write programs that use the RTC. Modify the setting of time and date. Display the current system clock time through the serial port.
13. Develop a project that accepts the keys of the keyboard pad through interrupt service routine and display the values on the 8-SEG LED.

Embedded Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-2	ICE-316T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To expose students to the basics of embedded system
2.	To expose students to the RTOS and inter process communication
3.	To acquaint the students with the different tools for testing and debugging
4.	To acquaint the students with the design knowledge of embedded system

Course Outcomes (CO)

CO 1	Understand the RTOS and inter-process communication.
CO 2	Identify and describe various characteristic features and applications of Embedded systems
CO 3	Evaluate and use various tools for testing and debugging embedded systems
CO 4	Design real time embedded systems using the concepts of RTOS.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	-	-	-	2	-	-	2	-	3
CO 2	3	2	-	-	-	-	2	-	-	2	-	3
CO 3	3	3	2	2	-	-	3	-	2	3	2	3
CO 4	3	3	3	3	-	-	3	-	3	3	3	3

Unit I

Introduction to Embedded Systems: Introduction to Embedded Systems –Structural units in Embeded procesor, selection of procesor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debuging.

Unit II

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS42 – RS 485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – need for device drivers.

Unit III

Embedded Firmware Development Environment: Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modeling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

Unit IV

RTOS Based Embedded System Design: Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance.

Textbooks:

1. Rajkamal, "Embedded Systems: Architecture, Programming and Design", McGraw Hill Education (India) Private Limited, New Delhi, 2015, 3rd Edition.
2. Lawrence M Thompson, Industrial Data Communication, 2nd edition, 1997.
3. Sriram Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata McGraw Hill

References:

1. David Simon, "An Embedded Software Primer", Pearson, 2009.
2. Dr. K. V. K. K. Prasad, "Embedded Real Time System: Concepts, Design and Programming"
3. K.V. Shibu, Introduction To Embedded Systems, Tata McGraw, 2009.

Embedded Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-2	ICE-316P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Embedded Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Read input from switch and Automatic control/flash LED (soft-ware delay).
2. Interrupts programming example using GPIO.
3. Configure watchdog timer in watchdog mode & interval mode.
4. Display numbers from 0-9 on seven segment display
5. To read key code from 4x4 matrix keyboard and LCD display
6. Display string on 16x2 LCD
7. Configure timer block for signal generation (with given frequency)
8. PWM Generator
9. DC motor speed control
10. Stepper motor control

Embedded Systems and Internet of Things	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	7	PC	PC	MAC-405

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Explain the real time embedded system and its components.
2.	Understand basic components and building blocks of Internet of Things.
3.	Apply skills to conduct interfacing of embedded boards with components, actuators and sensors.
4.	Design embedded and IOT Systems for various applications.

Course Outcomes (CO)

CO 1	Explain the real time embedded system and its components.
CO 2	Understand basic components and building blocks of Internet of Things.
CO 3	Apply skills to conduct interfacing of embedded boards with components, actuators and sensors.
CO 4	Design embedded and IOT Systems for various applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	-	-	-	2	-	-	2	-	3
CO 2	3	2	-	-	-	-	2	-	-	2	-	3
CO 3	3	3	2	2	-	-	3	-	2	3	2	3
CO 4	3	3	3	3	-	-	3	-	3	3	3	3

Unit-I

Introduction to Embedded and IoT Systems: Definition, Examples and components of embedded and IoT Systems, Embedded and IoT Systems Design Process, Various Embedded and IoT cores controllers. Hardware/Software Co-design for Embedded and IoT Systems, design challenge, Simplified IoT Architecture.

Unit-II

Microcontrollers for Embedded Systems: Arduino embedded platform, Peripheral interfacing and programming with Arduino platform, Sensors and Actuator interfacing, Cloud support with Arduino platform. Arduino–Board details, IDE programming, Raspberry Pi and Interfaces.

Unit-III

Protocols for Embedded and IoT Systems: Serial protocols, UART, I2C, and SPI. NFC, Wireless protocols like, RFID, Zig-bee, IEEE 802.15.4e, Thread, 6LoWPAN, Constrained Application Protocol (CoAP), Extensible

Messaging Protocol (XMPP) , WebSocket , Advanced Message Queueing Protocol (AMQP) , Message Queue Telemetry Transport (MQTT), Web Real Time Communications (WebRTC), LoRa, SIGFOX, Z Wave.

Unit-IV

IoT Based Embedded Systems: Basic architecture of an IoT based Embedded Systems, Embedded Hardware for IoT applications, like Raspberry Pi, Arduino, and Raspberry Pi based development board, IoT Cloud Platform and IoT client applications on mobile phones. Case Studies of Embedded and IoT Systems: Embedded application development through Arduino and Raspberry Pi based development boards.

Textbook(s):

1. “Embedded Systems: Architecture, Programming and Design”, McGraw Hill Education (India) Private Limited, New Delhi, 2015, 3rd Edition.
2. Dr. OvidiuVermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers

References:

1. Olivier Hersent, David Boswarthick and Omar Elloumi, The Internet of Things: Key Applications and Protocols, John Wiley and Sons Ltd., UK 2012.
2. Abubeker K M, Open Source Programming & Embedded System Design Using Arduino IDE
3. Internet of Things by Raj Kamal, Tata McGraw Hill Publication

Embedded Systems and Internet of Things Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	7	PC	PC	MAC-457

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Embedded Systems and Internet of Things) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Interfacing Push button Switch interfacing with Arduino based Embedded System
2. External Peripheral Interfacing with Arduino based Embedded System.
3. On Chip peripheral programming with Arduino/Raspberry Pi based Embedded System
4. Serial Communication Protocol programming with Arduino/Raspberry Pi based Embedded Systems.
5. Wireless communications with Arduino/Raspberry Pi Embedded IOT Platform.
6. Bluetooth communication interfacing with Arduino/Raspberry PiEmbedded IOT Board.
7. WiFi module interfacing with Arduino/Raspberry Pi Embedded IOT Board.
8. Embedded Systems design with IOT capability.
9. IOT based Temperature monitoring embedded system with open source cloud tools.

Embedded Systems for Electric Vehicles	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	EV-EAE	EV-EAE-5	EV-417T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of automotive fundamentals.
2.	To impart the knowledge of vehicle management system.
3.	To impart the knowledge of vehicle automotive telematics.
4.	To impart the knowledge of electronic diagnostics of vehicles.

Course Outcomes (CO)

CO 1	To understand the basics of automotive fundamentals.
CO 2	To understand the vehicle management system.
CO 3	To understand the vehicle automotive telematics.
CO 4	To understand system diagnostic standard and regulation requirement.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Automotive Fundamentals: Automotive physical configuration, drive train, suspension, brakes, steering system. Systemsapproach to control and instrumentation: Characteristics of digital electronic system, Instruments, Control system. Vehicle motion control: Cruise control system, Antilock brakingsystem, Electronic suspension system, Electronic steering control, automotive instrumentation,on board and off – board diagnostics, occupant protection systems.

UNIT II

Vehicle Management Systems: Vehicle cruise control- speed control anti-locking braking system-electronic suspension - electronic steering, wiper control; Vehicle system schematic for interfacing with EMS, ECU. Energy Management system for electric vehicles- for sensors, accelerators, brake Battery management, Electric Vehicles-Electrical loads, power management system-electrically assisted power steering system

UNIT III

Automotive Telematics: Role of Bluetooth, CAN, LIN and flex ray communication protocols in automotive applications; Multiplexed vehicle system architecture for signal and data / parameter exchange between EMS, ECUs with other vehicle system components and other control systems; Realizing bus interfaces for diagnostics, dashboard display, multimedia electronics.

UNIT IV

Electronic Diagnostics For Vehicles: System diagnostic standards and regulation requirements – On board diagnosis of vehicles electronic units & electric units-Speedometer, oil and temperature gauges, and audio system.

Textbook(s):

1. William B. Ribbens,”Understanding Automotive Electronics”, Elseiver,2012
2. Ali Emedi, Mehrdedehsani, John M Miller , “Vehicular Electric power system- land, Sea, AirAnd Space Vehicles” Marcel Decker, 2004.
3. L.Vlacic, M.Parent, F.Harahima,”Intelligent Vehicle Technologies”, SAE International, 2001.
4. Jack Erjavec,Jeff Arias,”Alternate Fuel Technology-Electric ,Hybrid & FuelCellVehicles”,Cengage ,2012

References:

1. Tom Denton, “Automotive Electricals / Electronics System and Components”, 3rd Edition, 2004.
2. Uwe Kiencke, Lars Nielsen, “Automotive Control Systems: For Engine, Driveline, andVehicle”, Springer; 1st edition, March 30, 2000.
3. Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 4th Edition, 2004.

Embedded Systems for Electric Vehicles Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	EV-EAE	EV-EAE-5	EV-417P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Embedded Systems for Electric Vehicles) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Program to toggle all the bits of port P1 continuously with 250 ms delay.
2. Program to interface a switch and a buzzer to two different pins of a port such that the buzzer
3. Program to interface LCD data pins to port P1 and display a message on it
4. Program to interface seven segment display using 89V51RD2
5. Program to interface keypad. Whenever a key is pressed, it should be displayed on LCD.
6. Program to transmit message from microcontroller to PC serially using RS232 and Program to receive a message from PC to microcontroller serially using RS232.
7. Program to interface Stepper Motor to rotate the motor in clockwise and anticlockwise Directions.
8. Program to read data from temperature sensor and display the temperature value.
9. Port RTOS on to 89V51 Microcontroller and verify. Run 2 to 3 tasks simultaneously on 89V51 SDK. Use LCD interface, LED interface, Serial communication.
10. Program to convert analog signal into digital (ADC).
11. Program to convert Digital into Analog (DAC).

e-Mobility	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	7	PCE	PCE-5	EEE-421T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Develop a comprehensive understanding of electric mobility.
2.	Analyse and evaluate electric vehicle systems.
3.	Explore charging infrastructure and techniques.
4.	Assess the environmental and energy aspects of electric mobility.

Course Outcomes (CO)

CO 1	Understand the fundamental concepts and components of electric mobility.
CO 2	Analyse and design electric vehicle systems.
CO 3	Evaluate of charging infrastructure and techniques.
CO 4	Examine the environmental and energy aspects of electric mobility.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	1	-	1	2	1	-	1	-	1
CO 2	3	3	2	1	-	-	2	1	-	1	-	1
CO 3	3	3	3	3	2	2	1	1	-	1	-	1
CO 4	3	2	2	1	-	-	1	1	-	1	-	1

UNIT-I

Introduction to E-Mobility: Overview of electric mobility, Environmental and energy-related challenges in transportation, Electric vehicles vs. internal combustion engine vehicles; Electric Vehicle Systems: Electric vehicle architecture and components, Electric powertrain: electric motor, power electronics, and energy storage systems, Electric vehicle control and management systems.

UNIT-II

Power Electronics for Electric Vehicles: Power electronic converters and their functions, Power semiconductor devices for electric vehicle applications, Power electronics for electric vehicle motor drives; Electric Motor Drives: Electric motor types used in electric vehicles, Electric motor characteristics and control techniques, Sensor-less control & field-oriented control (FOC) of electric motors.

UNIT-III

Energy Storage Systems for Electric Vehicles: Battery technologies and characteristics, Battery management systems (BMS) and state-of-charge estimation; Charging Infrastructure and Techniques: Charging infrastructure for electric vehicles, Charging techniques: slow charging, fast charging, and rapid charging, Charging standards and protocols (e.g., CHAdeMO, CCS, and Tesla Supercharger)

UNIT – IV

Environmental and Energy Aspects of Electric Mobility: Environmental impact of electric vehicles, Life cycle assessment (LCA) of electric vehicles, Policy and regulatory framework for promoting electric mobility;
Practical Exercises and Case Studies: Hands-on exercises on electric vehicle components and systems, Case studies on electric vehicle design, performance analysis, and optimization, Simulation and modeling of electric vehicle systems using software tools.

Textbook(s):

1. James Larminie and John Lowry, "Electrical Vehicle Technology Explained", Wiley
2. Ali Emadi "Advanced Electric Drive Vehicles" online at kindle

References:

1. Tom Denton, Taylor and Francis “Electric And Hybrid Vehicles”

e-Mobility Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	7	PCE	PCE-5	EEE-421P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (e-Mobility) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of electric vehicle powertrain components identification.
2. Study of electric Vehicle Performance Analysis.
3. Studt of power electronics converter efficiency.
4. Study of Electric Motor Control Techniques.
5. Battery Management System (BMS) Operation and State-of-Charge Estimation.
6. Study of charging efficiency and time analysis.
7. Study of Electric Vehicle Thermal Management.
8. Study of energy storage system comparison.
9. Study of impact of electric vehicle charging on the electrical grid.
10. Study of Life Cycle Assessment (LCA) of Electric Vehicles.
11. Study of commonly used pulse width techniques.
12. Study of Buck converter closed loop voltage control.

Energy Conservation Schemes	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	7	PCE	PCE-5	EEE-423

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Develop a strategic direction for organizations involved with energy and power
2.	To Understand the role of energy management and energy Auditing.
3.	To Understand the various types of theft in Electro-mechanical & Electronics meters
4.	To Understand Energy Conservation in Green Building

Course Outcomes (CO)

CO 1	Develop a strategic direction for organizations involved with energy and power
CO 2	Understand the role of energy management and energy Auditing.
CO 3	Understand the various types of theft in Electro-mechanical & Electronics meters
CO 4	Understand Energy Conservation in Green Building

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	-	-	-	2	-	-	2	1
CO 2	3	2	2	2	-	-	-	2	-	-	2	1
CO 3	3	2	2	2	-	-	-	2	-	-	2	2
CO 4	3	2	2	2	-	-	-	2	-	-	2	2

UNIT I

Energy Conservation and Energy Policies: Energy policies of India and their development, Central and estate Policies on the consumption and wastage of energy, need of renewable energy in India, Energy efficiency, Energy accounting, monitoring and control, Electricity audit and related instruments, Energy consumption models, Specific Energy Consumption, Eco assessment and Evaluation methods, Energy conservation schemes, Investment in energy saving equipments, subsidies and tax rebates, Development of Energy Management System.

UNIT II

Energy Conservation in Electrical Installations: Electric loads of air conditioning and refrigeration, Energy conservation, Power consumption in compressors, Energy conservation measures, Electrolytic process, Electric heating, Furnace operation and scheduling, Transformer loading, Efficiency analysis, Feeder loss evaluation, Reactive Power, Power factor and its improvement, Capacitor sizing, Capacitor losses, location, placement and maintenance, Case studies.

UNIT III

Energy Efficient Motors: Types and operating characteristics of electric motors, Energy efficient control and starting – Load matching, Selection of motors, Efficiency and load analysis, Energy efficiency, High efficiency motors, Industrial drives, Control schemes, Variable speed drives and Energy conservation schemes, Pumps and fans, Efficient control strategies, Over-sizing Case studies.

UNIT IV

Energy Efficient Building / Green Building: Energy Conservation in Buildings Air conditioning, monitoring and control systems of energy efficient buildings. Principle of Energy efficient building design water heading system, photovoltaic systems and Energy conservation in lighting schemes, Energy efficient light sources, Domestic, commercial and industrial lighting, Lighting controls, Luminaries.

Textbooks:-

1. H. Partab, “Art and Science of Utilisation of Electrical Energy”, BBES, 1970.
2. S.C. Tripathy, “ Electric Energy Utilization and Conservation”, Tata McGraw Hill, 1991

References:

1. Bureau of Energy efficiency of India.
2. IEEE Bronze Book: IEEE Standard 739-1984 – Recommended Practice for Energy Conservation and Cost Effective Planning in Industrial Facilities, IEEE Publications, 1996.
3. Albent & Steve Doty Thumann: Plant Engineers and Managers Guide to Energy conservation, 10e, River Publications, 2002.
4. W.C. Turner, Energy Management Handbook, 8e, Fairmont press, 2012.
5. UNESCAP – Guide Book on Promotion of Sustainable Energy Consumption.

Energy Economics and Policies	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	7	PCE	PCE-5	EEE-425

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand energy conservation and energy efficiency.
2.	Understand energy generation
3.	Understand energy pricing and financial aspects
4.	Understand energy security and policies

Course Outcomes (CO)

CO 1	Ability to understand energy conservation and energy efficiency.
CO 2	Ability to understand energy generation
CO 3	Ability to understand energy pricing and financial aspects
CO 4	Ability to understand energy security and policies

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT I

Origin and Definitions of Energy Economics, Link between Economics and Energy, Energy Resources and Energy Commodities; Properties of Energy Resources and Energy Commodities, concept of Energy conservation and Energy efficiency.

UNIT II

Demand for Energy as a Derived Demand, World Energy Consumption – Economic Growth and World Energy Consumption, Demand substitution and energy use Classification of Energy supplies: renewable and non-renewable, Fossil fuels (coal, oil, natural gas), Renewable energy (Hydro, Marine, Wind, Solar, Geothermal, Biomass), Nuclear power, Trend and patterns of energy production

UNIT III

Global and National scenario Trend and Patterns of Energy Consumption and the Energy Crisis (since Oil shocks of 1970 and other events) Energy Pricing and Taxation: Production Cost versus Return on Investment, Models of Pricing, Market Failures, Peak and Off-peak Pricing, Subsidies, The role of regulatory bodies like MERC, Energy Finance: Banks, International organisations, Green Finance initiatives .

UNIT IV

Concept of Sustainable Development and SDGs, Energy Security: India’s initiatives, Energy and Climate Change, Energy Efficiency and carbon emissions: Global and National trends, Energy Policy The Economics of Climate Change, Climate Change Background, Overview of GHG Emissions, Economic Approach to Control the Greenhouse Effect, Options to Cope with Global Warming, Generic Options, National Policy Options, Emissions Trading System (ETS).

Textbooks:

1. Energy Economics: Concepts, Issues, Markets and Governance by Subhes C. Bhattacharyya, 2nd Ed, 2019, Springer Science & Business Media
2. International Energy Markets: Understanding Pricing, Policies, and Profits. 2nd Edition. Carol A. Dahl. PennWell.

References:

1. Pindyck, R., and D. Rubinfeld. Microeconomics. 8th ed., Pearson
2. Energy Economics: Theory and Applications Peter Zweifel, Aaron Praktiknjo, Georg Erdmann, 2017, Springer.

Energy Harvesting Techniques

L	P	C
4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-1	ICE-312

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the fundamentals of solar energy conversion and familiarize with solar PV and Solar thermal systems
2.	To familiarize with the wind resource and hydropower, principles of conversion and technologies
3.	To familiarize with the biomass resource, appropriate conversion technology for the given biomass resource and end use
4.	To introduce design of solar PV system and wind power system

Course Outcomes (CO)

CO 1	Understand the fundamentals of solar energy, wind energy conversion and familiarize with biomass resource, hydropower and ocean power technology
CO 2	Identify an appropriate conversion technology for the given biomass resource & end use.
CO 3	Analyse the PV systems performance based on performance indices
CO 4	Design maximum power point circuit for solar PV system and wind turbine system

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	-	-	-	3	-	-	2	-	3
CO 2	3	2	-	-	-	-	3	-	-	2	-	3
CO 3	3	3	2	2	-	-	3	-	2	3	2	3
CO 4	3	3	3	3	-	-	3	-	3	3	3	3

Unit I

Solar PV and Solar Thermal Energy: Solar Energy: radiation – extra terrestrial, spectral distribution, solar radiation on earth, measurements; solar thermal system – solar thermal power and its conversion, solar collectors, flat plate, solar concentrating collectors, Solar Photovoltaic (PV) technology - photovoltaic effect, efficiency of solar cells, semi-conductor materials, solar PV system, characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, Efficiency of Solar cell

Unit II

Wind Energy harvesting: Fundamentals of Wind energy , characteristics and measurement, Wind energy conversion principles, Forces of the Blades, meteorology of wind, world distribution of wind, wind speed variation with height, Types of a wind turbine generator unit, Horizontal axis propeller type wind turbine generator, Advantages and drawbacks

Small Hydropower Energy: Overview of small, mini and micro hydro power plants and their resource assessment, Structural parts of Hydropower Station

Unit III

Other Non-conventional Energy Sources

Biomass: Biomass resources, types, production, classification and characterization; Techniques for biomass assessment. Concept of Waste segregation, management and treatment. thermo-chemical biomass conversion to energy, gasification, Biological Conversion: Biodegradation substrate; Anaerobic digestion-biogas production

Ocean and Tidal Energy – Principle of ocean thermal energy conversion, wave energy conversion machines, problems and limitations, fundamentals of tidal power, conversion systems and limitations;

Hydrogen Energy – properties of hydrogen, sources, production and storage, transportation, problems for use as fuel; fuel cells – introduction with types, principle of operation and advantages.

Unit IV

Design of Solar PV System and Wind System

Solar PV system: Maximizing the solar PV output, and load matching, Design of maximum power point tracker

Design of Wind Turbine: Wind turbine design considerations; Horizontal axis machines, vertical axis machines, grid-connected systems –types, topology, characteristics, fixed speed and variable speed systems, Role of non-conventional energy system in smart grid.

Textbook(s):

1. Non-Conventional Energy Sources, G.D.Rai, NewDelhi.
2. Fundamentals of Renewable Energy Resources by G.N.Tiwari, M.K.Ghosal, Narosa Pub., 2007.

References:

1. Solar Energy Principles, Thermal Collection &Storage, S.P.Sukhatme: Tata McGraw Hill Pub., NewDelhi.
2. Non-Conventional Energy Resources by B.H. Khan, Tata McGraw Hill Pub., 2009.
3. Renewable Energy, power for a sustainable future, Godfrey Boyle,2004,

Energy Storage Systems in Microgrids	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	MT-EAE	MT-EAE-1	MT-312T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the introductory knowledge of energy storage systems and microgrids.
2.	To impart the knowledge of energy storage systems
3.	To impart the knowledge of battery energy storage system
4.	To impart the knowledge of pumped hydropower energy storage

Course Outcomes (CO)

CO 1	To understand the introductory knowledge of energy storage systems and microgrids.
CO 2	To understand the knowledge of energy storage systems
CO 3	To understand the knowledge of battery energy storage systems
CO 4	To understand the knowledge of pumped hydropower energy storage systems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	2	3	3	2	2	2	1	3
CO 2	3	3	3	3	2	3	3	2	2	2	1	3
CO 3	3	3	2	3	2	3	1	2	2	2	1	3
CO 4	3	3	3	3	2	3	3	2	2	2	1	3

UNIT-I

Introduction to Microgrids: Basic concept of microgrid, operation of microgrids in grid connected and isolated mode, emerging and future microgrids, issues and challenges to renewable energy systems, distributed power generation – need and contribution, applications of energy storage systems in renewable energy microgrids, interfacing between an energy storage system and a microgrid.

UNIT-II

Energy Storage Systems: Scope of energy storage, need and opportunities of energy storage, basic principle of energy storage, classification and key disciplines, introduction to various energy storage systems and their technological overview, importance of energy storage systems in renewable power generation.

UNIT-III

Battery Energy Storage Systems: Fundamental concept of batteries, battery performance, charging and discharging of a battery, storage density, energy density, safety issues, advantages and disadvantages of battery energy storage. Introduction to (i) Lead-Acid (ii) Nickel-Cadmium, (iii) Zinc Manganese dioxide, and modern batteries: (i) Zinc-Air (ii) Nickel Hydride, (iii) Lithium Battery. Battery energy storage in solar and wind energy microgrids.

UNIT-IV

Pumped Hydropower Energy Storage: Basic principle, constructional details, benefits and drawbacks, comparison with battery energy storage, pumped hydropower storage in solar and wind energy microgrids, microgrids with hybrid energy storage systems and their benefits. Use of power electronic converters in energy storage systems.

Textbook(s):

1. Huggins, Robert ‘Energy Storage’, Springer, 2010
2. David Wenzhong Gao, “Energy Storage for Sustainable Microgrid”, Science Direct, 2015.

References:

1. Ter-Gazarian ‘Energy Storage for Power Systems’, Institution of Engineering and Technology, 1994.
2. Sandeep Dhundhara, Yajvender Pal Verma, “Energy Storage for Modern Power System Operations” 1st Ed. September 2021 Wiley

Energy Storage Systems in Microgrids Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	MT-EAE	MT-EAE-1	MT-312P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Energy Storage Systems in Microgrids) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To design and study the performance of a microgrid consisting of solar photovoltaic and battery energy storage.
2. To conduct the study of the operation of microgrid under various load conditions using Matlab Simmulink.
3. To study the effect of change in wind speed and pitch angle on the operation of DC Microgrid system using Matlab/Simulink.
4. To study the series-parallel behaviour of different PV panels for a stand-alone microgrid
5. To study and plot the state of charge characteristics of a battery at rated load
6. To determine the system performance of a wind energy microgrid with battery energy storage using Matlab/Simulink.
7. To determine the system performance of a solar energy microgrid with battery energy storage using Matlab/Simulink.
8. To determine the system performance of a wind energy microgrid with pumped hydropower storage using Matlab/Simulink.
9. To evaluate the system performance of a hybrid wind and solar energy microgrid with Battery energy storage using Matlab/Simulink.
10. To evaluate the system performance with three renewable sources connected together to form a microgrid with battery storage using Matlab/Simulink.
11. To conduct the study of the effect of changes in solar irradiation on the operation of a solar energy microgrid system.
12. To study the buck and boost mode of operation of bidirectional converter in the battery back-up system

Energy Systems and Technologies	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	TES-EAE	TES-EAE-2	TES-332T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the fundamentals of energy, energy resources and analyze the thermal energy systems.
2.	To learn the fundamentals of different energy storage devices.
3.	To learn the fundamentals of different fuel cells.
4.	To design and develop zero energy buildings.

Course Outcomes (CO)

CO 1	Understand the basics of energy, energy sources and analyze the thermal energy systems.
CO 2	Learn the fundamentals of different energy storage devices.
CO 3	Learn the fundamentals of different fuel cells.
CO 4	Design and development of zero energy buildings.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	-	-	2	3	-	-	-	-	3
CO 2	3	2	2	-	-	2	3	-	-	-	-	3
CO 3	3	2	2	-	-	2	3	-	-	-	-	3
CO 4	3	2	2	-	-	2	3	-	--	-	-	3

UNIT-I

Basics of Energy: Major sectors of energy consumption and standard of living, classification of energy resources: classification of Energy Sources, Common forms of energy, environmental aspects of energy, Consumption trend of India's and world's energy resources, developments in renewable energy Sector.

Thermal energy systems: cogeneration: cogeneration system of Rankine and vapor compression cycle, cogeneration system of Brayton and vapor absorption cycle, their construction, working, and thermodynamic analysis.

UNIT-II

Energy storage: necessity of energy storage; energy storage methods; mechanical energy storage: pumped storage, compressed air storage, flywheel storage; chemical energy storage: battery storage, hydrogen storage, reversible chemical reaction storage; Thermal energy storage: sensible heat storage, latent heat storage, biological storage.

UNIT-III

Fuel cell: Definition, working principle of a fuel cell, fuel cell characteristics, fuel cell efficiency, classification of fuel cells: phosphoric acid fuel cell, alkaline fuel cell, moltencarbonate fuel cells, polymer electrolyte membrane (PEM) fuel cells, solid oxide fuel cell, performance and limitations.

UNIT - IV

Zero Energy Buildings: Definitions, concepts, classification, advantages and disadvantages, zero energy building vs green building, Building performance metrics, net zero retrofits for existing buildings, data on zero energy building worldwide, technologies and applications: Building Integrated Photovoltaic System (BIPV), Solar Thermal Collectors (STC), Building-Integrated Wind Turbine (BIWT), Rooftop PV System, Ground-Mounted Solar Panels, Geothermal Heat Pumps (GHP), Combined Heat and Power (CHP) system, LED Lighting, etc.

Textbook(s):

1. Chauhan, D.S., “Non-Conventional Energy Resources”, New Age International PvtLtd. (2006).
2. Khan, B. H., “Non-conventional energy resources”, Mc Graw Hill (2012).
3. Moran, M. J., Shapiro, H. N., “Fundamentals of Engineering Thermodynamics”, John Wiley & Sons (2014).
4. Attia S., “Net Zero Energy Buildings (NZEB): Concepts, Frameworks and Roadmap for Project Analysis and Implementation”, Butterworth-Heinemann (2018).

References:

1. Sorensen B., “Renewable Energy” Second Edition, Academic Press, 2000.
2. Soli J. Arceivala, “Green Technologies for a better Future”, McGraw Hill Education (India) Private Ltd., New Delhi, 2014.
3. Asdrubali, F., Desideri U., “Handbook of Energy Efficiency in Buildings”, Butterworth-Heinemann (2018).
4. Nag, P. K., “Engineering Thermodynamics”, Mc Graw Hill Education (2017).

Energy Systems and Technologies Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	TES-EAE	TES-EAE-2	TES-332P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Energy Systems and Technologies) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study different renewable energy utilization techniques.
2. Study and compare different biomass based fuels.
3. Carry out exergy analysis of an Rankine cycle using suitable software.
4. Carry out exergy analysis of a cogeneration system using suitable software.
5. Carry out optimization of a Rankine system.
6. Carry out optimization of a cogeneration system.
7. Carry out exergy and environmental analysis of a refrigeration cycle.
8. Study the effect of design variable on the emission of greenhouse gases for the refrigeration system.
9. Visit to net zero energy building.

Engineering Optimization	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/CST	6	PCE	PCE-1	CIE-312
ECE	7	PCE	PCE-4	ECE-415

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	This course will expose students to operations research modelling and essential tools for optimization.
2.	Analyse models using optimization techniques based upon the fundamentals of engineering mathematics
3.	The stochastic models for discrete and continuous variables to control inventory and simulation for decision making.
4.	Formulation of mathematical models for quantitative analysis of managerial problems in industry.

Course Outcomes (CO)

CO 1	To Identify appropriate optimization method to solve complex problems involved in various industries.
CO 2	To Find the appropriate algorithm for resource management using mathematical foundations.
CO 3	To Explain the theoretical workings of the analytical methods for making effective decision on variables so as to optimize the objective function.
CO 4	To Apply the knowledge of modern methods of meta-heuristic concepts to articulate real-world competitive situations to identify strategic decisions to counter the consequences.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	1	2	-	-	-	-	-	-	-	2
CO 2	2	2	-	2	-	-	-	-	-	-	-	2
CO 3	2	1	-	2	2	-	-	-	-	-	-	2
CO 4	2	1	-	2	2	-	-	-	-	-	-	2

UNIT-I

Introduction to Optimization: Engineering application of Optimization – Statement of an Optimization problem – Optimal Problem formulation – Classification of Optimization problem. Definition of Global and Local optima – Optimality criteria.

UNIT-II

Optimization algorithms for solving unconstrained optimization problems – Gradient based method: Cauchy’s steepest descent method, Newton’s method, Conjugate gradient method.

UNIT-III

Optimization algorithms for solving constrained optimization problems – direct methods – penalty function methods – steepest descent method – Engineering applications of constrained and unconstrained algorithms.

UNIT - IV

Modern methods of Optimization: Genetic Algorithms – Simulated Annealing – Ant colony optimization – Tabu search – Neural-Network based Optimization – Fuzzy optimization techniques

Textbook(s):

1. Rao S. S., 'Engineering Optimization: Theory and Practice', New Age Publishers , 2012, 4th Ed

References:

1. Deb K., 'Optimization for Engineering Design Algorithms and Examples', PHI, 2000
2. Arora J., 'Introduction to Optimization Design', Elsevier Academic Press, New Delhi, 2004
3. Saravanan R., 'Manufacturing Optimization through Intelligent Techniques', Taylor & Francis (CRC Press), 2006
4. Hardley G., 'Linear Programming', Narosa Book Distributors Private Ltd., 2002

Environmental Engineering - II	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	5	PC	PC	CEC-309

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To analyse the Physical, Chemical and Biological characteristics of wastewater.
2.	To understand various processes of disposal of sewage.
3.	Able to differentiate various unit operations and processes with design applications.
4.	To explain municipal solid waste sources, its characteristics and treatment options.

Course Outcomes (CO)

CO 1	Analyse the Physical, Chemical and Biological characteristics of wastewater.
CO 2	Understand various processes of disposal of sewage.
CO 3	Differentiate various unit operations and processes with design applications.
CO 4	Explain municipal solid waste sources, its characteristics and treatment options.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	3	2	3	0	0	2	0	0	0	1	0
CO 2	2	1	3	3	2	1	1	0	1	1	1	2
CO 3	1	2	3	3	2	1	0	0	0	1	1	1
CO 4	2	1	1	2	2	1	2	0	1	1	1	1

UNIT-I

Sewerage systems and their components: Introduction to sewerage system, Estimation of sewerage and drainage discharge, Dry weather flow, capacity of sewers, self-cleansing and non-scouring velocities, calculations of sizes and grades, forms and cross sections of sewers, hydraulic characteristics of circular sewer sections, egg shaped sewers, systems of drainage, separate, combined and partially combined systems.

Quality and characteristics of sewage: physical, chemical and biological characteristics of sewage, Aerobic and anaerobic decomposition of sewage, nitrogen, sulphur and carbon cycles, population equivalent, relative stability.

UNIT-II

Disposal of Sewage Effluents: Disposal of treated / untreated / partially treated effluents in natural water bodies, Self-purification of stream, Standard for effluent disposal on land, Disposal by land treatment / sewage farming methods, sewage sickness and its preventive measures, Treatment standards for sewage effluents.

Primary Treatment of Wastewater: Types of treatment units in primary treatment, their functions and efficiencies, analysis and design of screening, grit chambers, detritus tank, skimming tanks and primary sedimentation tank.

UNIT III

Secondary Treatment of Wastewater: Concepts of Biological treatment and removal mechanism, Aerobic and Anaerobic systems, analysis and design of attached and suspended growth systems like–trickling filter, Rotatory biological contractor, activated sludge process, septic tank, upflow anaerobic sludge blanket reactor (UASB), Imhoff tank, and oxidation pond; secondary sedimentation tank.
Sludge Thickening and Sludge Digestion: Sludge characteristics, sludge volume and solids relationships, Aerobic and anaerobic digestion, Factors affecting sludge digestion and their control, disposal of digested sludge.

UNIT IV

Municipal Solid Wastes and its Disposal: Sources and collection of municipal solid wastes, characteristics of solid wastes, treatment and disposal–sanitary landfilling method, composting, incineration, thermal pyrolysis, dumping in-to the sea, pulverisation and shredding, autoclaving.

Textbook(s):

1. S.K. Garg, Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol.-II).
2. Dr. B.C. Punmia, Ashok Kr. Jain, Arun Kr. Jain, Wastewater Engineering, Laxmi Publications.

References:

1. Metcalf and Eddy, Wastewater Engineering: Treatment and Reuse, Tata McGraw-Hill, New Delhi.
2. G L Karia and R A Christian, Wastewater Treatment Concepts and Design Approach, Prentice Learning Private Ltd., New Delhi.
3. Manuel of Sewerage and Sewage Treatment, CPH and EE organization, Ministry of Works and Housing, Govt. of India, New Delhi, 2006.
4. S R Qasim, and G Zhu, Wastewater Treatment and Reuse, CRC Press, Taylor and Francis Group, New York.
5. M L Davis, Water and Wastewater Engineering, McGraw-Hill, New Delhi.

Environmental Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	5	PC	PC	CEC-357

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Environmental Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To determine pH, turbidity, electrical conductivity of the given sample.
2. To determine the total hardness, calcium and magnesium in the given sample.
3. To find the amount of Fluoride, Sulfate, iron and manganese in the given sample.
4. To determine the optimum coagulant dose quantity for a given sample of raw water.
5. To determine chlorine demand and residual chlorine.
6. To determine the most probable number [MPN] of coli-forms of the given sample.
7. To determine the solids [total, suspended and dissolved] of the given sample
8. To find out total settle-able solids [by Imhoff Cone] in the given wastewater sample.
9. To estimate the amount of dissolved oxygen present in the given wastewater sample.
10. To estimate the value of biochemical oxygen demand [BOD] in the given water sample/sewage sample.
11. To find out chemical oxygen demand [COD] of the given wastewater sample.
12. Field visit of water/sewage treatment plant.

Environmental Impact Assessment	**L**	**P**	**C**
	4		**4**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	6	PCE	PCE-1	CEE-310

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Define and Classify Environmental Impacts and the terminology
2.	To Understand the environmental Impact assessment procedure
3.	To Explain the EIA methodology
4.	To List and describe environmental audits

Course Outcomes (CO)

CO 1	Identify the environmental attributes to be considered for the EIA study
CO 2	Formulate objectives of the EIA studies
CO 3	Identify the methodology to prepare rapid EIA
CO 4	Prepare EIA reports and environmental management plans

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	-	-	2	-	3	-		-	-	2	-
CO 2	-	1	-	2	-	-	-	3		1	-	1
CO 3	-	3	1	-	1	-	2	-	1	1	-	-
CO 4	-	2	-	-	1	-	1	-	2	-	1	3

UNIT-I

Introduction: The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Composition of Expert Committee, Ecological sensitive places, International agreements.

UNIT-II

EIA Methodologies: Environmental attributes-Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Ad Hoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods. EIA review-Baseline Conditions -Construction Stage Impacts, post project impacts.

UNIT-III

Environmental Management Plan: Environment Management Plan Preparation, Monitoring of Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, Monitoring Methods, Pre- Appraisal and Appraisal. Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions.

UNIT – IV

Environmental Legislation and Life cycle Assessment: Environmental laws and protection acts, Constitutional provisions-powers and functions of Central and State government, The Environment (Protection) Act 1986, The Water Act 1974, The Air act 1981, Wild Life act 1972, Guidelines for control of noise, loss of biodiversity, solid and Hazardous waste management rules.
Life cycle assessment: Life cycle analysis, Methodology, Management, Flow of materials-cost criteria- case studies**.**

Textbook(s):

1. Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers, 2002
2. Anjaneyulu. Y and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, 2007

References:

1. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., 1991.
2. Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., 1996.

Ethical Hacking	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-CS	7	PC	PC	CS-425T
EAE	7	CS-EAE	CS-EAE-5	CS-425T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To acquire knowledge on about various security threats that exists and can be exploited.
2.	To learn how bots, botnets, viruses, worms, Trojans, DOS attacks, DDOS attacks etc. work and are utilized for hacking.
3.	To learn various ethical laws that exist in India and abroad and their significance.
4.	To understand how loopholes and potential risks can be detected and learn wide variety of solutions that can be applied to protect data and networks.

Course Outcomes (CO)

CO 1	Ability of students to understand concepts of Ethical hacking tools and techniques.
CO 2	Ability of students to learn aspects of security, importance of data gathering, foot printing and system hacking.
CO 3	Ability of students to learn and analyze advanced concepts such as DDoS Attacks, Buffer Overflows, SQL Injection, Cross Site Scripting, Virus Creation.
CO 4	Apply and use ethical hacking techniques to real world problems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	2	2	-	-	-	1	2	2	2
CO 2	3	2	2	2	1	1	-	-	1	2	2	2
CO 3	3	2	1	1	1	2	-	-	1	2	2	2
CO 4	3	2	1	1	1	2	-	-	1	2	2	2

UNIT-I

Introduction to Ethical Hacking, Hacking Laws, Foot-printing, Reconnaissance,, Scanning,System hacking Cycle, Enumeration, Cracking Password, Types of password attacks, Trojans and Backdoors, Types of Trojans, Viruses, Worms, Rootkits.

UNIT-II

Sniffers, Types of Sniffing, Phishing, Methods of Phishing, Types of Phishing Attacks, Process of Phishing, Denial of Service, Classification of DoS attacks, Bots and Botnets, Botnets Life Cycle, System and Network Vulnerability.

UNIT-III

Ping of Death attack, Session Hijacking, Spoofing vs Hijacking, Session Hijacking Levels, Network Level Hijacking, 3 way handshake, IP Spoofing, RST Hijacking, TCP/IP Hijacking, SQL Injection, Cross Site Scripting.

UNIT – IV

Dark web, Darknet and Tor ,Layers of Web, Uses of Deep Web, Ethical use of Darknet, How to access Darknet safely, Accessing the Deep Web Authentication: RSA Secur ID Token, Biometrics, Hacking Wireless Networks, Tools for ethical hacking.

Textbook(s):

1. S. McClure, J. Scambray and G. Kurtz, Hacking Exposed 7: Network Security Secrets & Solutions, Tata Mc Graw Hill Publishers, 3rd ed., 2012.
2. Sean-Philip Oriyano, CEH v9: Certified Ethical Hacker Version 9, 1st Ed., Wiley & Sons, 2016.

References:

1. M.T. Simpson, N. Antill, “Hands-On Ethical Hacking and Network Defense”, 3rd Ed., Cengage Learning , 2016
2. Rafay Baloch, “A Beginners Guide to Ethical Hacking”, 1st Ed., CRC Press, 2014

Ethical Hacking Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-CS	7	PC	PC	CS-425P
EAE	7	CS-EAE	CS-EAE-5	CS-425P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Ethical Hacking) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to ethical hacking. Fundamentals of computer networking. TCP/IP protocol stack.
2. Setup a honey pot and monitor the honey pot on network
3. Write a script or code to demonstrate SQL injection attacks
4. Create a social networking website login page using phishing techniques
5. Write a code to demonstrate DoS attacks
6. Install rootkits and study variety of options
7. Study of Techniques uses for Web Based Password Capturing.
8. Install jcrypt tool (or any other equivalent) and demonstrate Asymmetric, Symmetric Crypto algorithm, Hash and Digital/PKI signatures studied in theory Network Security And Management
9. Implement Passive scanning, active scanning, session hizaking, cookies extraction using Burp suit tool
10. Case studies: various attacks scenarios and their remedies.

EV Charging Infrastructure Technology	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	EV-EAE	EV-EAE-3	EV-413T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basics of energy storage system and charging technologies.
2.	To impart the knowledge different types of EV chargers.
3.	To impart the knowledge EVSE Power Module selection and technical specification.
4.	To impart the knowledge of EV Charging Infrastructure.

Course Outcomes (CO)

CO 1	To understand the different charging technologies.
CO 2	To understand the different types of chargers.
CO 3	Understand the EVSE modules and their selection.
CO 4	To understand EV charging infrastructure's principle, objective, and selection.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Introduction: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles - Battery based energy storage - Fuel Cell based energy storage - Super Capacitor based energy storage - Fly wheel based energy storage.

Charging Methods: Electric Vehicle Technology and Charging Equipment's, Basic charging Block Diagram of Charger, Difference between Slow charger and fast charger, Slow charger design rating, Fast charger design rating

UNIT II

Types of Chargers: AC charging and DC charging - On board and off board charger specification - Type of Mode of charger Mode 2, Mode 3 and Mode 4 - Electric vehicle supply equipment (EVSE) associated charging time calculation - Selection and sizing of fast and slow charger (AC & DC) - AC Pile Charger, DC Pile Charger.

UNIT III

EVSE Power Module Selection and Technical Specification - Selection of EVSE Communication Protocol (PLC / Ethernet / Modbus/ CAN Module) - Communication gateway - Specification of open charge point protocol (OCCP 1.6/2.0) - Bharat DC001 & AC001 Charger specification - Communication Interface between charger and CMS (Central Management System) – Payment apps.

UNIT IV

The EV Charging Infrastructure (EVCI): The critical role of EVCI to enable massive EV adoption; interdependence and interactions of EVCI with existing infrastructures; principal objectives in the establishment of EVCI; role of renewable and storage resources and their effective integration; location, planning and implementation of EVCI stations; current EV charging providers and their business models; identified gaps and major challenges; policy and regulatory aspects

Textbook(s):

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2010.
2. Dr.Yogini Dilip Borole, DR. V. Shanmugasundram, ‘Electric Vehicle Adoption to Revolutionize Automobile Sector’, IIP press, 2021.

References:

1. Michael Plint& Anthony Martyr, “Engine Testing & Practice”, Butterworth Heinmenn, 3rd ed, 2007

EV Charging Infrastructure Technology Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	EV-EAE	EV-EAE-3	EV-413P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (EV Charging Infrastructure Technology) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To create a basic Electric Vehicle model using MATLAB/Simulink- Powertrain Blocksets
2. To create a basic Electric Vehicle model using MATLAB/Simulink- Driver Controller
3. To create a basic Electric Vehicle model using MATLAB/Simulink- Power Converter
4. To create a basic Electric Vehicle model using MATLAB/Simulink- Vehicle body
5. To create a basic Electric Vehicle model using MATLAB/Simulink- SOC (Stage of Charge)
6. To create a basic Electric Vehicle model using MATLAB/Simulink- Output circuit
7. To create complete Electric vehicle model and perform simulation various drive cycles.
8. To Model batteries and develop battery management systems (BMS).
9. To Model traction motors and develop Motor Control Units (MCU).
10. To Model fuel cell systems (FCS) and develop fuel cell control systems (FCCS)
11. Induction Motor Mathematical Modelling In MATLAB Simulink
12. Passive Cell Balancing Of Three Lithium-ion Cells For Electric Vehicle Projects
13. Capacitor Based Active Cell Balancing Of Four(4) Lithium-Ion Cells

Evolutionary Computation	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI	7	PC	PC	AI-407T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand Evolutionary Algorithms in the context of meta-heuristics
2.	To understand Evolutionary Algorithm's important parametric components
3.	To learn to formulate a given problem as an optimization problem and apply EAs
4.	To understand and appreciate the state-of-the-art research in EC

Course Outcomes (CO)

CO 1	To Formulate a given problem amenable for evolutionary optimization/search
CO 2	To analyse and apply appropriate evolutionary algorithms for a given problem
CO 3	To Analyse the state-of-the-art evolutionary computation research literature and apply them for solving dynamic problems
CO 4	To Design suitable evolutionary algorithms for a real world application

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	1	2	-	-	-	-	-	-	-	2
CO 2	2	2	-	2	-	-	-	-	-	-	-	2
CO 3	2	1	-	2	2	-	-	-	-	-	-	2
CO 4	2	1	-	2	2	-	-	-	-	-	-	2

UNIT-I

Introduction to Evolutionary Computation – Evolutionary Algorithms (Genetic Algorithms, Genetic Programming, Differential Evolution, Evolution Strategies, Covariance Matrix Adaptation etc.) – Different Components of Evolutionary Algorithms.

UNIT-II

Fitness Landscapes – Adaptive Parameter Control and Tuning – Constraint Handling – Niching and Fitness Sharing – Memetic Algorithms – Ensemble Evolutionary Algorithms

UNIT-III

Multi-Objective Optimization – Hyper-Heuristics – Special Forms of Evolution (Co-evolution and Speciation) – Theoretical Analysis of Evolutionary Algorithms – Interactive Evolutionary Algorithms –

UNIT - IV

Evolutionary Machine Learning – Surrogate Assisted Optimization –NeuroEvolution-Open Ended Evolution. Applications of Evolutionary Algorithms

Textbook(s):

1. E. Eiben and J. E. Smith, "An Introduction to Evolutionary Computing", Natural Computing Series, Springer, 2nd Edition, 2015.

References:

1. Eyal Wirsansky, "Hands-On Genetic Algorithms with Python: Applying Genetic Algorithms to Solve Real-World Deep Learning and Artificial Intelligence Problems", Packt Publishing, 2020.
2. Iaroslav Omelianenko, "Hands-on Neuroevolution with Python: Build HighPerforming Artificial Neural Network Architectures using Neuroevolution-based Algorithm", Packt Publishing, 2019.
3. Slim Bechikh, Rituparna Datta and Abhishek Gupta (Eds.), "Recent Advances in Evolutionary Multi-objective Optimization", Adaptation, Learning, and Optimization Book – 20, Springer, 2017.
4. Nelishia Pillay and Rong Qu, "Hyper-Heuristics: Theory and Applications", Springer, 2018.
5. Hitoshi Iba, "Evolutionary Approach to Machine Learning and Deep Neural Networks: Neuro-Evolution and Gene Regulatory Networks", Springer, 2018.

Evolutionary Computation Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
CSE-AI	7	PC	PC	AI-407P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Evolutionary Computation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Case study based experimentation to be followed for all the experiments.

1. Deep Neural Network Architecture Search: Discover optimal architectures for deep neural networks, improving their performance on tasks like image recognition and natural language processing.
2. Swarm Robotics: To optimize the collective behaviour of swarms of robots, enabling them to coordinate and perform tasks efficiently, such as cooperative transport or exploration missions.
3. Automated Machine Learning: Study the process of machine learning, including feature selection, hyper-parameter tuning, and model selection, making it easier for non-experts to apply machine learning algorithms effectively.
4. Energy Management in Smart Grids: Study to optimize energy management in smart grids, facilitating demand-response scheduling, load balancing, and renewable energy integration.
5. Drug Discovery: To study and analyse molecules for drug discovery, accelerating the identification of potential candidates with desired properties and reducing the time and cost of the development process.
6. Cybersecurity: To optimize intrusion detection systems, network security protocols, and malware detection algorithms, enhancing the ability to detect and respond to cyber threats.
7. Multi-Objective Optimization: To solve multi-objective optimization problems in various domains, including, resource allocation, and decision-making.
8. Traffic Signal Control: Study to optimize traffic signal timings and control strategies, improving traffic flow, reducing congestion, and minimizing travel time in urban areas.
9. Renewable Energy System Design: Understand and study to optimize the design and placement of renewable energy systems, such as solar panels and wind turbines, maximizing energy generation and minimizing costs.
10. Supply Chain Optimization: Study to optimize supply chain networks, including inventory management, distribution routing, and supplier selection, improving efficiency and reducing costs.

Exploratory Data Analytics and Data Visualization	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	7	PC	PC	DS-433T
EAE	7	DS-EAE	DS-EAE-5B	DS-433T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the need for Data Mining and advantages to the business world.
2.	To get a clear idea of various classes of Data Mining techniques, their need, scenarios (situations) and scope of their applicability
3.	To learn the algorithms used for various type of Data Mining problems
4.	To understand how to explore and communicate data using data visualization techniques

Course Outcomes (CO)

CO 1	Describe the life cycle phases of Data Analytics through discovery, planning and building.
CO 2	Understand and apply Data Analysis Techniques.
CO 3	Implement various Data streams.
CO 4	Understand item sets, Clustering, frame works & Visualizations.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	1	2	-	3	-	2	3	-	1	-	-
CO 2	-	1	2	-	3	-	2	3	-	-	-	-
CO 3	-	1	2	-	2	-	3	-	-	1	-	-
CO 4	-	2	2	-	2	-	2	-	-	-	-	-

UNIT-I

Introduction to Data Analytics: Sources and nature of data, classification of data (structured, semi-structured, unstructured), characteristics of data, introduction to Big Data platform, need of data analytics, evolution of analytic scalability, analytic process and tools, analysis vs reporting, modern data analytic tools, applications of data analytics. Data Analytics Lifecycle: Need, key roles for successful analytic projects, various phases of data analytics lifecycle – discovery, data preparation, model planning, model building, communicating results, and operationalization.

UNIT-II

Data Analysis: Regression modeling, multivariate analysis, Bayesian modeling, inference and Bayesian networks, support vector and kernel methods, analysis of time series: linear systems analysis & nonlinear dynamics, rule induction, neural networks: learning and generalisation, competitive learning, principal component analysis and neural networks, fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, stochastic search methods.

UNIT-III

Mining Data Streams: Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, Real-time Analytics Platform (RTAP) applications, Case studies – real time sentiment analysis, stock market predictions.

UNIT – IV

Introduction to Visualization and Stages – Computational Support – Issues – Different Types of Tasks – Data representation – Limitation: Display Space- Rendering Time – Navigation Links. Human Vision – Space Limitation – Time Limitations – Design – Exploration of Complex Information Space – Figure Caption in Visual Interface – Visual Objects and Data Objects -Space Perception and Data in Space – Images, Narrative and Gestures for Explanation.

Textbook(s):

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer.
2. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, ElsevierRobert

References:

1. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press.
2. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big Data Analytics", John Wiley

Exploratory Data Analytics and Data Visualization Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	7	PC	PC	DS-433P
EAE	7	DS-EAE	DS-EAE-5B	DS-433P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Exploratory Data Analytics and Data Visualization) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) using in R.
2. To perform data import/export (.CSV, .XLS, .TXT) operations using data frames in R.
3. To get the input matrix from user and perform Matrix addition, subtraction, multiplication, inverse transpose and division operations using vector concept in R
4. To perform statistical operations (Mean, Median, Mode and Standard deviation) using R
5. To perform data pre-processing operations i) Handling Missing data ii) Min-Max normalization.
6. To perform dimensionality reduction operation using PCA for Houses Data Set
7. To perform Simple Linear Regression with R..
8. To perform K-Means clustering operation and visualize for iris data set
9. Learn how to collect data via web-scraping, APIs and data connectors from suitable sources as specified by the instructor.
10. Perform association analysis on a given dataset and evaluate its accuracy

Fabrication Technology	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-2	ECE-322T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of various processes of IC fabrication
2.	To impart the knowledge of properties of semiconductor crystal.
3.	To impart the knowledge of different methods used in VLSI fabrication process.
4.	To impart the knowledge of process integration.

Course Outcomes (CO)

CO 1	To understand the properties of semiconductor crystal.
CO 2	To Analyse the fundamentals of IC fabrication.
CO 3	To understand the different methods used in VLSI fabrication process.
CO 4	To build the basic knowledge of process integration.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	1	3	1	-	-	1	1	-	1
CO 2	3	2	2	1	3	1	-	-	1	1	-	1
CO 3	3	2	2	1	3	1	-	-	1	1	-	1
CO 4	3	2	2	1	3	1	-	-	1	1	-	1

UNIT I

Introduction: History of IC’s; Operation & Models for Devices of Interest: CMOS and MEMS. Clean room and Wafer Cleaning: Definition, Need of Clean Room, RCA cleaning of Si. Oxidation: Dry and Wet Oxidation, Kinetics of Oxidation, Oxidation Rate Constants, Dopant Redistribution, Oxide Charges, Device Isolation, LOCOS, Oxidation System.

UNIT II

Lithography: Overview of Lithography, Radiation Sources, Masks, Photoresist, Components of Photoresist Optical Aligners, Resolution, Depth of Focus, Advanced Lithography: E-beam Lithography, X-ray Lithography, Ion Beam Lithography. Diffusion: Pre-Deposition and Drive-in Diffusion Modelling, Dose, 2-Step Diffusions, Successive Diffusion, Lateral Diffusion, Series Resistance, Junction Depth, Irvin’s Curves, Diffusion System.

UNIT III

Ion Implantation: Problems in Thermal Diffusion, Advantages of Ion Implantation, Applications in ICs, Ion Implantation System, Mask, Energy Loss Mechanisms, Depth Profile, Range & Straggle, Lateral Straggle, Dose, Junction Depth, Ion Implantation Damage, Post Implantation Annealing, Ion Channelling, Multi Energy Implantation. Thin Film Deposition: Physical Vapor Deposition: Thermal evaporation, Resistive Evaporation, Electron beam evaporation, Laser ablation, Sputtering Chemical Vapor Deposition: Advantages and disadvantages of Chemical Vapor deposition (CVD) techniques over PVD techniques, reaction types, Boundaries and Flow.

UNIT IV

Different kinds of CVD techniques: APCVD, LPCVD, Metal organic CVD (MOCVD), Plasma Enhanced CVD etc. Etching: Anisotropy, Selectivity, Wet Etching, Plasma Etching, Reactive Ion Etching. Metallization/Interconnects: Overview of Interconnects, Contacts, Metal gate/Poly Gate, Metallization, Problems in Aluminum Metal contacts, Al spike, Electromigration, Metal Silicides, Multi-Level Metallization, Planarization, Inter Metal Dielectric. NMOS, CMOS process etc.

Textbook(s):
1. VLSI Technology, S. M. Sze, 2nd Edition, McGraw Hill, 2003.
2. Silicon Process Technology, S K Gandhi,2nd Edition, Wiley India,2009
3. Testing of Digital Systems, N. K. Jha and S. Gupta, 2nd, Cambridge University Press. 2003.

References:
1. Silicon VLSI Technology, Plummer, Deal and Griffin ,1st Edition, Pearson Education, 2009
2. Fundamental of Semiconductor Fabrication, Sze and May, 2nd Edition, Wiley India, 2000.

Fabrication Technology Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-2	ECE-322P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Fabrication Technology) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Design the layout of NMOS and PMOS.
2. Design layout of CMOS inverter using CMOS Technology.
3. Design layout of NAND/NOR structure using CMOS Technology.
4. Design layout of multiplexer using CMOS Technology.
5. Simulation and analysis of MOS Amplifier using CMOS Technology.
6. Simulation, Analysis and layout of Current Source using CMOS Technology
7. Simulation, Analysis and layout of Current Sink using CMOS Technology.
8. Simulation, Analysis and layout of Differential Amplifier using CMOS Technology.
9. Simulation, Analysis and layout of Current Mirror using CMOS Technology.
10. Simulation, Analysis and layout of MOS diode/ active resistor.

Finite Element Methods	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-1	MEE-310T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand various fundamentals of Finite Element Analysis.
2.	To understand the application of Finite Element Analysis in different types of discrete system.
3.	To understand the formulation of Eigen value problem and boundary value problem.
4.	To understand the applications of FEM in solving various structural problems.

Course Outcomes (CO)

CO 1	Able to apply various fundamental concept of Finite Element Analysis.
CO 2	Able to apply Finite Element Analysis in different types of discrete system.
CO 3	Able to formulate and solve Eigen value problem and two dimensional single value problems.
CO 4	Able to perform structural analysis using Finite Element Analysis.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Basic of Finite Element Method, Variational calculus, Integral formulation, variational methods: Methods of weighted residuals, Approximate solution using variational method, Modified Galerkin method, Boundary conditions.
Basic Finite Element Concepts: Basic ideas in a finite element solution, General finite element solution procedure, Finite element equations using modified Galerkin method, Axis symmetric Problems .

UNIT-II

Discrete System: Axial spring element, Axial bars, Torsion bars, Application in Heat transfer and Solid Mechanic Problems, Plane truss problem, software application ANSYS etc.
Beam: Euler Beam element and its application.

UNIT-III

Eigen value problems: Formulation and problems
Single value problem in 2D: Boundary value problem, axis symmetric problems

UNIT – IV

Numerical on 2D Solid mechanics, Interpolation function (triangular, Quadrilateral, serendipity elements), numerical integration and modelling consideration.

Textbook(s):

1. J N Reddy "An Introduction to finite element method" Tata Mc Graw Hill 3rd edition.
2. S.S. Rao, "Finite Element Method In Engineering", Pergaman Press.

References:

1. O.C. ZienKiewicz, "The Finite Element Method", Tata McGraw Hill.
2. Larry J. Segerlind, "Applied Finite-Element Analysis", John Wiley and Sons.
3. Kenneth H. Huebner, "Finite Element Method for Engineers", John Wiley and Sons.
4. Darell W. Pepper, J.C Heinrich "The Finite Element Method" CRC press.
5. V.Ramamurti "Finite Element Method in Machine Design"Norosa Publishing House.

Finite Element Methods Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-1	MEE-310P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Finite Element Methods) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Force and stress analysis using link elements in Trusses.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of axi-symmetric components.
4. Stress analysis of flat plates.
5. Stress analysis of flat plates and simple shells.
6. Thermal stress and heat transfer analysis of plate.
7. Thermal stress analysis of cylindrical shells.
8. Thermal stress analysis of spherical shells.
9. Vibration analysis of spring-mass systems.
10. Model analysis of beams.

Flexible AC Transmission System	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	PS-EAE	PS-EAE-4	PS-433T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge of various FACTS devices which are used for proper operation of AC system.
2.	To understand the techniques of practical FACTS controller design for various applications.
3.	To impart knowledge of the operating principles, control system of different FACTS controllers.
4.	To understand the various advanced FACTS controllers used in power system and its applications.

Course Outcomes (CO)

CO 1	Ability to understand the concepts of FACTS and compensation in transmission line.
CO 2	Ability to understand the basic VAR compensator and its application.
CO 3	Ability to understand the static series controller and its applications.
CO 4	Ability to understand various types of power controllers in transmission system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	2	3	1	1	1	2	2	3	3
CO 2	3	1	2	1	2	1	2	1	2	3	3	3
CO 3	3	2	1	2	2	1	2	1	1	3	3	3
CO 4	3	1	1	2	2	1	1	1	1	1	3	3

UNIT-I

FACTS Concepts:Transmission, Interconnection, Flow of Power in AC system, Power Flow and Dynamic Stability Consideration of a Transmission Interconnection, Relative Importance of Controllable Parameters, Real and Reactive PowerControl in Electrical Power Transmission Lines–Loads & System Compensation-Uncompensated TransmissionLine–Shunt and Series Compensation.

UNIT-II

Static Shunt Compensator and Applications:Objectives of Shunt Compensation, Mid-Point VoltageRegulation, Voltage Instability Prevention, Improvement of Transient Stability, Power Oscillation Damping, Methods of Controllable VAR Generation, Variable Impedance Type Static VAR Generators Switching ConverterType VAR Generators Hybrid VAR Generators.

UNIT-III

Static Series Compensator and Applications:Concept of Series Capacitive Compensation,Improvement of Transient Stability, Power Oscillation Damping, Thyristor Switched Series Capacitor (TSSC), and Thyristor Controlled Series Capacitor (TCSC) Control schemes for GSC TSSC and TCSC.

UNIT – IV

Advanced FACTS Controllers: SVC, STATCOM, Unified Power flow controller (UPFC) - Interline power flow controller (IPFC) - Unified Power quality conditioner (UPQC), generalised unified power flow controller (GUPFC).

Textbook(s):

1. Hingorani H G and Gyugyi. L “Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems” New York, IEEE Press, 2000.
2. Padiyar.K.R, “ FACTS Controllers in Power Transmission and Distribution” New Age Int. Publishers, 2007

References:

1. Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash “Flexible AC Transmission Systems: Modeling and Control”, Springer, 2012
2. Yong-Hua Song, Allan Johns, “Flexible AC Transmission Systems”, IET, 1999

Flexible AC Transmission System Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	PS-EAE	PS-EAE-4	PS-433P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Flexible AC Transmission System) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To Compute Transmission Line Parameters using MATLAB.
2. Modelling of TCSC controller for Transient Stability Enhancement.
3. To Simulate the V-I characteristics of Static VAR Compensator.
4. To Study the Effects of Series and Shunt Compensation on Long Transmission Line.
5. To Study Series Compensated Transmission Line using Matlab.
6. To Study Shunt Compensated Transmission Line using Matlab.
7. Matlab simulation for calculation of Series and Parallel Capacitor.
8. To Simulate the Dynamic Response of the STATCOM.
9. To Determine the Reactive Power Compensation by using FACTS Devices.
10. Matlab program on Series-Series Compensated Transmission Line.
11. Matlab program on Shunt–Shunt Compensated Transmission Line.
12. To Design Short and Medium Transmission Line in Matlab.

Flexible Manufacturing Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	QM-EAE	QM-EAE-2	QM-328T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To study different aspects of Flexible Manufacturing System and determine difference between traditional manufacturing system and Flexible Manufacturing System.
2.	To understand different components of Computer Integrated Manufacturing System with its importance in modern manufacturing environments pertaining to managing different projects.
3.	To understand how Automated Material Movement is achieved through the use of AGV, ATC and ASRS and its importance as an integral part of Flexible Manufacturing System.
4.	To understand how Artificial Intelligence and Computer Aided Quality Control helps Flexible Manufacturing System works effectively.

Course Outcomes (CO)

CO 1	Analyse different aspects of Flexible Manufacturing System and determine difference between traditional manufacturing system and Flexible Manufacturing System.
CO 2	To analyse and explain different components of Computer Integrated Manufacturing System with its importance in modern manufacturing environments pertaining to managing different projects.
CO 3	To analyse and explain how Automated Material Movement is achieved through the use of AGV, ATC and ASRS and its importance as an integral part of Flexible Manufacturing System.
CO 4	To Evaluate how Artificial Intelligence and Computer Aided Quality Control helps Flexible Manufacturing System works effectively.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	2	-	-	-	-	-	2
CO 2	3	3	3	2	-	2	-	-	-	-	-	2
CO 3	3	3	3	2	-	2	-	-	-	-	-	2
CO 4	3	3	3	2	-	2	-	-	--	-	-	2

UNIT I

Introduction and Definition: Flexible Automation and Manufacturing Cell and Flexible Manufacturing System. Flexible Automation and Manufacturing systems and its productivity, History of FMS systems, definition, concept, benefits, problems in batch production, Types of FMS, Components of FMS, control of workstation, AGV systems, Functions of FMS, Scheduling and loading FMS, Layout configurations for FMS, communication in FMS, simulation in FMS, Installation and examples of FMS, optimization of FMS, typical layout of FMS, The FMS software. Feasibility report of FMS, advanced control cycle of FMS.

UNIT II

CIM System: Introduction to CAD & CAM and its tools, Concept and origin of CIM, components of CIM, Emerging technologies of CIM, computer control system, sensing and identifying for manufacturing, CIMS data files, factors affecting performance, advantages and limitations, performance evaluation of a CIM system. Human centered CIM system, CIM technology in manufacturing environments, Factory information system, Sequential and concurrent engineering.

UNIT III

High Volume Production System: Types of Automated assembly systems, Automated production or transfer lines, Equipment and arrangement of transfer lines, methods of work transport, transfer mechanisms, Assembly line balancing, numericals on line balancing, computerized line balancing methods.

Automated Material Movement: Function, Types of material movement systems, material movement through conveyors, material movement through robots, material movement through AGVs, automated guided vehicle operation and control, Advantages and limitations of AGVs, economic considerations.

Automatic tool changer (ATC), Storage and automated production line, Automated storage and retrieval system (ASRS), Carousel storage system, In-process storage system, communication with material in storage and in movement.

UNIT IV

Introduction to artificial intelligence in manufacturing automation, expert systems, AI programming for expert systems.

Computer Aided Quality Control: CNC 3D Coordinate Measuring machines, TQM, QC & CIM, Inspection and Testing, SPC, Role of computers in QC, Non contact inspection methods, Post process Metrology, Computer aided inspection using robots, integration of CAD / CAM with inspection system, Flexible Inspection system, Reverse Engineering.

Textbook(s):

1. P Radhakrishnan, S subramanym, V Raju; CAD/CAM/CIM; New Age International Publishers.
2. K.C. Jain, Sanjay Jain, Principles of Automation and Advanced Manufacturing systems, Khanna Publications.

References:

1. Ibrahim Zeid, R Sivsubramanian, CAD/ CAM Theory & Practice, MCGraw Hill.

Flexible Manufacturing Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	QM-EAE	QM-EAE-2	QM-328P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Flexible Manufacturing Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Develop programs on CNC lathe.
2. Develop programs on CNC milling.
3. Study and operate a Coordinated Measuring Machine and 6 axis robot.
4. Study working of a Flexible manufacturing system.
5. Operate FMS with automatic storage and retrieval, conveyor, lathe, robot milling machine.
6. Simulation of CIM and scheduling problem 1 on CIM Software (such as ER-Virtual / any other).
7. Simulation of CIM and scheduling problem 2 on CIM Software.
8. Simulation of CIM and scheduling problem 3 on CIM Software.

Fluid Mechanics and Hydraulic Machines	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	5	PC	PC	MEC-305
MAE	6	PC	PC	MEC-308

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand fundamental concepts of fluid flow and fluid statics.
2.	To understand various kinematic, dynamic, and boundary layer concepts of fluid flow.
3.	To understand the concepts of dimensional analysis to predict fluid flow behaviour and different flows and energy losses through pipe.
4.	To study impulse and reaction turbines, and centrifugal pump.

Course Outcomes (CO)

CO 1	Analyse the basic concept of fluid flow and evaluate the problems related to fluid statics and fluid kinematics.
CO 2	Analyse various kinematic, dynamic, and boundary layer concepts of fluid flow.
CO 3	Apply dimensional analysis to predict fluid flow behaviour and different flows and energy losses through pipe.
CO 4	Analyse and evaluate the hydraulic performance of hydraulic turbines and pumps.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	2	-	2	-	-	-	-	-	2
CO 2	3	3	3	2	-	2	-	-	-	-	-	2
CO 3	3	3	3	2	-	2	-	-	-	-	-	2
CO 4	3	3	3	2	-	2	-	-	--	-	-	2

UNIT-I

Fundamental Concepts of Fluid Flow: Fundamental definitions, Fluid properties, classification of fluids, Pressure and its measurements, Pascal’s law, pressure variation in a fluid at rest, manometers (piezometer, simple and differential manometers).

Fluid Statics: Forces on solid surfaces (vertical, horizontal, inclined, and curved), Buoyancy, buoyant force, center of buoyancy, Stability of submerged and floating bodies Metacenter and Metacentric height.

UNIT-II

Kinematics of Fluid Flow: Types of fluid flow, streamline, path line and streak line, Equations for acceleration, Irrotational and rotational flow, velocity potential and stream function, Continuity equation.

Dynamics of Fluid Flow: Navier-Stokes (momentum) Equation, Euler's equation of motion, Bernoulli's equation, Venturi meter; Pitot tube.
Boundary Layer Flow: Boundary Layer Theory and Applications: Boundary Layer thickness, displacement, momentum and energy thickness, Flow separation.

UNIT-III

Dimensional Analysis and Principles of Similarity: Buckingham's Theorem and its applications, Dimensionless Numbers-Reynolds, Froude, Euler, Mach, Weber Number and their significance.
Laminar & Turbulent Flow: Developing and fully developed flow, Hagen–Poiseuille flow through a circular pipe, characteristics of turbulent flow in pipe, Shear stress and Velocity distribution for turbulent flow in smooth and rough pipes.
Pipe Flow Systems: Darcy-Weisbach equation, Energy losses in pipelines.

UNIT – IV

Introduction: Introduction and classification of hydraulic turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube-theory functions and efficiency.
Centrifugal Pumps: classifications, working, work done, manometric head- losses and efficiencies, specific speed, cavitation & NPSH.

Textbook(s):
1. R.K. Bansal, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P) Ltd; (2002).
2. Jagadish Lal, "Fluid machines Including Fluid mechanics", Metropolitan Book Co., New Delhi, 1995.

References:
1. D.S. Kumar, "Fluid Mechanics & Fluid Power Engineering", S.K. Kataria& Sons, 2001.
2. Kumar, K.L, "Engineering Fluid Mechanics", Eurasia Publishing House, New Delhi, 1995.
3. P.N Modi and S.M Seth, "Hydraulics and Fluid Mechanics", Standard Book House.
4. S.K Agrawal, "Fluid mechanics and machinery", Tata McGraw hill.

Fluid Mechanics and Hydraulic Machines Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	5	PC	PC	MEC-353
MAE	6	PC	PC	MEC-354

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Fluid Mechanics and Hydraulic Machines) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Determination of metacentric height of a given ship model.
2. To verify the Bernoulli's theorem.
3. To determine the coefficient of discharge for a given venturimeter.
4. To determine the coefficient of discharge for a given orifice plate.
5. To determine the Reynolds's number and hence the type of flow either laminar or turbulent
6. To determine the head loss due to friction in pipe and hence to determine the head loss coefficient.
7. Determination of coefficient for minor losses.
8. To conduct an experiment on the Jet on vane apparatus and determine the efficiency of jet.
9. To study and conduct performance test on the given Pelton wheel turbine and draw its performance characteristics curves.
10. To study and conduct performance test on the given Francis wheel turbine and draw its performance characteristics curves.
11. To study and conduct performance test on the given centrifugal pump and draw its performance characteristics curves.
12. To study the constructional details of hydraulic ram and draw its layout.
13. Performance test on reciprocating pump.

Fluids and Thermal Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	ME-OAE	ME-OAE-3	OME-439T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about fundamental concepts of fluid flow and fluid statics.
2.	To understand various kinematic, dynamic, and boundary layer concepts of fluid flow.
3.	To understand the concepts of dimensional analysis to predict fluid flow behaviour and different flows through pipe
4.	To understand fundamental concepts of thermodynamic principles.

Course Outcomes (CO)

CO 1	Explain fundamental concepts of fluid flow and fluid static principles
CO 2	Analyse various kinematic, dynamic, and boundary layer concepts of fluid flow
CO 3	Apply dimensional analysis to predict fluid flow behaviour and examine different flow through pipe
CO 4	Explain fundamental concepts of thermodynamic principles.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	2	-	-	-	-	--	-	-	2

UNIT-I

Fundamental Concepts of Fluid Flow: Fundamental definitions, applications of fluid mechanics, difference between fluid and solid, continuum hypothesis, fluid properties: density, specific volume, specific gravity, specific weight, viscosity- dynamic viscosity, kinematic viscosity, Newton’s law of viscosity, and types of fluid.
Fluid statics: pressure definition, types of pressure, Pascal’s law, pressure variation in a fluid at rest, manometers: piezometer, simple U tube manometer, and differential U tube manometer.

UNIT-II

Fluid Kinematics and Dynamics – types of flow – velocity field and acceleration – continuity equation (in cartesian co-ordinates)- stream line-streak line-path line- stream function – velocity potential function – flow net, Bernoulli’s equation – applications – venturi meter, orifice meter and Pitot tube.
Boundary layer – definition- boundary layer on a flat plate – laminar and turbulent boundary layer-

displacement, energy and momentum thickness, boundary layer separation.

UNIT-III

Flow through a pipe: Fully developing and developed flow, laminar flow through circular pipe (Hagen poiseulle's equation), turbulent flow through circular pipe: introduction, characteristics, turbulence intensity, velocity profile, major and minor losses.

Dimensional analysis: significance, Buckingham Pi- theorem, dimensionless parameters: Reynolds number, Mach number, Froude's number, Euler number, Weber number.

UNIT - IV

Thermal engineering: Thermodynamic systems: Closed, Open and Isolated systems. Microscopic and Macroscopic view. Intensive and Extensive properties. Zeroth law of Thermodynamics, State, Process, Cycle. Point functions and Path functions, Equation of State. Work and Heat.

Introduction to First Law of Thermodynamics, Internal energy. Non flow and processes, p-v diagrams, Application of first law for steady flow processes, Limitation of first law of thermodynamics.

Textbook(s):

1. D. S. Kumar, "Fluid Mechanics and Fluid Power Engineering", S. K. Kataria & Sons, (2012)
2. R. K. Bansal, " A text book of fluid mechanics and hydraulic machines", Laxmi Pub., (2019)
3. P. K. Nag, "Engineering Thermodynamics", Mc Graw Hill Education, 6th ed. (2017)

References:

1. R. W. Fox, A. T. McDonald, P. J. Pritchard, "Fluid Mechanics", John Wiley & Sons, 8th ed. (2013).
2. M. J. Moran, H. N. Shapiro, "Fundamentals of Engineering Thermodynamics", John Wiley, 8th ed. (2014).
3. S. K. Som, G. Biswas, "Introduction to fluid mechanics and fluid machines", McGraw Hill, 2nd ed. (2008)

Fluids and Thermal Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	ME-OAE	ME-OAE-3	OME-439P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Fluids and Thermal Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To verify the Bernoulli's theorem.
2. To determine the coefficient of discharge for a given venturimeter.
3. To determine the coefficient of discharge for a given orifice plate.
4. To determine the Reynold's number and hence the type of flow either laminar or turbulent.
5. To determine the coefficient of discharge using orifice meter.
6. To determine the head loss due to friction in pipe and hence to determine the head loss coefficient (major).
7. To determine the head loss in pipe fittings (minor losses).
8. To determine the coefficient of discharge using mouthpiece.
9. To create a python code to determine the coefficient of discharge for a given venturi meter for different heads
10. To create a python code to determine the coefficient of discharge for a given orifice meter for different heads
11. To create a python code to determine the final temperature of a hot steel ingot immersed in cold water using first law of thermodynamics.
12. To create a python code to determine the coefficient of performance of a refrigerator working under a given set of conditions.

Fracture Mechanics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	DMS-EAE	DMS-EAE-3	DMS-419T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the different modes of fracture failure and identify the fractured surfaces of some common materials.
2.	To understand the concept of stress intensity factor, stress concentration and Airy's stress function.
3.	To understand the concept of anelastic deformation at the crack tip, J integral and Crack Tip Opening Displacements (CTOD).
4.	To understand various test methods for the calculation of critical fracture mechanics parameters and several NDT techniques for crack detection.

Course Outcomes (CO)

CO 1	Describe mechanisms of fracture failure and identify the fractured surfaces of various materials.
CO 2	Understand the linear elastic fracture mechanics using the principle of stress intensity factor and Airy's stress function.
CO 3	Analyse the elastic-plastic fracture mechanics problem using the J integral and CTOD approach.
CO 4	Evaluate fracture mechanics parameters through various test methods and examine cracks by several NDT techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	-	2	-	-	-	-	-	3
CO 2	3	3	3	3	-	2	-	-	-	-	-	2
CO 3	3	3	3	3	-	2	-	-	-	-	-	2
CO 4	3	3	3	3	-	2	-	-	--	-	-	3

UNIT-I

Introduction: Introduction and historical review, Sources of micro and macro cracks. Stress concentration due to elliptical hole, Brittle and ductile fracture, Modes of fracture failure. Energy release rate (G), Griffith's theory. Fractured surfaces: Acquaintance with some common fracture surfaces of various materials, like steels, C.I, non ferrous alloys etc.

UNIT-II

Linear Elastic Fracture Mechanics: Stress concentration in the vicinity of notches and cracks, concept of stress intensity factor (K), Stress intensity factor for different types of cracks and geometry. Airy's stress function, Westergaard's Approach.

UNIT-III

Anelastic Deformation at the Crack Tip: Crack tip plastic zones and its evaluation, Effective Crack Length, Irwin Plastic Zone Correction, Dugdale approach.
Elastic Plastic Fracture Mechanics (EPFM): J-integral and its evaluation, application of J-integral. Concepts of Crack Tip Opening Displacements (CTOD), Relationship between CTOD and J.

UNIT – IV

Evaluation of Fracture Mechanics Parameters: Test methods to determine critical stress intensity factor (K_{Ic}), J-integral (J_{Ic}), Energy release rate (G_{Ic}), CTOD.
Crack Detection through various Non-Destructive Testing (NDT) techniques: Liquid penetration, Ultrasonic testing, Radiographic, Magnetic particle inspection.

Textbook(s):
1. Prashant Kumar, ‘Elements of Fracture Mechanics”; Tata McGraw- Hill Publishing Company Limited.
2. T.L. Anderson, ‘Fracture Mechanics”; 3rd edition, Taylor & Francis, ISBN0849316561, 2005.

References:
1. D.Breok, ‘Elementary Fracture Mechanics”; Noordhoff International, 1985.
2. J.F. Knott, “Fundamentals of Fracture Mechanics”, John Wiley & Sons, New York.
3. E.E.Gdoutos, “Fracture Mechanics- An introduction”; Springer.

Fracture Mechanics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	DMS-EAE	DMS-EAE-3	DMS-419P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Fracture Mechanics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To determine the fatigue behaviour of the given material using Fatigue testing machine.
2. Optical measurement of stress intensity factor.
3. To inspect cracks in bodies using various FEM software like: IDEAS, NASTRAN / PATRAN, ABAQUS etc.
4. To detect cracks using various Non-Destructive Testing (NDT) techniques: Liquid penetration, Ultrasonic testing, Radiographic, Magnetic particle inspection.
5. Measurement of Fatigue Crack Growth Rates.
6. To determine fracture mechanics parameters using various indirect methods like J-integral, energy release rate, singular element method etc.
7. Thermoelastic stress analysis (TSA) technique for the evaluation of fatigue crack propagation.
8. To measure Linear-Elastic Plane-Strain Fracture Toughness K_{Ic} of metallic materials.
9. To measure Elastic-Plastic Fracture Toughness J_{Ic} of metallic materials.

Fuzzy Logic and Neural Networks	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
ECE	7	PCE	PCE-4	ECE-411T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Introduce students to the various neural network and fuzzy systems models.
2.	Reveal different applications of these models to solve engineering and other problems.
3.	Introduce the theory and applications of artificial neural network and fuzzy systems to engineering applications with emphasis on image processing and control.
4.	Discuss neural networks and fuzzy systems, architectures, algorithms and applications, including Back-propagation, BAM, Hopfield network, Competitive Learning, ART, SOFM, Fuzzy inference methods and expert systems.

Course Outcomes (CO)

CO 1	Comprehend the concepts of feed forward neural networks
CO 2	Analyze the various feedback networks.
CO 3	Understand the concept of fuzziness involved in various systems and fuzzy set theory.
CO 4	Comprehend the fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2	3	3	-	2	-	-	1	3	2
CO 2	3	3	1	1	1	-	1	1	-	2	2	1
CO 3	3	2	3	3	2	-	2	-	-	2	3	1
CO 4	1	2	3	2	2	-	1	-	-	1	2	2

UNIT-I

Artificial Neural Network:History, Overview Of Biological Neuro-System, Mathematical Models Of Neurons, ANN architecture, Learning Rules, Learning Paradigms-Supervised, Unsupervised and Reinforcement Learning, ANN training Algorithms-perceptions, Training rules, , Back Propagation Algorithm, K Means clustering, Probabilistic Neural Network, Multilayer Perception Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.

UNIT-II

Fuzzy Logic: Introduction to fuzzy logic, Classical and fuzzy sets: Overview of Classical Sets, Membership Function and Fuzzy rule Generation. Operation on Fuzzy Sets: Compliment, Intersection, Unions, Combinations of Operations, Aggregation Operations Fuzzy Arithmetic: Fuzzy numbers, Linguistic variables, arithmetic operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.

UNIT-III

Fuzzy Logic: Classical Logic, Multivalued logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges. Uncertainty based Information: Information& Uncertainty, Nonspecificity of Fuzzy & Crisp Sets, and Fuzziness of Fuzzy Sets.

UNIT - IV

Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks. Application of Fuzzy Logic & Neural Networks in Intelligent Machine Design.

Textbook(s):
1. Haykins S., Neural Networks, Pearson Education, 2009
2. Yen J. & Langari R., Fuzzy Logic—Intelligence Control & Information, Pearson Education Asia, 1999.

References:
1. Lee H.H., First Course on Fuzzy Theory & Application, Springer Publications, 2005.
2. Ross T.J., Fuzzy Logic with Engineering Applications, Wiley India, 2011
3. Kumar S., Neural Networks, Tata Mc GrawHill Publications, 2004.

Fuzzy Logic and Neural Networks Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-4	ECE-411P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Fuzzy Logic and Neural Networks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Plot the correlation plot on some suitable dataset and visualize giving an overview of relationships among data.
2. Create a perceptron with appropriate number of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights
3. Write a program to implement artificial neural network without back propagation.
4. Write a program to implement artificial neural network with back propagation.
5. Implement crisp partitions for real-life iris dataset.
6. Write a program to implement logic gates.
7. Implement SVM classification by fuzzy concepts.
8. Implement linear regression and multi-regression for a set of data points
9. Implement Union, Intersection, Complement and Difference operations on fuzzy sets.
10. Create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.

Fuzzy Systems and Applications	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI	6	PC	PC	AI-318T
EAE	7	SC-EAE	SC-EAE-3	SC-477T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1. develop the fundamental concepts such as fuzzy sets, operations and fuzzy relations
2. lean about the fuzzification of scalar variables and the defuzzification of membership functions
3. learn three different inference methods to design fuzzy rule based system.
4. develop fuzzy decision making by introducing some concepts and also Bayesian decision methods

Course Outcomes (CO)

CO 1	To understand the basic ideas of fuzzy sets, operations and properties of fuzzy sets and also about fuzzy relations
CO 2	To understand the basic features of membership functions, fuzzification process and defuzzification process
CO 3	To design fuzzy rule-based system.
CO 4	To know about combining fuzzy set theory with probability to handle random and non-random uncertainty, and the decision-making process.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	-	3	-	3	-	-	-	3	-
CO 2	-	-	3	-	3	-	2	-	-	-	2	-
CO 3	-	3	3	3		-	-	3	-	-	2	-
CO 4	3	2	-	3	-	-	-	-	-	-	-	2

UNIT-I

Classical sets: Operations and properties of classical sets, Mapping of classical sets to the functions. Fuzzy sets - Membership functions, Fuzzy set operations, Properties of fuzzy sets. Classical and Fuzzy relations: Cartesian product, crisp relations-cardinality, operations and properties of crisp relations. Fuzzy relations-cardinality, operations, properties of fuzzy relations, fuzzy Cartesian product and composition, Fuzzy tolerance and equivalence relations, value assignments and other format of the composition operation

UNIT-II

Fuzzification and Defuzzification: Features of the membership functions, various forms, fuzzification, defuzzification to crisp sets, - cuts for fuzzy relations, Defuzzification to scalars. Fuzzy logic and approximate reasoning, other forms of the implication operation.

UNIT-III

Fuzzy Systems: Natural language, Linguistic hedges, Fuzzy (Rule based) System, Aggregation of fuzzy rules, Graphical techniques of inference, Membership value assignments: Intuition, Inference, rank ordering, Fuzzy Associative memories.

UNIT – IV

Fuzzy decision making: Fuzzy synthetic evaluation, Fuzzy ordering, Preference and consensus, Multi objective decision making, Fuzzy Bayesian, Decision method, Decision making under Fuzzy states and fuzzy actions. Classification by equivalence relations-crisp relations, Fuzzy relations, Cluster analysis, Cluster validity, C-Means clustering, Hard C-Means clustering, Fuzzy C-Means algorithm, Classification metric, Hardening the Fuzzy C-Partition.

Textbook(s):

1. Timothy J.Ross - Fuzzy logic with engineering applications, 3rd edition, Wiley,2010
2. George J.KlirBo Yuan - Fuzzy sets and Fuzzy logic theory and Applications, PHI, New Delhi,1995

References:

1. S.Rajasekaran, G.A.Vijayalakshmi - Neural Networks and Fuzzy logic and Genetic Algorithms, Synthesis and Applications, PHI, New Delhi,2003..

Fuzzy Systems and Applications Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI	6	PC	PC	AI-318P
EAE	7	SC-EAE	SC-EAE-3	SC-477P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Fuzzy Systems and Applications) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Implementation of Fuzzy Operations.
2. Implementation of Fuzzy Relations (Max-min Composition)
3. Implementation of Fuzzy Controller (Washing Machine).
4. Implementation of Simple Neural Network (McCulloh-Pitts model)
5. Implementation of Perceptron Learning Algorithm.
6. Implementation of Unsupervised Learning Algorithm.
7. Implementation of Simple Genetic Application.
8. Study of ANFIS Architecture

Gas Dynamics & Jet Propulsion	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-1	MEE-314T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the features of compressible isentropic flows.
2.	To understand the features of irreversibilities like shocks.
3.	To understand the jet and rocket propulsion technologies.
4.	To understand the jet and rocket propulsion technologies.

Course Outcomes (CO)

CO 1	Able to analyse the compressible isentropic flows.
CO 2	Able to analyse the non-isentropic flows like shocks.
CO 3	Able to apply gas dynamics principles to jet and space propulsion systems.
CO 4	Able to apply gas dynamics principles to jet and space propulsion systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow

UNIT-II

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables

UNIT-III

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

UNIT – IV

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory ofrocket propulsion, performance study, staging, terminal and characteristic velocity, spaceflights

Textbook(s):

1. Ahmed F. El-Sayed, Aircraft Propulsion and Gas Turbine Engines, CRC Press, 2008.
2. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.

References:

1. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.
2. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.
3. H.S. Mukunda, “Understanding Aerospace Chemical Propulsion”, Interline Publishing, 2004.

Gas Dynamics & Jet Propulsion Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-1	MEE-314P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Gas Dynamics & Jet Propulsion) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study sound velocity in different solids and fluids.
2. To study various gas properties for different altitude in atmosphere.
3. To study the wave propagation at different Mach number.
4. To study the flow through constant area duct with friction. (Fanno flow)
5. To study the flow in constant area duct with heat transfer. (Rayleigh flow)
6. To study the shock waves generated in the flow field.
7. Study of free jet
8. To find the calorific value of fuel by using Bomb Calorimeter.

Generation, Transmission and Distribution	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	EE-OAE	EE-OAE-4	OEE-429T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the function of various parts of electrical generating stations.
2.	Normal operation of the electric transmission and distribution systems.
3.	Functioning of the medium and high voltage transmission system.
4.	Components of the transmission and distribution lines.

Course Outcomes (CO)

CO 1	Ability to understand the function of various parts of electrical generating stations.
CO 2	Interpret the normal operation of the electric transmission and distribution systems.
CO 3	Maintain the functioning of the medium and high voltage transmission system.
CO 4	Maintain the components of the transmission and distribution lines.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT I

Introduction of conventional and non-conventional electrical power generating stations, Solar power plant, Wind power plant, Coal power plant, Hydro power plant and Nuclear power plant.

UNIT II

Basics of Transmission and Distribution Single line diagrams with components of the electric supply transmission and distribution systems.Classification of transmission lines: Primary and secondary transmission; standard voltage level used in India.Classification of transmission lines: based on type of voltage, voltage level, length and others Characteristics of high voltage for power transmission. Method of construction of electric supply transmission system – 110 kV, 220 kV, 400 kV.Method of construction of electric supply distribution systems – 220 V, 400V, 11 kV, 33 kV.

UNIT III

Transmission Line Parameters and Performance Line Parameters: Concepts of R, L and C of line parameters and types of lines. Performance of short line: Efficiency, regulation and its derivation, effect of power factor, vector diagram for different power factor. Performance of medium line: representation, nominal ‘T’, nominal ‘π’ and end condenser methods. Transposition of conductors and its necessity. Skin effect and proximity effect.

UNIT IV

A.C Distribution System AC distribution: Components classification, requirements of an ideal distribution system, primary and secondary distribution system.Feeder and distributor, factors to be considered in design of feeder and distributor. Types of different distribution schemes: radial, ring, and grid, layout, advantages, disadvantages and applications. Voltage drop, sending end and receiving end voltage.Distribution Sub-Station: Classification, site selection, advantages, disadvantages and applications.Single Line diagram (layout) of 33/11KV Sub-Station, 11KV/400V substation, Symbols and functions of their components.

Textbook(s):
1. Mehta, V.K., Principles of Power System, S. Chand and Co. New Delhi
2. Soni;Gupta; Bhatnagar, A Course in Electrical Power, Dhanpat Rai and Sons New Delhi

References:
1. Gupta, J.B., A Course in Power Systems, S.K. Kataria and sons, New Delhi
2. Uppal, S.L., A Course in Electrical Power, S.K.Khanna Publisher New Delhi

Generation, Transmission and Distribution Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	EE-OAE	EE-OAE-4	OEE-429P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Generation, Transmission and Distribution) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Demonstrate cable jointing procedures of unarmored cables
2. Demonstrate cable jointing procedures of armored cables
3. Prepare a report on different types of insulators and bushings used in transmission systems with their specifications.
4. Prepare a report on different type of Transmission Towers used in the industry
5. Prepare a report on different types of connectors used in the transmission lines
6. Prepare a report after studying distribution system of a residential colony
7. Interpret and explain the given Blueprint of a Substation,
8. Understand use of crimping tools to fit lugs at cable ends of unarmored cables
9. Understand use of crimping tools to fit lugs at cable ends of armored cables
10. Understand use of earth tester

Geometric Modelling and Analysis	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-4	MEE-403T
MAE	7	OAE-MAE	OAE-1	MAO-425T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the need, scope and importance of geometric modelling in industry.
2.	To make the students understand about the various geometric co-ordinate systems.
3.	To study the use of graphics standard and various CAD/CAE tools for automation of an industry.
4.	To study research assignments based on use of standard CADand CAE packages for modelling of mechanical elements.

Course Outcomes (CO)

CO 1	To learn geometric modelling and different modelling package.
CO 2	To understand the various geometric co-ordinate systems.
CO 3	To understand graphics standards and various optimization techniques for analysis.
CO 4	To analyse research assignments based on use of standard CADand CAE packages for modelling of mechanical elements.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	1	-	-	-	-	2
CO 2	3	3	3	3	-	-	1	-	-	-	-	2
CO 3	3	3	3	3	-	-	2	-	-	-	-	2
CO 4	3	3	3	2	-	-	2	-	--	-	-	2

UNIT-I

Geometric Modeling: Classification of Geometric Modelling – Wire frame, Surface and Solid Modelling, applications – representation of curves and surfaces – Parametric form. Design of curved shapes- Cubic spline – Bezier curve – B-spline – Design of Surfaces - features of Surface Modelling Package – Solid Primitives, CSG. B-rep and description of other modelling techniques, creating 3D objects from 2D profiles (extrusion, revolving etc).

UNIT-II

Geometric co-ordinate systems - Cartesian, Cylindrical and Spherical coordinate systems. Display co-ordinate systems - Global, Local, View and Screen coordinate systems. Computer graphics, Non-interactive Vs interactive computer graphics, applications, graphics system configuration. 2D and 3D transformation techniques -

Translation, Rotation, Scaling and Reflection principles. Principle of concatenated transformation. Orthographic and Perspective Projections of Geometric Models. Introduction to computer aided animation system.

UNIT-III

Definition of graphics standard, geometrical data, direct and indirect data transfer. Neutral file formats - Data Exchange Format (DXF) and Initial Graphics Exchange Specification (IGES) Mechanical Design Analysis and Optimization: Design analysis for mass properties, Stress, Thermal stress, using CAD/CAE packages, Optimum design of machine components using multivariable nonlinear optimization techniques using iterative CAD/CAE software tools.

UNIT – IV

Research Assignments: Individual research assignments will be based on use of standard CADand CAE packages for modeling of mechanical elements, Assembly and Automated Drawing. Project involving assembly, position, kinematic and dynamic analysis of a mechanism. Interference analysis in motion. Optimization of mechanical system design using CAD/CAE software tools, Project on mechanical systems design and analysis. Make a prototype for design validation.

Textbook(s):

1. Ibrahim Zeid, "Mastering CAD/CAM", Tata McGraw Hill Education (P) Ltd., Special Indian Edition, 2008.
2. Amarendra N Sinha and Arun D Udai, "Computer Graphics", Second reprint, Tata McGraw Hill, 2009.

References:

1. Hill F. S. and Kelley S. M, “Computer Graphics using Open G”, third edition, Prentice Hall, 2007.
2. Dr. Sadhu Singh, ”Computer Aided Design and Manufacturing”, Khanna Publishers, New Delhi.
3. Kelley David S, “Pro/ENGINEER Wildfire 5.0 Instructor”, Tata McGraw Hill, 2011.
4. Shih Randy H, “Introduction to Finite Element Analysis Using Creo Simulate 1.0”, SDC Publications, 2011.
5. Shih Randy H, “Parametric Modeling with Creo Parametric 1.0-An Introduction to Creo Parametric 1.0”, SDC Publications, USA, 2011.

Geometric Modelling and Analysis Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-4	MEE-403P
MAE	7	OAE-MAE	OAE-1	MAO-425P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Geometric Modelling and Analysis) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. CAD Introduction – Sketcher.
2. Solid modeling: Extrude, Revolve, Sweep, Vibrational sweep and Loft.
3. Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form.
4. Exercises in Modeling and drafting of Mechanical Components.
5. Force and Stress analysis using link elements in Trusses.
6. Stress analysis of flat plate.
7. Modeling curves (B-Splines and Bezier).
8. Tool path generation for Turning and Milling.

Geotechnical and Transportation Engineering	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	CE-OAE	CE-OAE-5	OCE-405

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the concept of Geotech engineering.
2.	To impart knowledge on understanding geogrids.
3.	To expose the students to various types of policies and various approaches.
4.	To impart knowledge about the special services of moving transactions

Course Outcomes (CO)

CO 1	Able to understand geotech engineering.
CO 2	Able to have sufficient knowledge to suggest appropriate materials for geogrids.
CO 3	Able to understand various characteristics of transport and its integration.
CO 4	Able to apply aspects of sustainability moving transactions & Simulation of ports

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	3	1	2	-	-	-	-	-	-
CO 2	1	-	-	2	-	3	-	-	-	-	-	-
CO 3	2	-	-	-	1	3	-	-	-	-	-	-
CO 4	-	-	-	-	1	3	2	-	-	-	-	-

UNIT-I

Shell foundations Prestressing in foundations Special construction problems Pile driving and well sinking Drainage of soil and dewatering of foundations Prestressed ground anchors. Shell foundations Prestressing in foundations Special construction problems Pile driving and well sinking Drainage of soil and dewatering of foundations Prestressed ground anchors Diaphragm walls Bored pile walls Reinforced earth and soil nailing Use of geotextiles in geotechnical engineering Sanitary landfills Gabions, Cribs Controlled yielding technique for reduction of lateral earth pressure Retaining walls with relieving shelves

UNIT-II

Geogrids: Materials used for geogrids Advantages and disadvantages of geogrids, categories of geogrids, Application of Geogrids on the Geotechnical Properties of Subgrade Materials. Subgrade Stabilization with Geotextiles. Advances in Geosynthetics Materials and Applications for Soil Reinforcement. The Orientation of Polymers to Produce High Performance Materials

UNIT-III

Exploring Rural Road Impacts Using Fuzzy Multi-criteria Approach. Safer Autonomous Navigation, Historical development of transport in India - 20 year Road Plans, National Transport Policy Recommendations, IRC, CRRI, Vision 2021, NHDP, PMGSY. Characteristics of different modes of transport and their integration and interactions - impact on environment. Probability concepts - Random numbers - Pseudo random generators - Arrival patterns - Service time distributions, Queue discipline – Manual simulation of simple queuing system.

UNIT - IV

Introduction to systems approach - Typical transportation systems - Mathematical models. Fundamentals of simulation - Monte Carlo method - Continuous and discrete models - Simulation languages. Probability concepts - Random numbers - Pseudo random generators - Arrival patterns - Service time distributions – Manual simulation of simple queuing system

Textbook(s):
1. Kadiyali, L. R., "Traffic Engineering and Transportation Planning", Khanna Publishers, New Delhi
2. Soil Mechanics in Engineering Practice" by Karl Terzaghi
3. Gordon, G., System Simulation, Prentice-Hall of India, 2005

References:
1. Traffic Engineering and Transport planning, Dr. L.R.Kadiyali, Khanna Publishers
2. Highway engineering, , Dr. L.R.Kadiyali, Khanna Publishers, ISBN No: 81-7409-165-3 1993
3. Principles of Traffic and Highway Engineering,Nicholas J. Garber and Lester A. Hoel,Cengage Learning
4. Transportation Engineering and Planning, C.S.Papacostas, PHI, ISBN-81-203-2154-5

Geotechnical Engineering	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	5	PC	PC	CEC-307

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To analyse bearing capacity and settlement of soil for shallow foundation.
2.	To understand the basics of pile foundation and evaluate the pile load carrying capacity.
3.	To interpret the earth pressure and understand various sheet pile walls.
4.	To analyse the stability of slopes and classify various soil stabilization methods.

Course Outcomes (CO)

CO 1	Understand various methods of soil exploration and analyse bearing capacity as well as settlement of soil for shallow foundation.
CO 2	Evaluate the load carrying capacity of pile foundation.
CO 3	Interpret the earth pressure and understand various types of sheet pile walls.
CO 4	Analyse the stability of slopes and classify various stabilization methods.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	2	3	0	0	2	0	0	0	1	0
CO 2	3	2	2	3	2	1	1	0	1	1	1	2
CO 3	3	3	2	3	2	1	0	0	0	1	1	1
CO 4	2	2	3	2	2	1	2	0	1	1	1	1

UNIT-I

Sub-soil Exploration: Methods of site exploration, Soil samples and samplers, Penetration tests, Geophysical methods-seismic refraction method, Electrical resistivity method.
Shallow Foundations: Types of foundations, guidelines for selection of foundation, Factors influencing selection of depth of foundation, Terminologies used for analysis of bearing capacity, Modes of shear failures, Factors affecting bearing capacity, Terzaghi’s, Skempton’s and Meyerhof’s bearing capacity theories, Effect of water table, IS code method, Plate load test, Standard penetration test, Static cone penetration test.
Settlement of Shallow Foundations: Components of settlement, Immediate settlement, Differential settlement, Angular settlement, Contact pressure and settlement under rigid and flexible footings.

UNIT-II

Deep Foundation: Classification of piles, Selection of type of pile, Static methods for determining pile load capacity, Dynamic methods for determining pile load capacity, Pile load test, Penetration tests, Group action of

piles, Group efficiency, Group settlement ratio, Settlement of pile group in clay, Negative skin friction, Under reamed pile foundations.
Well Foundation: Introduction, Types & components of a Well Foundation, Shapes of well.

UNIT-III

Earth Pressure: Introduction, Earth pressure at rest, Active and passive state, Rankine's earth pressure theory, his approach for determining active and passive earth pressure in frictional and c-ϕ soil, Coulomb’s theory of earth pressure, Graphical method.
Sheet Pile walls: Classification of sheet pile walls, Cantilever sheet pile wall, Anchored sheet pile wall and Braced sheeting.

UNIT – IV

Stability analysis of slopes: Introduction, Factor of safety analysis of finite and infinite slopes, Types of slope failure, Swedish slip circle method, Taylors stability number, Friction circle method.
Stabilisation of soils: Methods of stabilisation, Mechanical stabilisation, Cement stabilisation, Lime stabilisation, Bitumen stabilisation, Chemical stabilisation, Stabilisation by heating and Electrical stabilisation.
Geotextiles: Reinforced Earth, Geotextiles-definitions, Types and functions.

Textbook(s):
1. Gopal Ranjan & ASR Rao, “Basic and Applied Soil Mechanics”, New Age International Publishers, 4th Ed 2022.
2. Dr B.C. Punmia, Er. AK Jain, & Dr. AK Jain, “Soil Mechanics and Foundations”, Laxmi Publications, 17th Ed 2021.

Reference Books:
1. Dr KR Arora, “Soil Mechanics and Foundation Engineering”, Standard Publishers Distributors (2020).
2. JE Bowles, Foundation Analysis and Design, McGraw-Hill, New Delhi (1996).
3. Venkataramaiah, “Geotechnical Engineering”, New Age International Publishers.
4. VNS Murthy, “Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering” (2016).
5. P. Purushothama Raj, “Soil Mechanics and Foundation Engineering”, Pearson Education India (2013).
6. DP Coduto, MR Yeung, WA Kitch, “Geotechnical Engineering: Principles and Practices”, Pearson, 2nd Ed (2017).
7. K Terzaghi, R B Peck, G Mesri, “Soil Mechanics in Engineering Practice”, John Wiley and Sons, (1996).

Geotechnical Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	5	PC	PC	CEC-355

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Geotechnical Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Determination of California Bearing Ratio by unsoaked method.
2. Determination of California Bearing Ratio by soaked method.
3. Determination of Optimum moisture content (OMC) and Maximum dry density (MDD) by proctor test using light compaction.
4. Determination of Optimum moisture content (OMC) and Maximum dry density (MDD) by proctor test using heavy compaction.
5. Determination of Consolidation properties.
6. Determination of Shear parameters by direct shear test.
7. Determination of Unconfined compressive strength of soil.
8. Determination of Shear parameters by triaxial test.
9. Determination of Undrained shears strength of cohesive soil by vane shear test.
10. Determination of Permeability by constant head test.
11. Determination of Permeability by falling head test
12. Determination of swelling pressure of an expansive soil (black cotton soil) by consolidometer method.
13. Determination of Free swell index of soil.
14. To conduct the Standard penetration test for soil.

Global Optimization Methods	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	SC-479T
EAE	7	SC-EAE	SC-EAE-4	SC-479T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To gain an understanding and appreciation of the principles and methodologies relevant to global optimization
2.	To solve advanced problems with the sophisticated global optimization techniques
3.	To build a solid theoretical background in optimization
4.	Explore the recent topics for future research and study

Course Outcomes (CO)

CO 1	To understand the basic concepts of global optimization
CO 2	To understand and analyse the concept of convex functions and its applications
CO 3	To understand and analyse the concept of non-convex functions and its applications
CO 4	To analyse the application of global optimization in various research fields.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	1	2	-	-	-	-	-	-	-	2
CO 2	2	2	-	2	-	-	-	-	-	-	-	2
CO 3	2	1	-	2	2	-	-	-	-	-	-	2
CO 4	2	1	-	2	2	-	-	-	-	-	-	2

UNIT-I

History of global optimization, structure of global optimization algorithms – stochastic and deterministic global phase- fathoming.

UNIT-II

Notions of convex analysis, necessary and sufficient conditions for local optimality, concave Minimization, Lipschitz Optimization

UNIT-III

Properties of Non-convex Functions, Convex Envelopes, Duality, Complexity, Applications and Software Issues, Decomposition algorithms

UNIT - IV

Case Study: Meta-heuristic algorithms, Surrogate modelling, global optimation in machine learning, parallel and distributed global optimization

Textbook(s):

1. R. Horst, P.M. Pardalos and N.V. Thoai, “Introduction to Global Optimization”, Kluwer Academic Publishers, 2001, ISBN: 0-7923-6756-1 (2nd edition).
2. Liberti, L. (2008). Introduction to global optimization. *Ecole Polytechnique*.

References:

1. "Global Optimization: Theory, Algorithms, and Applications" by D.T. Pham, X.S. Yang, and N.K. Nishikawa.
2. "Introduction to Global Optimization" by E. A. Easdown.
3. "Global Optimization: Deterministic Approaches" by I. E. Grossmann and C. A. Floudas.
4. "Global Optimization Algorithms: Theory and Application" by T. Terlaky, P.M. Pardalos, and M.G.C. Resende.
5. "Global Optimization Methods in Geophysical Inversion" by M. A. Alfonseca and L. Tenorio.
6. "Handbook of Global Optimization" edited by R. Horst and P. M. Pardalos.
7. "Global Optimization: A Stochastic Approach" by R. Umetani.
8. "Introduction to Global Optimization Exploiting Space-Filling Curves" by J. Mockus, V. Tiesis, and A. Zilinskas.
9. "Convexification and Global Optimization in Continuous and Mixed-Integer Nonlinear Programming" by C. J. Buchheim and C. M. Büskens.

Global Optimization Methods Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	SC-479P
EAE	7	SC-EAE	SC-EAE-4	SC-479P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Global Optimization Methods) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study Ackley's Function: A classic multimodal optimization problem with many local minima.
2. Study Rastrigin's Function: A non-convex function with a large number of local minima.
3. Analyse Traveling Salesman Problem (TSP): Finding the shortest route for a salesman visiting multiple cities and returning to the starting city.
4. Knapsack Problem: Selecting a combination of items with maximum value while staying within a given weight constraint.
5. Neural Network Architecture Search: Optimizing the structure and hyper-parameters of a neural network for a given task.
6. Global Parameter Estimation: Fitting a mathematical model to experimental data to estimate the values of model parameters.
7. Study Sphere Function - a widely used function for testing optimization algorithms.
8. Supply Chain Optimization: Optimizing the flow of goods, materials, and information across a supply chain network to minimize costs and maximize efficiency.
9. Optimal Power Flow: Optimizing the generation and distribution of electrical power in a power system while satisfying various constraints.
10. Implementing and studying the performance of the PSO algorithm on various benchmark functions.

Graph Theory for Computer Science	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	6	PCE	PCE-2	CIE-338T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand and apply the fundamental concepts in graph theory .
2.	To apply graph theory based tools in solving practical problems
3.	Model problems using graphs and to solve these problems algorithmically
4.	Reason from definitions to construct mathematical proofs by integrating core theoretical knowledge.

Course Outcomes (CO)

CO 1	Understand precise and accurate mathematical definitions of objects in graph theory.
CO 2	Able to formulate and prove central theorems about trees, matching, connectivity, colouring and planar graphs;
CO 3	Able to describe and apply some basic algorithms for graphs;
CO 4	Able to construct mathematical proofs by integrating core theoretical knowledge.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	1	2	3	3	1	3	1	2	1	1
CO 2	2	2	1	2	2	2	2	2	2	2	2	2
CO 3	2	2	1	2	2	2	3	2	3	2	3	3
CO 4	3	2	1	2	1	2	1	2	1	2	1	1

UNIT-I

Introduction: Graphs- Introduction, Isomorphism, Sub Graphs, Walks, Paths, Circuits, Connectedness, Components, Euler Graphs, Hamiltonian Paths and Circuits, Trees - Properties of Trees, Distance and Centers in Tree, Rooted and Binary Trees. Special Classes of Graphs: Bipartite Graphs, Line Graphs, Chordal Graphs

Graphs- Introduction, Isomorphism, Sub Graphs, Walks, Paths, Circuits, Connectedness, Components, Euler Graphs, Hamiltonian Paths and Circuits, Trees-Properties of Trees, Distance and Centers in Tree, Rooted and Binary Trees. Special Classes of Graphs: Bipartite Graphs, Line Graphs, Chordal Graphs.

UNIT-II

Spanning Trees: Fundamental Circuits, Spanning Trees in a Weighted Graph, Cut Sets: Properties of Cut Set, All Cut Sets, Fundamental Circuits and Cut Sets, Connectivity and Sep-arability, Network Flows, 1-Isomorphism, 2-Isomorphism, Combinational and Geometric Graphs, Planer Graphs, Different Representation of a Planer

Graph

UNIT-III

Chromatic Number, Chromatic Partitioning, Chromatic Polynomial, Matching, Covering, Greedy Coloring Algorithm, Four Color Problem, Directed Graphs -Types of Directed Graphs, Digraphs and Binary Relations, Directed Paths and Connectedness, Euler Graphs

UNIT - IV

Fundamental principles of counting – Permutations and combinations – Binomial theorem – combinations with repetition – Combinatorial numbers – Principle of inclusion and exclusion – Derangement – Arrangements with forbidden positions.
Generating functions – Partitions of integers – Exponential generating function – Summation operator – Recurrence relations – First order and second order – Non-homogeneous recurrence relations – Method of generating functions.

Textbook(s):

1. Narsingh Deo, “Graph Theory: With Application to Engineering and Computer Science”, PHI, 2003.
2. Grimaldi R.P. “Discrete and Combinatorial Mathematics: An Applied Introduction”, Addison Wesley, 1994.

References:

1. Clark J. and Holton D.A, “A First Look at Graph Theory”, Allied Publishers, 1995.
2. Mott J.L., Kandel A. and Baker T.P. “Discrete Mathematics for Computer Scientists and Mathematicians”, PHI, 1996.
3. Liu C.L., “Elements of Discrete Mathematics”, Mc Graw Hill, 1985.
4. Rosen K.H., “Discrete Mathematics and Its Applications”, Mc Graw Hill, 2007.

Graph Theory for Computer Science Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	6	PCE	PCE-2	CIE-338P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Graph Theory for Computer Science) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Program to find the number of vertices, even vertices, odd vertices and number of edges in a Graph.
2. Program to Find Union, Intersection and ring-sum of 2 graphs.
3. Program to Find Minimum Spanning tree Using Prim's Algorithm
4. Program to Find Minimum Spanning tree Using Kruskal's Algorithm
5. Program to find Shortest Path between 2 Vertices using Dijkstra Algorithm
6. Program to find Shortest Path between every pair of vertices in a graph using Floyd-Warshall's Algorithm.
7. Program to find Shortest Path between 2 Vertices using Bellman Ford's Algorithm.
8. Program For finding maximum Matching for bipartite graph
9. Program For finding maximum Matching for General Path
10. Program to find maximum flow from source node to sink node using Ford-Fulkerson Algorithm

Green Building Construction Materials and Practices	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	CE-OAE	CE-OAE-3	OCE-401

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the concepts of Green Building
2.	To imbibe the basics of green design and sustainable development concepts.
3.	To analyse problems related to conventional building and determine effect of green building
4.	To learn guidelines for design, development, and certification of green buildings.

Course Outcomes (CO)

CO 1	Define fundamental concepts of green building and various types of techniques involved.
CO 2	Analyse the complexities and problems associated with conventional building
CO 3	Determine the parameters that are required to design a green building.
CO 4	Design a green building in different scenarios and conditions.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	1	-	-	-	-	-	1	-	1
CO 2	3	2	2	2	-	1	-	-	-	-	-	-
CO 3	1	3	1	2	-	-	-	-	-	-	-	-
CO 4	3	3	3	2	1	-	-	1	-	-	-	1

UNIT-I

Green Building Concept: Overview of green building movement; Concept of Green building and sustainable development; Issues and strategies of green building and sustainable development; Objectives Principles and Benefits of Green building design; Introduction to High performance building; integrated design process of high-performance building; Green project requirements and strategies; Overview of various green rating systems worldwide.

UNIT-II

Indoor Built Environment: Problem of Existing Buildings and Built Environment; Energy use in buildings; Greenhouse Gas Emissions and Indoor Air pollution; Building Water Use; Land use and consumption; Construction Materials; Construction, Operation and Demolition Waste, Low emitting materials; Building and material reuse, Factors affecting indoor environment quality; Ventilation and filtration; Building materials and finishes- Emittance level; Indoor Environment quality best practice.

UNIT-III

Green Building Design: Passive Design Strategies: Optimum Design, Performing Insulation Solution, Ventilation; Active Strategies: Equipment, Renewable Energy; Retrofitting; Net Zero Building Design; Embodied Energy Estimation; Life Cycle Assessment Analysis.
Building energy simulation: Building energy efficiency standards- Lighting system design- Lighting economics and aesthetics- Impacts of lighting efficiency- Energy audit and energy targeting, Technological options for energy management.

UNIT - IV

Green Building Assessment: Green Building Organizations, Green Building Rating Tools, Green building certification procedure.
IGBC Guidelines: Introduction; IGBC green new building Rating system – Overview and process – project checklist; Sustainable architecture and design; Site selection and planning; Water conservation and energy efficiency; Building materials and resources; Indoor Environment quality; Innovation and development.

Textbook(s):

1. Green Building Technology Guide: Volume 1 - Residential, Fred Andreas, Academic Press Inc., 2020, First Ed.
2. The Idea of Green Building, A. K. Jain, Khanna Publishers, 2014, First Edition.

References:

1. Green Building Guidance: The Ultimate Guide for IGBC Accredited Professional Examination, Karthik Karuppu, Notion Press, 2019, First Edition.
2. Sustainable Construction: Green Building Design and Delivery, Charles Kibert, John Wiley & Sons, 2005.
3. Alternative Energy Systems in Building Design, Peter Gevorkian, McGraw-Hill Education, 2009, First Edition.

Green Energy Concepts in Smart Cities	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	GTSE-EAE	GTSE-EAE-3	GTSE-429

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concept of green energy, smart city and associated challenges.
2.	To understand latest technologies used in smart building.
3.	To understand concepts in smart cities.
4.	To understand the importance of different smart system.

Course Outcomes (CO)

CO 1	Define types of green energy and smart cities fundamentals.
CO 2	Apply knowledge of green energy in smart cities.
CO 3	Explain application of IoT in smart cities.
CO 4	Discuss management of Green Energy in Smart Cities.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	2	-	-	-	3	-	-	-	-	-
CO 2	1	-	2	-	-	1	3	-	-	-	-	-
CO 3	1	-	1	-	3	1	2	-	-	-	-	-
CO 4	-	2	3	-	-	1	1	-	-	-	-	-

UNIT-I

Green smart cities: Fundamental of smart city & Infrastructure: Introduction of Smart City, Concept of smart city, Objective for smart cities, History of Smart city world and India. Need to develop smart city, Dimension of smart cities, Global Standards and performance benchmarks, Practice codes, Smart city planning and development, financing smart cities development, Governance of smart cities, Challenges of managing infrastructure in India and world, various types of Infrastructure systems, technology innovation, main areas of intervention: green building, smart grid, smart lighting, smart mobility.

UNIT-II

Planning and development of Smart city Infrastructure: Energy and ecology, solar energy for smart city, Housing, sustainable green building, safety, security, disaster management, economy, cyber security, Project management. Green Building Requirements: Principles of Energy, Heat Flow, Fuel Types, Air Flow, Moisture Flow, Condensation and Dew Point, Relative Humidity, Concept of Earth air Tunnel System for moderating air temperature, Waste and Material Management in Green Cities

Green Energy for Sustainability and Energy Security: Introduction, Energy Systems: Their Composition, Systems: Their Adverse Impacts, Green Energy and Sustainability: The Target and Solution, Diversification and Localization of Energy Systems: A Means to Sustainability and Energy Security.

UNIT-III

Transforming smart cities with IoT: Internet of Things (IoT) and the Smart City, IoT architectures of smart cities, IoT Technologies for Smart Cities, Radio-Frequency Identification, Near-Field Communication, Low-Power Wide-Area, Wireless Telecommunications, Wireless Sensor Network, IoT Applications for Smart Cities, Smart Urban Mobility: Traffic Monitoring, Smart Parking, Connected Vehicles, Urban Sustainability: Smart Lighting, Smart Meters, Smart Waste Management, Smart Buildings and Environment, Air Quality Monitoring, Building Automation, Noise Monitoring, smart sensors and its types, IoT challenges in smart cities.

UNIT - IV

Green Energy Management in Smart Cities: Introduction, Energy Requirements of Smart Cities, Industrial and Ecological System, Air Pollution Reduction Plan, Air Pollution Reduction Plan, Peak Data Management, Energy Management: Low-Carbon Transportation, Industrial Waste Reduction, Energy-Efficient Buildings, Green and Flexible Infrastructure, Intelligent System Development.
Electromagnetic Pollution and Its Management: Introduction, causes of Electromagnetic Pollution, possible effects and consequences of Electromagnetic Pollution, possible solution to Electromagnetic Pollution.

Textbook(s):
1. K. Saravanan and G. Sakthinathan, “Handbook of Green Engineering Technologies for Sustainable Smart Cities”, CRC Press, Taylor and Francis Group, First edition (2022).

References:
1. Xianguo Li, “Green Energy Basic Concepts and Fundamentals”, Springer-Verlag London Limited (2011).
2. Kibert C.J., “Sustainable Construction - Green Building Design and Delivery” John Wiley and Sons, New York
3. Vijay Laxmi Kalyani, “Green Energy: The Need of the World” (2015**).**

Green Energy Technology	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	TES-EAE	TES-EAE-4	TES-449T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about different types of Solar thermal Systems.
2.	To understand the classification of Solar Photovoltaic systems.
3.	To understand the wind energy systems and construction of various turbines.
4.	To understand micro hydro power systems and bio-energy systems.

Course Outcomes (CO)

CO 1	Determine the need for solar energy and its applications.
CO 2	Analyse the Solar Photovoltaic Systems and compare Grid connected,Off-grid, stand-alone systems.
CO 3	Utilize the technology for harnessing the wind power.
CO 4	Design and analysis of micro hydro power plant and biomass energy conversion systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	-	-	2	3	-	-	-	-	3
CO 2	3	3	2	-	-	2	3	-	-	-	-	3
CO 3	3	3	2	-	-	2	3	-	-	-	-	3
CO 4	3	3	2	-	-	2	3	-	--	-	-	3

UNIT-I

Solar Energy: The sun as a source of energy, radiation – extra-terrestrial and terrestrial, spectral distribution, solar constant, solar radiation measurements, solar radiation data, solar radiation geometry.
Solar Thermal Systems: Classification of solar thermal systems, Concentrated and non-concentrating solar Power (CSP) systems— Flat plate collectors, parabolic collectors, parabolic dish collector, solar tower.
Solar thermal systems: Solar water heater, solar refrigeration and air conditioning systems, solar furnace, solar dryer, and solar distillation systems.

UNIT-II

Solar Photovoltaic (PV) Systems: Solar cell fundamentals, p-n junction, solar cell characteristics, efficiency of PV cell, Fill factor, effect of solar insolation and temperature on solar cell performance, classification of PV cells, solar cell, module, and array.
Solar PV systems: Classification: Grid connected, Off-grid, stand-alone systems, hybrid solar PV system, solar PV

applications: water pumping, lighting, medical refrigeration, telecommunication, signalling, and village power.

UNIT-III

Basics of wind energy: introduction, types of wind: global winds, local winds, factors affecting distribution of wind energy on earth surface, wind data collection, variation of wind speed with height and time.
Wind turbine: Energy estimation of wind, power extraction from wind, axial thrust on wind turbine, torque developed by wind turbine.
Wind Energy Systems: Types of wind energy systems—Horizontal axis wind turbines (HAWTs): construction, working, specifications, vertical axis wind turbines (VAWTs): construction, working, specifications.

UNIT - IV

Micro Hydro Power Systems: advantages and disadvantages, layout of micro-hydro scheme, Classification: impulse turbines, reaction turbines, turbine selection, characteristics, and selection.
Biomass-energy Systems: Classification of bio-fuels- biogas, biodiesel, charcoal, producer gas, Biomass resources, biomass conversion technologies, waste to heat energy conversion system and sewage to energy conversion system.

Textbook(s):

1. Khan B. H., “Non-conventional energy resources”, Mc Graw Hill (2012).
2. Sukhatme S.P., Nayak J.K., “Solar Energy”, Tata Mcgraw (2010).
3. Balfour John R., Shaw Michael L., JarosekSharlave,” Introduction to Photovoltaics”, Jones and Bartlett Publishers, Burlington (2011).
4. Ackermann Thomas, “Wind Power in Power Systems”, John Wiley and Sons, UK (2012).

References:

1. Nelson Vaughn C., Kenneth L. Starcher, “Introduction to Bioenergy”, CRC press, UK; (2015).
2. Garg H. and Prakash J., “Solar Energy: Fundamentals and Applications”, McGraw Hill Education, 2017.

Green Energy Technology Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	TES-EAE	TES-EAE-4	TES-449P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Green Energy Technology) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study different types of solar collectors.
2. Study different types of solar thermal based systems.
3. Analyze the performance of solar thermal power system.
4. Analyze the performance of solar refrigeration system.
5. Carry energy analysis of a flat plate solar collector.
6. Carry exergy analysis of a flat plate solar collector.
7. Study and compare different bio-fuels.
8. Learn the assembling of a PV system.
9. Simulate the performance of a PV cell.
10. Study and compare HAWT and VAWT.
11. Visit to solar based energy system.

Heat and Mass Transfer	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	5	PC	PC	MEC-311
MAE	5	PC	PC	MEC-305

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the students about the knowledge of conduction, convection, thermal radiation.
2.	To enable them to make calculations of heat transfers that will help them in design and analysis of any thermal system.
3.	To introduce the students about different types of heat exchangers.
4.	To introduce the students about the knowledge of condensation, boiling and mass transfer.

Course Outcomes (CO)

CO 1	Evaluate rate of heat transfer by conduction, convection and radiation for standard industrial configuration and solve problems.
CO 2	Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.
CO 3	Apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations; and explain basic laws for radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems.
CO 4	Explain the phenomena of boiling and condensation; and apply diffusive and convective mass transfer equations and correlations to solve problems for different applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	1	2	-	2	-	-	2
CO 2	3	3	3	3	2	-	2	-	2	-	-	2
CO 3	3	3	3	3	-	-	2	-	2	-	-	2
CO 4	3	3	3	3	2	-	2	-	2	-	-	2

UNIT-I

Conduction: Introduction to Heat Transfer, Various modes of heat transfer, Fourier’s Law, thermal conductivity of solids, liquids and gases, factors influencing conductivity, general differential equation of conduction, one dimensional steady state conduction, simple cases of conduction through a plane and composite wall, cylinder and sphere, thermal diffusivity, overall heat transfer coefficient, Heat transfer through cylindrical & Spherical surfaces, Critical thickness of insulation.

Fins and Transient Conduction: Heat transfer from extended surfaces, conduction convection system, general conduction analysis, fins of uniform cross-sectional area, fin performance, Transient heat conduction: lumped system analysis.

UNIT-II

Forced Convection: Introduction, dimensional analysis of forced convection and important dimensionless numbers, velocity and thermal boundary layer, laminar boundary layer equations for internal and external flows, laminar forced convection on a flat plate and in a tube.

Natural Convection: Basic Concepts, dimensional analysis of natural convection and important dimensionless numbers, empirical relationship for natural convection, natural convection on a flat plate and in a tube.

UNIT-III

Heat Exchanger –Types of Heat exchangers, overall heat transfer coefficient, design of heat exchangers logarithmic mean temperature difference (LMTD) method, effectiveness-NTU method of heat exchangers, fouling factor and correction factor.

Thermal Radiation: Concept of thermal radiations, radiation properties of surfaces, type of bodies (black and non black bodies), Kirchhoff's law, Planck's distribution law, Wein's displacement law, Stefan-Boltzmann's relation, intensity of radiation, radiant heat exchange between black and grey surfaces, configuration factor, radiation shielding, solar radiation; green house effect.

UNIT – IV

Condensation and Boiling: Introduction to condensation phenomena, Film and Drop wise condensation, Film-wise condensation on vertical plate and horizontal tubes. Boiling: Classification, Flow Regimes of Pool boiling, Heat transfer correlations in boiling and condensation.

Mass Transfer: Basic Concepts, Diffusion Mass Transfer, Fick's Law of Diffusion, Molecular and eddy diffusion; concept of mass transfer coefficients, theories of mass transfer, Heat and mass transfer phenomenon, molecular diffusion from an evaporating fluid surfaces, dimensionless analysis of convective mass transfer.

Textbook(s):

1. Incropera, Dewitt, "Fundamentals of Heat and Mass Transfer", Wiley India Pvt. Ltd.
2. R. C. Sachdeva, "Heat Transfers" McGraw Hill.

References:

1. Mahesh M. Rathore, "Engineering Heat and Mass Transfer", University Science Press.
2. P. K. Nag, "Heat and Mass Transfer", Tata McGraw Hill Book Company.
3. Holman, J.P., "Heat Transfer", Tata McGraw Hill Book Company.
4. Domkundwar S., Arora S. C., Domkundwar Anand V., "A Course in Heat and Mass Transfer", Dhanpat Rai & Company.

Heat and Mass Transfer Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	5	PC	PC	MEC-357
MAE	5	PC	PC	MEC-353

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Heat and Mass Transfer) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To find the thermal conductivity of an asbestos sheet.
2. To determine the thermal conductivity of metal rod.
3. To determine thermal conductivity of an insulating powder.
4. To determine overall heat transfer coefficient and the temperature distribution across the width of a composite wall.
5. To determine convective heat transfer coefficient, temperature distribution, efficiency and effectiveness of PIN-FIN in natural convection.
6. To determine convective heat transfer coefficient, temperature distribution, efficiency and effectiveness of PIN-FIN in forced convection.
7. To determine LMTD and effectiveness of parallel and counter flow heat exchanger.
8. To determine the forced convective heat transfer coefficient, for flow of air inside a horizontal pipe.
9. To determine the surface heat transfer coefficient for a heated vertical cylinder in natural convection
10. To determine Stefan-Boltzmann constant of radiation heat transfer.
11. To study boiling heat transfer phenomenon for pool boiling.
12. To determine emissivity of a test surface.

High Voltage Engineering	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	7	PCE	PCE-5	EEE-427

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Understand the concept of High voltage Breakdown in materials
2.	To Design and development of high voltage equipment and utility establishment
3.	To Analyze and measure the magnitude of HVDC, HVAC (power frequency & high frequency) and impulse by different measurement schemes.
4.	To analyze insulation coordination and testing

Course Outcomes (CO)

CO 1	Understand the concept of High voltage Breakdown in materials
CO 2	Design and development of high voltage equipment and utility establishment
CO 3	Analyze and measure the magnitude of HVDC, HVAC (power frequency & high frequency) and impulse by different measurement schemes.
CO 4	Analyze insulation coordination and testing

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	3	2	2	2	-	-	-	1	-	2	2
CO 2	2	3	2	2	2	-	-	-	1	-	2	3
CO 3	2	3	2	2	2	-	-	-	1	-	2	2
CO 4	2	3	2	2	2	-	-	-	1	-	2	2

UNIT I

High Voltage and Breakdown Phenomenon: Electric field stress due to high voltage, gas ,vacuum, liquid, solids and composites as dielectrics and insulator, estimation and control of electric stress and numerical methods for its computation, surge voltages and their distribution and control, application of insulating materials in transformer, rotating machines, circuit breakers, cable, power capacitors, bushings; breakdown in gaseous and liquid dielectrics, collision process, ionization process, Townsend's Criteria of breakdown in gases, Paschen's law, breakdown in pure and commercial liquids as insulator; intrinsic, electromechanical and thermal breakdown of solid dielectrics, breakdown in composite dielectrics.

UNIT II

Generation of High Voltages and Currents: Generation of high direct current voltages and high alternating current voltages, generation of impulse voltages and impulse currents, tripping and control of impulse generators.

UNIT III

Measurement of High Voltages and Currents: Measurements of high voltages - direct, alternating and impulse, measurements of high currents–direct, alternating and impulse, Oscilloscope for impulse voltage and current measurements.

UNIT IV

Over Voltage, Insulation Coordination and Testing: Causes of over voltage – lightning, switching, faults and other abnormal conditions, principles of insulation coordination in high voltage, extra high voltage and ultra high voltage power systems, measurement of DC resistivity, dielectric constant, loss factor and partial discharge, testing of insulators and bushings, isolators and circuit breakers, cables, transformers, surge arresters, measurement of Radio Interference.

Textbook(s):
1. M. S. Naidu & V. Kamaraju, “High Voltage Engineering”, Tata McGraw Hill Publications, 3rd Edition.
2. E. Kuffel, W.S. Zaengl & J. Kuffel, “High Voltage Engineering – Fundamentals”, Elsevier, 2nd Edition.

References:
1. C. L. Wadhwa, “High Voltage Engineering”, New Age International (P) Ltd, 1997.
2. Ravindra Arora & Wolfgang Mosh, “High Voltage Insulation Engineering”, New Age International (P) Ltd, 1995.

Holistic Human Health	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OUHV-463
OAE	7	UHV-OAE	UHV-OAE-4A	OUHV-463

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce students to the universal health principles
2.	To initiate / strengthen the process and practices to keep the Body in harmony
3.	To generate interest, commitment and to make effort for realising holistic human health and staying healthy
4.	To develop the vision for holistic human health

Course Outcomes (CO)

CO 1	Develop the feeling of self-regulation or responsibility for the nurturing and protection of the Body.
CO 2	Formulate the program to take personal responsibility for his/her own health.
CO 3	Develop the vision for holistic human health and Model healthy habits in personal & professional life
CO 4	Formulate the strategy to contribute in maintaining the health of his/her family, society and nature.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	3	1	1	-	1
CO 2	-	-	-	-	-	3	-	3	1	1	-	1
CO 3	-	-	-	-	-	3	-	3	1	1	-	1
CO 4	-	-	-	-	-	3	-	3	1	1	-	1

UNIT-I

Module 1: Introduction and Understanding the Human Being

This module discusses the current perspective on health, its lack of a holistic outlook and shortcomings as a result of this. It puts forth the necessity for a change in perspective which can be brought about with better understanding of the reality. It also talks about the entire process of the course. The course learnings are put forward as proposals that students can verify for themselves in a logical way with reasoning and self-exploration rather than in the form of dos and don'ts.

In the process of understanding, the course focuses first and foremost on a complete understanding of the human being and not merely on the physical body of the human being.

The expected outcome from this module is a thorough understanding of the two realities that constitute the human being (the Self and the body), the differences in their needs and fulfillment of these needs, the differences in their activities and responses, the way to maintain harmony and the importance of this background in understanding health (harmony) in the Self and the body.

I. Current health perspective, need for change and process of understanding
1. Perspective about health – need for change
2. Process of the Course –process of Self–exploration (on the basis of Natural Acceptance)

II. Understanding the Human being, its Aspirations and fulfillment of these
aspirations
3. Human being as a co-existence of Self and body
4. Basic aspiration of every human being- happiness and prosperity in continuity
5. Exploring the meaning of happiness and prosperity
6. Harmony within the Self – desires (feelings) in line with the Natural Acceptance

Practice/activity session for module 1:
1. Observing the Self by the Self (seeing the desires, thoughts and expectations within the Self)
2. Observing the body by the Self

UNIT-II

Module 2: Universal Health Principles and Guidelines

This module explains, very clearly and in depth, the universal health principles that are derived from an understanding of the reality as it is. It elaborates separately on the principles relating to the body and those relating to the Self and its interaction with the body.

The module further charts out the guidelines for health which are drawn from the basic universal health principles. These guidelines take into account the differences in human beings at the level of their physical body and personality and the impact of the changes constantly occurring in one's environment.

The expected outcome of this module is for students to see the universality of the health principles, the logic and rationality behind them and to understand the guidelines for health drawn from the understanding of the health principles as the foundation.

III. Universal health principles for all
7. Universal Health principles (in accordance with the reality) – Principles relating to the body
8. Universal Health Principles (contd.) - Principles relating to interaction of the Self with the body
9. Universal health principles (contd.)

IV. Guidelines for health based on the principles
10. Guidelines for health - details
11. Guidelines for Health (contd.)
12. Guidelines for health (contd.)

Practice/Activity session for module 2:
1. Observing the interaction between the Self and the body by the Self
2. Observing (by the Self) who is the decision maker in the interaction between the Self and the body

UNIT-III

Module 3: Implementation

Module 3 describes the practical details of implementing the health guidelines on a day-to-day basis. It deals with our intake and describes the importance of having our daily routine (lifestyle) in synchronization with the diurnal and seasonal rhythms in nature.

In continuation this module deals with the practical benefits of physically working with nature, physical exercises and postures to regulate the internal and external organs of the body (e.g. yoga) and breath regulation (e.g. pranayam) and incorporating these practices in the daily routine of the student's life.

The module also provides an understanding of common herbs and spices that can be found in the kitchens of most households (particularly in India) and how these can be used to bring the body back to harmony and health if and when it does go into disharmony (ill-health).It also throws light on when an individual can treat minor ailments at home and when one needs to resort to the use of medication and treatment (a dependence on external machines etc. if the body has gone into chronic or permanent disharmony).

V. Implementation of Health in the Individual

13. Program for staying healthy – practices and processes
14. Intake
15. Intake (contd.)
16. Intake (contd.)
17. Daily routine
18. Daily routine (contd.)
19. Daily routine (contd.)

VI. Implementation of Health in the Individual (Contd.)

20. Labor
21. Exercise
22. The practice of postures for regulating the internal and external body organs (Yoga) and its impact on the health of the body
23. The practice of regulation of breath (pranayam) and its impact on the health of the body
24. Use of household remedies to keep body in harmony/bring it back from disharmony to harmony
25. When to resort to medication (when body is in temporary disharmony) and treatment (when the body I in permanent disharmony)

Practice session for module 3:

1. Maintaining an intake that is nurturing for the body
2. Maintaining a daily routine that is in synchronization with natural cycles
3. Incorporating the practice of yoga and pranayam in the daily routine
4. Practically identifying household remedies and using them for minor ailments

UNIT - IV

Module 4: The Healthy Environment

The fifth module emphasizes the importance of seeing the human being as an integral part of the larger whole. This larger framework includes all that the human being is interconnected with and interdependent on i.e. the environment of the human being. This includes relationships within the family, the society and all of nature/ existence. The module helps the student to understand the harmony at all these levels, the importance of living in harmony at all these levels and the impact of the environment (family, society and nature) on the health of the human being.

VII. Understanding the role of the environment in the health of an individual

26. Impact of environment (family, society and nature) on health of body
27. Understanding harmony in family (trust in relationships)
28. Understanding harmony in family (contd.) (respect in relationships)
29. Understanding harmony in family (contd.) (other feelings in relationship)
30. Understanding harmony in Society (trust/relationships, system in society)
31. Understanding harmony in Nature (innate order and harmony versus struggle for survival)
32. Understanding existence as co-existence (units submerged in space)

Practice sessions for Module 4:

1. Practically contributing to the health within the family, working out the possibility of contributing to health at the level of society
2. Working with nature and making effort to maintain the harmony in nature using cyclic processes

Module 5: Holistic Health

This last module is dedicated to a final look at the health of the human being in totality – in a holistic manner. It also briefly touches on implementation of health guidelines at levels beyond those of the individual i.e. implementation at the level of family and society.

The module ends with providing an understanding about the purpose or goal of the human being and looks at health in the body as a means of attaining this higher purpose rather than assuming health in the body as being the goal in itself.

A final sum-up of the entire course is also provided in this module.

VIII. Holistic Human health

33. Holistic Human Health (Health of Self + Health of body + Health of Environment (i.e. family, society, nature)
34. Implementation of health at level of family – designated family member to take responsibility
35. Implementation of health at level of society – health systems
36. Purpose of a healthy body and Sum up

Practice/Activity sessions for Module 5:

1. Observing what contributes to harmony within the Self (feeling of relationship, harmony and co-existence)
2. Designing a health system for society that contributes to harmony at every level. The student also needs to work out how he/she can contribute in this system and process.

Textbooks:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. Professional Ethics and Human Values, Premvir Kapoor, Khanna Book Publishing, New Delhi, 2022.

References:

1. Charaka Samhita
2. The Complete Book of Ayurvedic Home Remedies, Vasant D. Lad
3. Quantum Healing-Exploring the frontiers of Mind-Body Medicine, Deepak Chopra
4. Ageless Body, Timeless Mind, Deepak Chopra
5. Jeevan Vidya EkParichay, A Nagraj
6. A Practical Guide to Holistic Health, Swami Rama
7. Ayurveda: The Science of Self-healing: A Practical Guide, Vasant D. Lad
8. PranayamRahasya, Swami Ramdev
9. Yog – Its Philosophy and Practice
10. The China Study, Thomas Campbell, T. Colin Campbell, 2006 (A Comprehensive Study of Nutrition, Implications for Diet, Weight Loss, And Long-term Health)

Documentaries and Videos

1. Forks over Knives
2. Plant Pure Nation
3. The Earthing Movie

Human Computer Interface	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CST	6	PCE	PCE-3	CIE-358T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the importance of good user interface design and usability engineering.
2.	To learn the technique to use keyboard keys, event recognition and prototype models.
3.	To equip with the knowledge of visual presentation, appropriate selection of content and colour, with dialog design.
4.	To understand the various design methodologies of interface and interaction models.

Course Outcomes (CO)

CO 1	Ability to understand the features and importance of good user interface design using usability engineering.
CO 2	Ability to implement keystroke features, speech and handwriting recognition and Prototype tools.
CO 3	Apply, adapt, and extend colour and content usage and dialog design.
CO 4	Ability to understand and analyse various user interface models and design issues.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT-I

Human Computer Interface - Human Computer Interface and Its Importance, Importance of User Interface - History of Human Computer Interface - Importance of Good Design - Benefits of Good Design - Principles of User Interface Design. Concept of Usability Engineering.

UNIT-II

Interaction Devices, Keyboard Keys, Function Keys, Pointing Devices, Speech Recognition, Handwriting Recognition, Speech Generation, Image Display, Video Display, Device Drivers, Techniques of Speech Recognition, Applications of Speech Recognition, Handwriting Recognition, Speech Generation. Prototypes in Human Computer Interface, Prototyping Tools, Wizard of OZ Technique

UNIT-III

Color and Content, color uses and limitations, content uses and limitations, Why Colors, Color Uses, Choosing Colors, Possible Problems with Colors, Page Title, Headings, Text, Messages, Error Messages, Icons. Formalism in Dialog Design, StateCharts, Petri Nets.

UNIT - IV

User Interface Design Process, User Interface Models, Design Methodologies, Cognitive Architecture, Object Oriented Modelling of User Interface Design, Designing an Interface, Process of Interaction Design.

Textbook(s):

1. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, “Human-Computer Interaction”, Pearson.

References:

1. Dr. Kavita Saini, Sanjay Saxena, Anirban Mukhopadhyay, Arup Chattopadhyay , “Human Computer Interface”, Vikas Publishing House.
2. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, Research Methods in HumanComputer Interaction, Wiley, 2010.

Human Computer Interface Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CST	6	PCE	PCE-3	CIE-358P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Human Computer Interface) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Software: FIGMA, Adobe XD

1. Study the evolution of Human Computer Interaction and usability engineering.
2. Design a system based on user- centred approach.
3. Understand the principles of good screen design by heuristic evaluation.
4. Calculate the screen complexity of existing Graphical User Interface and redesign to minimize it.
5. Create prototype and add interactions to it.
6. Design Cascading Menu and Pop-up Menu for Graphical System.
7. Design appropriate icons to resemble their use in a GUI.
8. Design a Low Fi Wireframe for Homepage and Search Result page of a website.
9. Study and implement Lemieux' practical guide to colour mixing and colour combinations in painting and Newton's colour wheel, along with the use of colour in branding and marketing.
10. Study and implement Nielsen’s 10 Principles for Interaction Design.

Human Economics	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	UHV-OAE	UHV-OAE-5	OUHV-467

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce students to the basic ideas about economic prosperity, which they can apply in their day-to-day life as responsible members of their family and as responsible citizens
2.	To understand and evaluate the role of economics in societal development
3.	To help students develop sensitivity to the economic issues in the development of the nation and commitment to participate in resolving them
4.	To equip the students with basic economic measures, tools and techniques to analyse economic issues

Course Outcomes (CO)

CO 1	Analyze the basic concepts in human economics and evaluate the efforts made to understand human economics
CO 2	Explain the sustainable & mutually fulfilling production & management systems and Evaluate the role of economics in societal development
CO 3	Compare the various theories in economics in the tradition and modern era
CO 4	Appraise the concepts and notions proposed in economics and see the way forward

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	3	1	1	-	1
CO 2	-	-	-	-	-	3	-	3	1	1	-	1
CO 3	-	-	-	-	-	3	-	3	1	1	-	1
CO 4	-	-	-	-	-	3	-	3	1	1	-	1

UNIT-I

Introduction to Human Economics: Human economics, Vision for universal human order and role of economics therein, Human needs and their fulfillment, three types of economics, Efforts in the tradition and modern era to understand human economics, Role of economics in day to day life

UNIT-II

Sustainable Ways of Wealth Generation and Sharing: Meaning of Wealth, Sustainable ways of wealth generation (production), Preservation and right utilization of wealth, Feeling of prosperity, Marketplace, Distribution and exchange, Value and price, Measures, tools and techniques for production and management
Role of Economics in Societal Development: Role of different societal orders in Societal Development and their

interdependence, Wealth and Economics Contributing to overall societal order- certainly not contradicting it

UNIT-III

Concepts in Economics in the Tradition and Modern Era: Concepts in Economics in the Indian and Western tradition, Theories of Economics in the modern era, Placement of various issues addressed in economics (demand and supply, price determination, national income, money and banking, budgeting, economic reforms, etc.)

UNIT - IV

Appraisal of the Concepts in Economics and the Way Forward: Evaluation of present day notion of Human Needs, Natural Resources, Wealth, economics etc., Inherent contradictions and dilemmas in modern day management, Way forward.

Textbook(s):

1. Sociology & Economics for Engineers, Premvir Kapoor, Khanna Publishing House, New Delhi, 2018.

References:

1. Schumacher, E.F. (1973) Small Is Beautiful: A Study of Economics as if People Mattered.London: Blond & Briggs.
2. Club of Rome – Limits to Growth, https://www.clubofrome.org/publication/the-limits-to-growth/
3. Dierksmeier, C. and M. Pirson(2009)Oikonomia and Chrematistike: Learning from Aristotle about the Future of Management.Journal of Business Ethics, 88(3): 417-430.
4. GaurRR, Asthana R and BagariaGP (2019)A Foundation Course in Human Values and Professional Ethics. Textbook and Teachers' Manual. New Delhi: Excel Books. India, ISBN 978-93-87034-47-1
5. Professional Ethics and Human Values, Premvir Kapoor, Khanna Book Publishing, New Delhi, 2022.
6. Introductory Microeconomics, Textbook for Class XII (2021-22), Published by NCERT
7. Macroeconomics, Textbook in Sociology for Class XII (2021-22), Published by NCERT
8. Illich, I. (1974) Energy and Equity. Worcester and London: The Trinity Press. UK.
9. Julien-François Gerber and Rajeswari S. Raina (eds.). 2018. Post-Growth Thinking in India: Towards Sustainable Egalitarian Alternatives, Orient Blackswan: New Delhi, ISBN: 9789352873937
10. Kumarappa, J.C. (1946) Economy of Permanence. Varanasi: SarvaSevaSanghPrakashan. India
11. Nagraj, A. (2001) AvartansheelArthshastra (Cyclical, Mutually Enriching Economics).Divya Path Sansthan, Amarkantak, India.

Human Machine Interface for Microgrids	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	MT-EAE	MT-EAE-4	MT-421T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge of the microgrid
2.	To impart the basic knowledge of Human machine interface
3.	To impart knowledge of the various distributed energy resources
4.	To impart knowledge of the working of HMI for micro grid

Course Outcomes (CO)

CO 1	Ability to understand and use of microgrid & distribution generation.
CO 2	Ability to understand HMI hardware and to design Human_Automaion Interaction
CO 3	Understand the operations of various renewable energy systems
CO 4	Understand design of Human and Machine Multi-Agent systems and Cooperation between Humans and Machines.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	1	1	1	2	2	2	2
CO 2	3	3	3	3	3	1	1	1	1	1	2	2
CO 3	3	3	3	3	3	1	2	1	2	1	2	2
CO 4	3	3	3	3	3	1	1	1	1	2	2	2

UNIT-I

Microgrid: Concept**,** requirements and applications, Microgrid formation, Distributed generation, Active distribution network, Microgrid configuration, Interconnections, Technical and Economic advantages. Challenges in Microgrid development.

UNIT-II

Human Machine Interface: Hardware components, Description techniques for human machine Interfaces: Model-based approaches for the design and evaluation of dependable usable Interactive systems, designing human automation interaction, effect of Age in HMI, Error on flight Deck: Interfaces, Organizations and culture.

UNIT-III

Distributed Energy Resources: Solar photovoltaic (PV) systems: Types of PV cell, plastic & organic solar cells, thin film solar cells, Working and operational constraints. Wind energy conversion systems (WECS): Variable speed wind generators, Wind turbine operating systems and their features & limitations, Small-scale hydroelectric power generation, fuel cells, micro turbines, Captive power plants, Energy storage devices, Integration of renewable energy sources.

UNIT-IV

Protection & Control Of Microgrid using HMI: Communication trends, Issues of interconnection, Distributed control system (DCS), Sub-station communication standardization, control architecture, Communication devices, Human–agent interaction, Analysis in the design of human and machine Multi-Agent systems, Authority and cooperation between humans and machines, Eye tracking from a Human Factors Perspective. Protection system, Management and operational issues of a Microgrid, Dynamic interactions of Microgrid with main grid.

Textbook(s):

1. S. Chowdhury, S.P. Chowdhury and P. Crossley, “Microgrids and Active Distribution Networks”, The Institution of Engineering and Technology, 2009.
2. Guy A. Boy, “The Handbook of Human-Machine Interaction (A Human-Centered Design Approach), 1st Edition, CRC Press.

References:

1. Stuart Borlase, “Smart Grids (Power Engineering)”, CRC Press.
2. Ali Keyhani, Mohammad N. Marwali, Min Dai, “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley.

Human Machine Interface for Microgrids Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	MT-EAE	MT-EAE-4	MT-421P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Human Machine Interface for Microgrids) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Simulation of basic Demand Side Management (DSM) technique for load management in microgrid.
2. To determine open-circuit voltage & short-circuit current characteristics of solar cell.
3. To obtain voltage and current characteristics of solar cells in a) Series combination b) Parallel combination.
4. Simulation of Maximum Power Point Tracking (MPPT) system for Photovoltaic (PV).
5. Simulation of real time data monitoring and logging for a solar power system.
6. To perform the operation of Wind energy conversion system and draw relevant characteristics curves.
7. To study the hardware component of a HMI and their physical verification.
8. To perform the operation of a renewable energy system using HMI.
9. To study the power flow in a bidirectional converter.
10. To build and test a solar powered DC microgrid.

Human Sociology	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	UHV-OAE	UHV-OAE-4B	OUHV-465

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce students to the basic concepts of sociology that would enable them to observe, interpret and relate to social life
2.	To explain the goals of societal institutions and their role in building a human society
3.	To develop an understanding of an equitable and just society and appreciate the various efforts for it in India and the rest of the world
4.	To generate interest, commitment and to make effort for becoming responsible citizens

Course Outcomes (CO)

CO 1	Evaluate the efforts made to understand human sociology and explain the goals of societal institutions and their role in building a human society
CO 2	Evaluate the role of individuals in setting up the tradition of humane culture and civilization
CO 3	Compare the various theories in sociology in the tradition and modern era
CO 4	Appraise the concepts proposed in sociology and formulate the way forward

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	3	1	1	-	1
CO 2	-	-	-	-	-	3	-	3	1	1	-	1
CO 3	-	-	-	-	-	3	-	3	1	1	-	1
CO 4	-	-	-	-	-	3	-	3	1	1	-	1

UNIT-I

Introduction to Human Sociology: Human Sociology, Vision for humane society, Dimensions of a society, Efforts in the tradition and modern era to understand human sociology, Role of sociology in day to day life
Societal Institutions, their Goals and Interdependence: Societal Institutions and their Goals, Types of social institutions, Relatedness and interdependence of social institutions, Culture and Civilisation, Complimentarity and opposition, Effort for mutual development, Social organisations, NGOs and GOs

UNIT-II

Preparing Individuals for the Tradition of Humane Culture and Civilisation: Social efforts for development of individual Sanskar (pre-birth to last rites)- both at the level of consciousness as well as its expressions in behaviour (role of culture and civilisation), Individual and collective Behaviour at the family and societal level givingrise to culture in the society, Basis for successful working of the social institutions, Preservation and enrichment of culture, Work and Service (seva), Agencies of socialisation

UNIT-III

Concepts in Sociology in the Tradition and Modern Era: Concepts in Sociology in the Indian and Western tradition, Theories of Sociology in the modern era, Placement of various issues addressed in sociology (social inequality, colonialism, nationalism, class and community, social movements, rural-urban linkages and divisions, caste system, tribal communities etc.)

UNIT - IV

Appraisal of the Concepts in Sociology and the Way Forward: A comparative study of different concepts proposed in sociology and the way forward, Role of students in a human society towards Nation building

Textbook(s):

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. Sociology & Economics for Engineers, Premvir Kapoor, Khanna Publishing House, New Delhi, 2018.

References:

1. Professional Ethics and Human Values, Premvir Kapoor, Khanna Book Publishing, New Delhi, 2022.
2. Indian Society, Textbook in Sociology for Class XII (2021-22), Published by NCERT
3. Social Change and Developmentin India, Textbook in Sociology for Class XII (2021-22), Published by NCERT
4. Hind Swaraj or, Indian home rule Mohandas K. Gandhi, 1909.
5. Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur (1990), Commonwealth Publishers, New Delhi
6. VyavaharvadiSamajshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
7. Integral Humanism, Deendayal Upadhyaya, 1965.
8. LohiyaKeVichar, Lok Bharti, RammanoharLohiya, 2008.
9. Human Society, Kingsley Davis, 1949.
10. VyavahatmakJanvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
11. The Communist Manifesto, Karl Marx, 1848.
12. Toward a True Kinship of Faiths: How the World's Religions Can Come Together Dalai Lama XIV, 2011.

Human Values and Madhyasth Darshan	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	UHV-OAE	UHV-OAE-3A	OUHV-457

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To help students understand the basic principles of Madhyasth Darshan
2.	To help students understand the existential realities including the human existence through Madhyasth Darshan
3.	To help them to see the participation of human beings in the nature/ existential realities (i.e. human values) and therefore the human conduct through each one of them
4.	To help students apply this understanding to make their living better at different levels- individual, family, society and nature

Course Outcomes (CO)

CO 1	Analyze the basic concepts of Madhyasth Darshan
CO 2	Analyze the human being, the needs and activities of human being through Madhyasth Darshan
CO 3	Formulate the role of human being in the entire existence, thus getting clarity about values at all levels of living and human conduct based on Madhyasth Darshan
CO 4	Model the foundation of human society and human tradition based on Madhyasth Darshan

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	3	1	1	-	1
CO 2	-	-	-	-	-	3	-	3	1	1	-	1
CO 3	-	-	-	-	-	3	-	3	1	1	-	1
CO 4	-	-	-	-	-	3	-	3	1	1	-	1

UNIT-I

Introduction to Madhyasth Darshan and its Basics: Need to study Madhyasth Darshan; introduction, basic formulations of the darshan; the complete expanse of study and the natural outcome of living according to the darshan.

Submergence of Nature in Space: The ever-present existence in the form of nature submerged in space; nature classified into two categories – material and consciousness, and four orders; the form, property, natural characteristic and self-organisation of the four orders, General direction and process of evolution in the nature/ existence.

UNIT-II

Human Being as an indivisible part of Nature: Human being as an indivisible part of nature; various types (five classes) of human beings; human being in the combination of self and body; purpose of self as realization, prosperity for the body; need of behavior and work for attaining the goals of realization and prosperity.

UNIT-III

Fulfillment of human goal of realization: Following natural, social and psychological principles for actualizing the human goal; form of conducive society and order for such practices, study process- achieving realization through self-study and practice while living in such a society (social order).

UNIT - IV

Human Conduct based on Madhyasth Darshan: Description of such a realized self, continuity of happiness, peace, satisfaction and bliss through realization, conduct of a realized human being. Possibility of finding solutions to present day problems (such as inequality of rich and poor, man and woman etc.) in the light of it.

Textbook(s):
1. Nagraj, A., “Manav Vyavahar Darshan”, Jeevan Vidya Prakashan, 3rd edition, 2003.

References:

1. Nagraj, A., “Vyavaharvadi Samajshastra”, Jeevan Vidya Prakashan, 2nd edition, 2009.
2. Nagraj, A., “Avartanasheel Arthashastra”, Jeevan Vidya Prakashan, 1st edition, 1998.

Human Values in Buddh and Jain Darshan	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	UHV-OAE	UHV-OAE-3B	OUHV-459

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To help students understand the basic principles of Bauddh and Jain Darshan
2.	To help them see the participation of human beings in the nature/ existential realities (i.e. human values) and therefore the human conduct through each one of them
3.	To help students apply this understanding to make their living better at different levels- individual, family, society and nature
4.	To facilitate the students in applying this understanding in their profession and lead an ethical life

Course Outcomes (CO)

CO 1	Analyze the basic concepts of Bauddh and Jain Darshan
CO 2	Analyze the human being, the needs and activities of human being through Bauddh and Jain Darshan
CO 3	Formulate the role of human being in the entire existence, thus getting clarity about values at all levels of living and human conduct based on Bauddh and Jain Darshan
CO 4	Model the foundation of human society and human tradition based on Bauddh and Jain Darshan

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	3	1	1	-	1
CO 2	-	-	-	-	-	3	-	3	1	1	-	1
CO 3	-	-	-	-	-	3	-	3	1	1	-	1
CO 4	-	-	-	-	-	3	-	3	1	1	-	1

UNIT-I

Introduction to Bauddh and Jain Darshan: Need to study Bauddh and Jain Darshan; the origin of the two philosophies, their basic principles and scope for further reading.
Basic Principles of Bauddh Darshan: Law of impermanence (changability); Four noble truths; Eightfold path; Law of cause- action (pratitya-samutpaad). Definition of some salient words of Bauddh Darshan – nirvana, dhamma, tri- ratna(Bauddh, Dharma and Sangh), pragya, karma, parmi, ashta-kalap, trishna, shad-ayatan, samvedana, vipassana, anitya, maitri, brham-vihaar, tathagata, arahant.

UNIT-II

Purpose and Program for a Human Being based on Bauddh Darshan: The purpose and program of a human being living on the basis of it, clarity and practice of human values and human conduct, the natural outcome of such a program on society, nature and tradition.

Purpose-freedom from suffering, nirvana; root of suffering- vikaar – raga, dvesha and moha, Progam – various steps of meditation for attaining knowledge; shamath and vipassana; sheel-samadhi-pragya; practice of equanimity (samatva), eightfold path(Ashtang Marg); combination of understanding and practice.

UNIT-III

Basic Principles of Jain Darshan: Basic realities – description of nine elements in existence (jeev, ajeev, bandh, punya, paap, aashrav, samvar, nirjara, moksha), 6 dravya of lok – dharma, adhrma, akash, kaal, pudgal, jeev; tri-lakshan, various types of pragya, various stages of realisation; samyak-gyan, samyak-darshan, samyak-charitra, syadvaad, anekantavaad, naya- nishchaya and vyavahar, karma-phal siddhanta

Definition of some salient words of Jain Darshan –arhant, jin, tirthankara, panch-parameshthi, atma, pramaan, kaal, pudgal, paramanu, kashay, leshya.

UNIT - IV

Purpose and Program for a Human Being based on Jain Darshan: The purpose and program of a human being living on the basis of it, clarity and practice of human values and human conduct, the natural outcome of such a program on society, nature and tradition, possibility of finding solutions to present day problems in the light of it.

Purpose (goal) - moksha, Program- following mahavrat, anuvrat, 10 lakshan dharma; samyak darshan-gyan-charitra. Commonality with Bauddh Darshan

Textbook(s):

1. Chattejee, S.G. and Datta, D.M., “An Introduction to Indian Philosophy”, University of Calcutta Press, 1960.

References:

1. “Dhammapad”, Vipassana Research Institute, 2001.
2. Drukpa, G., “Musings from the Heart”, Drukpa Publications Private Ltd, 2018.
3. Jyot, “Ekcheezmilegi Wonderful”, A Film Directed by Jyot Foundation, 2013.
4. Goenka, S.N., “The Discourse Summaries”, Vipassana Research Institute, 1987.
5. Madhavacharya, “Sarva-darshan Samgraha”, Chaukhambha Vidya Bhavan, Varanasi, 1984.
6. Varni, J., “Samansuttam”, SarvaSeva Sangh Prakashan, Varanasi, 7th Edition, 2010.
7. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers’ Manual), R. R. Gaur, R. Asthana, G. P. Bagaria (2019 Second Revised Edition), Excel Books, New Delhi [ISBN 978-93-87034-47-1].
8. Professional Ethics and Human Values, Premvir Kapoor, Khanna Book Publishing, New Delhi, 2022.

Human Values in Vedic Darshan (Sankhya, Yoga and Vedanta)	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	UHV-OAE	UHV-OAE-3C	OUHV-461

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To help students understand the basic principles of the Vedic Darśana covering Nyāya-Vaiśeṣika, Sāṃkhya-Yoga, and Mīmāṃsā-Vedanta Darśana and Upaniṣads
2.	To help them to see the participation of human beings in the nature/ existential realities (i.e. human values) and therefore the human conduct through each one of them
3.	To help students apply this understanding to make their living better at different levels- individual, family, society and nature
4.	To facilitate the students in applying this understanding in their profession and lead an ethical life

Course Outcomes (CO)

CO 1	Analyze the basic concepts of the Vedic Darśana - Nyāya-Vaiśeṣika, Sāṃkhya-Yoga, Mīmāṃsā-Vedanta Darśana and Upaniṣads
CO 2	Analyze the human being, the needs and activities of human beings through Vedic Darśana.
CO 3	Formulate the role of human being in the entire existence, thus getting clarity about values at all levels of living and human conduct based on Vedic Darśana
CO 4	Model the foundation of human society and human tradition based on Vedic Darśana

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	3	1	1	-	1
CO 2	-	-	-	-	-	3	-	3	1	1	-	1
CO 3	-	-	-	-	-	3	-	3	1	1	-	1
CO 4	-	-	-	-	-	3	-	3	1	1	-	1

UNIT-I

Introduction to Vedic Darśana: Need to study Nyāya-Vaiśeṣika, Sāṃkhya-Yoga, Mīmāṃsā-Vedanta Darśana and Upaniṣads; the origin of these philosophies, their basic principles and scope for further reading.
YogaDarśana: Yoga Darśana- the steps of Aṣṭāṃga yoga (yama, niyama, āsana, prāṇāyāma, pratyāhāra, dhāraṇā, dhyāna and samādhi) and the challenges in following them, afflictions (kleṣa)- avidyā, asmitā, rāga, dveṣa, abhiniveṣa, different types of vṛttis (pramāṇa, viparyaya, vikalpa, nidrā, smṛti), the process of nirodha of vṛttis; maitri, karuṇā, muditā, upekṣā; description of yama, niyama, āsana and praṇayaama; kriyāyoga –tapa, svādhyāya and īśvara-praṇidhāna; different steps of samādhi, different types of saṃyama, vivekakhyāti, prajñā

UNIT-II

NyāyaDarśana: Introduction to NyāyaDarśana, 16 padārthas (pramāṇa, prameya, saṃśaya, prayojana, dṛṣṭānta, siddhānta, avayava, tarka, nirṇaya, vāda, jalpa, vitaṇḍā, hetuābhāsa, chala, jāti, nigrahasthāna) paṃcāvayavaprakriyā (pratijñā, hetu, udāharaṇna, upanaya, nigamana)
VaiśeṣikaDarśana: karma phala; mindful dāna; śucitā-aśucitā; reasons of rāga-dveśa, avidyā, sukha- Introduction to VaiśeṣikaDarśana, definition of Dharma, abhyudaya, niḥśreyasa; 6 padārthas (dravya, guṇa, karma, sāmānya, viśeśa, samvāya) – their definition, characteristics and relationship; nitya-anitya; cause-effect relationships; dṛṣṭa-adṛṣṭaduḥkha, etc. and how to get rid of them

UNIT-III

Upaniṣad and Vedanta Darśana: Introduction to Upaniṣad and Vedanta Darśana; Īśopaniṣad – Idea of renouncement, Karma Yoga, balance of Vidyā-Avidyā and Prakṛti-Vikṛti; Tattirīyopaniṣad – Different names of the God and their meaning, parting message of Guru to the graduating student (Śikṣāvallī), Nature of Brahma and Prakṛti, Methods of Upāsanā; Nature of Ātmā, Description of existence, principle of karma-phala, description of paṃcakośa, nature of mukti, process and way to achieve it, antaḥkaraṇa-śuddhi, different nature of paramātmā/brahma, Īśvara, Four qualifications (Sādhana-catuṣṭaya)

UNIT - IV

SāṃkhyaDarśana: SāṃkhyaDarśana- Puruṣārtha, the nature of Puruṣa and Prakṛti, 24 elements of Prakṛti,bondage and salvation (liberation), the principle of satkāryavāda, triguṇātmakaprakṛti
Purpose and Program for a Human Being based on the Vedic Darśanas: The purpose and program of a human being living on the basis of the Vedic Darśana, clarity and practice of human values and human conduct, the natural outcome of such a program on society, nature and tradition. Vedic system of living in a society - PaṃcaMahāyajṇa, Varṇa System, Āśrama System, 16 Saṃskāras, etc.

Textbook(s):
1. Acharya Udayveer Shastri, Sankhya Darshanam (vidyodaya Bhashyam), GovindramHasanand
2. Acharya Rajveer Shastri, Patanjal Yog Darśana Bhashyam, Arsha Sahitya Prachar Trust
3. Acharya Udayveer Shastri, Brahma Sutra (Vedanta Darshanam), GovindramHasanand

References:
1. Krishna, I. (2010) The SāṃkhyaKarika, BharatiyaVidyaPrakashan, 4th edition
2. Madhavacharya, Sarva-DarshanaSamgraha, ChaukhambhaVidyabhavan, Varanasi.
3. Muller, F.M. (1928) The Six Systems of Indian Philosophy, London: Longmans Green and Co. Publication.
4. Maharaj O. () Patanjal Yogpradeep, Geeta press Gorakhpur
5. Vachaspati M. Sankhyatatvakaumudi, Motilal Banarasi Das Publication.
6. Shreemad Bhagwat Geeta
7. Shankaracharya, VivekChoodamani
8. Rajyoga, Swami Shivananda
9. The Nyāya Sutras of Gotama, Sinha, N. (Ed.). Motilal Banarsidass Publ. (1990).
10. Professional Ethics and Human Values, Premvir Kapoor, Khanna Book Publishing, New Delhi, 2022.11. Vedic Vision: Ancient Insights Into Modern Life, Satyavrata Siddhantalankar, Vijay Krishn Lakhanpal, 1999
12. Sanskar Chandrika, Dayananda Saraswati, and Satyavrata Siddhantalankar. Vijay KrishnLakhanpal, 1990.
13. THE TAITTIRIYA Upanishad, Achari, Sri Rama Ramanuja. (2013).
14. Vedic religion: The Taittiriya-Upanishad with the commentaries of Sankaracharya Suresvaracharya and Sayana (Vidyarana). Sastri, A. Mahadeva. (2016).
15. Taittiriyopanishad Sankara Bhashya With Hindi Translation Gita Press 1936.
16. Gautama's Nyāyasūtras: With Vātsyāyana-Bhāṣya. Jha, Ganganatha, ed. Oriental Book Agency, 1939.
17. Nyaya Darshnam, Acharya Udayveer Shastri, Vijaykumar Govindram Hasanand (2018)
18. Vaisheeshika Darshanam, Acharya Udayveer Shastri, Vijaykumar Govindram Hasanand (2017)
19. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Asthana, G. P. Bagaria (2019 Second Revised Edition), Excel Books, New Delhi [ISBN 978-93-87034-47-1].

Hydraulics and Pneumatics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-2	ICE-320T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To expose the students to pneumatic and hydraulic system and their applications
2.	To impart knowledge on pneumatic and hydraulic actuators and valves
3.	To expose the students on the basic pneumatic circuit design
4.	To impart knowledge on pneumatic control and its system

Course Outcomes (CO)

CO 1	Ability to understand the basic parts of the pneumatic and hydraulic system, pneumatic and electrical controllers, converters and their applications
CO 2	Ability to apply fundamental concepts of Pneumatic and Hydraulic systems to develop pneumatic and hydraulic system applications
CO 3	Ability to analyze the piping and instrumentation diagrams used in process industry and pneumatic and hydraulic system for preventive maintenance and troubleshooting.
CO 4	Ability to design a hydraulic and pneumatic circuit

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	-	-	-	-	-	-	2	-	3
CO 2	3	3	2	-	-	2	-	-	2	2	-	3
CO 3	3	3	2	3	-	2	-	-	2	3	2	3
CO 4	3	3	3	3	-	2	2	2	2	3	2	3

UNIT I

Pneumatic and Hydraulic System Components

Introduction: Basic requirement for Pneumatic System, Components of pneumatic system: Types of air compressors, air treatment stages, pressure regulation (FRL unit), Introduction to hydraulic system, components of hydraulic system, Types of pumps, comparison of pneumatic & hydraulic system.

UNIT II

Control Valves and Actuators

Control valves- types of control valves, classification of control valves, Directional Control Valves-actuators, cylinders valve positioner, piston & motor actuators, electro pneumatic actuators, hydraulic actuators.

UNIT III

Basic Pneumatic Circuits

Basic pneumatic circuits, Timing & sequence diagram: Sequence operation of hydraulic and pneumatic cylinders and motors; Electro Pneumatic & Electro Hydraulic Systems design, Relay Logic circuits, Feedback control systems, pneumatic telemetry systems: Pneumatic temperature & pressure transmitters their working and applications, electrical control in pneumatic circuit.

UNIT IV

Pneumatic and Hydraulic Converters and Controllers

Pneumatic Relay, Flapper nozzle assembly, Pneumatic amplifier, Pneumatic & Hydraulic Controllers (P, PI, PID), P&ID diagrams, converters: I/P, P/I, Maintenance & troubleshooting of pneumatic & hydraulic systems. Introduction to Mechatronic Systems & their applications

Text Books:

1. C. D. Johnson , "Process Control Instrumentation Technology", PHI, 2002
2. Andrew Parr, "Pneumatic & Hydraulic", PHI, 1999.

References:

1. D. Considine, "Process Industrial Instruments & Control Handbook", McGraw Hill, 1993.
2. B. G Liptak, "Instrument Engineers Handbook", Chilton Book Co.
3. S. R. Majumdar, "Pneumatic system", Tata McGraw-Hill Education

Hydraulics and Pneumatics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-2	ICE-320P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Hydraulics and Pneumatics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Operating single acting cylinder and double acting cylinder using 3/2 push button valve.
2. Operating double acting cylinder using 5/2 pilot operated valve.
3. Operating double acting hydraulic cylinder using hydraulic 4/3 and 4/2 valve.
4. Operating single and double acting cylinder using special purpose valve – Time delay valve, Quick exhaust valve, Twin pressure valve, Check valve etc.
5. Write a program for sequencing of two cylinders using pneumatic components only.
6. Write a program for sequencing of two cylinders using electro pneumatic components.
7. Sequencing of multiple double acting piston cylinder arrangement using electro-pneumatic components.
8. PLC programming- Operate single acting cylinder and double acting cylinder using push button and direction Control valve. Use push buttons in the AND, OR and Latching conditions.
9. Write a PLC program for to and fro motion of single acting cylinder and double acting cylinder automatically.
10. Write a PLC program for sequencing of three cylinders in following sequence

    A+B+C+ A-B+C+ A- B-C+ A-B-C-

IC Engines and Gas Turbines	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-1	MEE-312T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the students about basic knowledge of components and working principles of different types of engines and turbines.
2.	To understand the basic principles of IC Engines and To know about different components in IC Engine.
3.	To know the basics of power generation in IC Engine. To analyse the combustion process in SI and CI engine. To understand and evaluate the auxiliary system in IC engine such as supercharger/ turbocharger.
4.	To understand the principles of compressors and turbines. To teach them principles of gas dynamics and jet propulsion.

Course Outcomes (CO)

CO 1	Understand the working principle of engines and fuel system in SI and CI Engine.
CO 2	Explain the combustion phenomenon in SI and CI engines.
CO 3	Explain the performance parameters for IC Engines, Engine Testing, Supercharging, Lubrication and Engine Cooling.
CO 4	Explain the concept of Gas Turbine and Gas Turbine Cycles for Aircraft Propulsion.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	1	2	2	-	2	-	-	2
CO 2	3	3	3	3	-	3	2	-	2	-	-	2
CO 3	3	3	3	3	-	3	2	-	2	-	-	2
CO 4	3	3	3	2	-	3	2	-	2	-	-	2

UNIT- I

Introduction: Basic engine components and nomenclature, Classification of engines, The working principle of engines, Comparison of 2-stroke and 4-stroke engines; CI, and SI Engines, Ideal and actual working cycles and their analysis, valve and port timing diagram.

Fuel system in SI and CI Engine and Automotive Fuels: Carburetion- working principles, chemically correct air-fuel ratio and load variation, compensating devices, venture and jet dimension calculation, modern fuel induction system, multi-point fuel injection system, fuel injection: common rail direct injection, Petroleum based fuels and their properties, knock rating of engine, fuels, necessity of alternative fuels, LPG, CNG, producer gas, biogas, H2, biodiesel and alcohols.

UNIT- II

Combustion Phenomenon in SI engines: Principles of combustion in SI engine, effect of engines and operating variables on ignition delay & flame propagation, Stages of Combustion, combustion chamber for SI engines, cycle to cycle variation, pre-ignition, abnormal combustion, theory of detonation, effect of engine and operating variables on detonation.
Combustion phenomenon in CI engines: Principles of combustion in CI engine, delay period, variables affecting, delay period, diesel knock, methods of controlling diesel knock, combustion process & combustion chambers for CI engines.

UNIT- III

Performance parameters for IC Engines: Engine Power, Engine Efficiencies, Performance Characteristics, Variables Effecting Performance Characteristics, Methods of Improving Engine Performance, Heat Balance.
Engine Testing, Supercharging, Lubrication and Engine Cooling: Engine performance and testing, measurement of power, supercharging limits of SI &CI engines methods of supercharging, superchargers, turbo charging, lubrication principles, function of lubricating system, properties of lubricating oil, additives, cooling system, air cooling, water cooling.

UNIT- IV

Gas Turbines: Introduction to gas turbines, simple open and close cycle gas turbine, efficiency and specific output of simple cycle, effects of regeneration, re-heating and inter-cooling on efficiency and work output, effect of operating variables on thermal efficiency, air rate, work ratio; water injection, Advantages and disadvantages of gas turbine; gas turbine components, performance and application of gas turbine, Combined cycle and cogeneration.
Gas Turbine Cycles for Aircraft Propulsion: Criteria of performance, Intake and propelling nozzle efficiencies, Simple Turbojet Cycle, The turbofan engine The turboprop engine, Thrust augmentation, Gas turbine combustion systems, Gas Turbine Emissions.

Textbook(s):
1. V. Ganesan, “Internal Combustion Engines”, Tata McGraw-Hill.
2. H. Cohen, GFC Rogers, HIH Saravanamuttoo, “Gas Turbine Theory”, Addison Wesley Longman Limited.

Reference Books:
1. John B Heywood, “Internal Combustion Engine Fundamentals”, Tata McGraw-Hill.
2. K. K. Ramalingam, “Internal Combustion Engines” 2nd ed, SCITECH Publications.
3. E.T. Vincent “Theory & Design of Gas Turbine and Jet Engine” Tata McGraw Hill.
4. Gas Turbine Principles and Practice, Cox Newnes.

IC Engines and Gas Turbines Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-1	MEE-312P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (IC Engines and Gas Turbines) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To draw the Valve Timing Diagram using the Cut Section CI Engine Model.
2. To draw the Valve Timing Diagram using the Cut Section SI Engine Model.
3. To make a trial on single cylinder 4-stroke Diesel Engine to calculate B.H.P., S.F.C. and to draw its characteristics curves.
4. To make a trial on 4-stroke high-speed diesel engine and to draw its Heat Balance Sheet.
5. To make a trial on SI Engine at constant speed to calculate B.H.P., S.F.C., Thermal efficiency and to draw its characteristic Curves.
6. To make Morse Test to calculate IHP of the multi cylinder petrol engine and to determine its mechanical efficiency.
7. To Study Lubrication and cooling systems employed in various I. C. Engines in the Lab.
8. To Study Braking system of automobile in the lab.
9. To study a Carburetor.
10. To study (I) the Fuel Injection System of a C.I. Engine, (II) Battery Ignition system of a S.I. Engine.
11. To study multi Cylinder four strokes vertical Diesel Engine test RIG with Hydraulic Dynamometer.
12. To study the Gas Turbine Model.

Industrial and Optical Instrumentation	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	5	PC	PC	ICC-309

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To expose the students to various measurement techniques used for measuring industrial process variables
2.	To impart knowledge on signal conversion and conditioning methods for measurement of industrial variables
3.	To expose the students on the basics of optical sources and detectors, optical fiber and fiber optic sensors and industrial application of fiber optic sensors
4.	To impart knowledge on various spectroscopic instruments used in the analysis of materials

Course Outcomes (CO)

CO 1	Ability to understand various measurement techniques used for measuring industrial process variables
CO 2	Ability to apply knowledge of various types of transducers, optical and analytical instruments for industrial applications
CO 3	Ability to analyze the Optical sources and detectors and various types of measurement techniques for industrial applications
CO 4	Ability to design signal conditioning circuit for various sensors and transducers used for measurement of industrial variables

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	-	-	2	-	-	-	2	-	3
CO 2	3	3	2	2	-	2	-	-	2	2	-	3
CO 3	3	3	3	3	-	2	-	-	2	3	2	3
CO 4	3	3	3	3	-	2	-	2	2	3	2	3

UNIT I

Temperature Measurements: Introduction; Definitions, standards, unit systems, points calibration of thermometers, study of filled in system thermometer, bimetallic thermometers, 3 and 4 wire RTD, high temperature measurement techniques, Radiation fundamentals -Radiation methods of temperature measurement, Total radiation pyrometers, Optical pyrometers, Bolometers

Level Measurements: Introduction, level measurement- differential pressure method, Electrical types of level gauges using resistance, capacitance, nuclear radiation and ultrasonic sensors

UNIT II

Pressure Measurements: Introduction, Definition of absolute pressure, gauge pressure and vacuum, their relation and units of pressure, Non-Electric type pressure measurement: manometers: U-tube, well type, Elastic type pressure gauge: Bourdon tube, Diaphragm and Bellows, Electrical methods: elastic elements with LVDT, strain gauges, capacitive type transducers for pressure measurement, Measurement of vacuum: McLeod gauge, thermal conductivity gauges, Ionization gauge, Electrical pressure transmitter

Flow Measurements: Introduction, units of flow measurement, classification of flow meters, variable head flow meters- orifice plate, venturi tube and flow nozzle, variable area flow meters- Rotameter, Electro Magnetic flow meters and ultrasonic flow meters, turbine and open channel flow meters

UNIT III

Force and Torque Measurement: Electric balance - Different types of load cells - Hydraulic, Pneumatic, strain gauge, Piezoelectric load cells, Different methods of torque measurement- Types of dynamometers, Absorption dynamometer- Prony brake and rope brake dynamometer.

Chemical Composition measurements: pH measurement – principle, electrodes for pH measurements, pH meter and its calibration, Electrical conductivity measurement – Measuring circuit, Water and steam purity measurement using electrical conductivity

UNIT IV

Optical Instrumentation: Optical sources and detectors: LED, laser, photo-diode, light dependent resistor, square law detectors and their characteristics; interferometer: applications in metrology; Principle of Optical fiber, basics of fibre optic sensing, Types of optical fibers

UV-Visible spectrometers, Mass Spectrometer: Introduction, types of mass spectrometers, Quadrupole Mass spectrometer, Time of Flight Mass spectrometer

Textbooks:

1. Patranbis D, ”Principles of Industrial Instrumentation” , Tata McGraw Hill Pub., New Delhi (1991)
2. Khandpur R S, “Handbook of Analytical Instruments (7th reprint)”, Tata McGraw Hill, New Delhi (2000)
3. Djafar.K. Mynbaev, Lowell. Scheiner, Fiber-Optic Communications Technology, Pearson, 1st Edition, 2008.

References:

1. Ernest.O. Doebelin and Dhanesh. N. Manik, Doebelin’s Measurement Systems, McGraw Hill, 6th Ed, 2011.
2. Wilson and Hawkes, Opto Electronics - An Introduction, Prentice Hall, New Delhi, 3rd Edition, 2003.
3. Bela G. Liptak, Instrument Engineers' Handbook, Volume One: Process measurement and analysis, CRC Press, 4th Edition, 2003.

Industrial and Optical Instrumentation Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	5	PC	PC	ICC-357

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Industrial and Optical Instrumentation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Measurement of Temperature using RTD
2. Measurement of level using electrical sensor
3. Measurement of pressure using electrical method
4. Measurement of flow using variable area technique
5. Measurement of force using load cell
6. Measurement of pH using pH meter
7. Measurement of flow using variable flow technique
8. Measurement of vaccum pressure using simulation software
9. Measurement of high temperature based on radiation principle using simulation software
10. Measurement of pressure using pressure transducer level using simulation software

Industrial Automation and Control	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-2	ICE-318T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To present the importance of automation in manufacturing and process industries.
2.	To introduce the basic types, levels, strategies of automation
3.	To expose to various control techniques employed in process automation
4.	To expose to programming of PLC and SCADA and its interfacing

Course Outcomes (CO)

CO 1	Understand the basic types, levels, strategies of automation
CO 2	Apply PLC programming basics for developing simple application
CO 3	Analyse the PLC and SCADA system and its interfacing connection diagram
CO 4	Develop PLC ladder program and SCADA program for given industrial application

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	-	-	-	-	-	-	-	-	2	3
CO 2	3	2	2	2	3	-	-	-	2	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	3	3	3	2	2	-	3	3	3	3

Unit I

Industrial Automation Introduction: Need and benefits of industrial automation, automation hierarchy, basic components of automation system, description of each components, types of automation system- fixed, programmable, flexible, different systems for industrial automation- PLC, HMI, SCADA, DCS, Drives.

Unit II

Industrial Control Systems: Process, Discrete manufacturing industries-Continuous and Discrete Control systems-An overview of Computer process control- Fundamentals of automated assembly system, Distributed Control System: Overview of DCS, DCS software, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

Unit III

PLC Programming: Building blocks of PLC- CPU, Memory organization, I/O modules, fixed and modular PLC and their types, redundancy in PLC module, I/O module selection criteria, interfacing I/O devices, PLC I/O addressing, PLC programming language, relay, timer, counter, PLC based applications.

Unit IV

SCADA and its Interfacing with PLC: Introduction to SCADA, typical SCADA architecture/block diagram, interfacing of SCADA with PLC: typical connection diagram, object linking and embedding for process control architecture, steps in creating SCADA screen for simple object, Applications of SCADA.

Textbooks:

1. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies Non-Conventional Energy Sources, G.D.Rai, New Delhi.
2. Krishna Kant, “Computer - Based Industrial Control”, 2nd Edition, Prentice Hall, New Delhi, 2011.

References:

1. John W. Webb and Ronald A. Reis, “Programmable Logic Controllers: Principles and Applications”, 5th Edition, Prentice Hall Inc., New Jersey, 2003.
2. Programmable logic controller, Dunning, Delmar
3. Lukas M.P, “Distributed Control Systems”, Van Nostrand Reinhold Co., New York, 1986.

Industrial Automation and Control Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-2	ICE-318P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Industrial Automation and Control) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study hardware and software platforms for DCS
2. Simulate analog and digital function blocks
3. Study, understand and perform experiments on timers and counters
4. Logic implementation for traffic Control Application
5. Logic implementation for Bottle Filling Application
6. Tune PID controller for heat exchanger using DCS
7. Write a PLC program for controlling the temperature of a room using PT100 temperature sensor.
8. Write a PLC program to control the conveyor belt in manufacturing industry.
9. Write a PLC program to control the lift up to 5 floors.
10. Write a PLC ladder diagram program to switch ON the heater on pressing the ON push button and switch OFF automatically after 20minutes.

Industrial Control Electronics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	PED-EAE	PED-EAE-2	PED-318T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of electric heating and electric welding.
2.	To impart the knowledge of various power electronic converters and power supplies.
3.	To impart the knowledge of power compensation techniques, power factor improvement and harmonic control.
4.	To impart the knowledge of starting, braking and speed control of electric motors.

Course Outcomes (CO)

CO 1	Able to understand about electric heating and electric welding.
CO 2	Able to know about various power converters, their operation and applications.
CO 3	Able to understand power factor control techniques and harmonic reduction.
CO 4	Able to understand the speed control methods of DC and Induction motors.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	2	2	1	1	1	1	1
CO 2	3	3	3	3	2	2	2	1	1	1	1	1
CO 3	3	3	3	3	2	2	2	1	1	1	1	1
CO 4	3	3	3	3	2	2	2	1	1	1	1	1

UNIT-I

Electric Heating: Introduction to electric heating, Advantages of electric heating, Resistance heating, Temperature control of furnaces, Induction and dielectric heating.

Welding: Introduction and classification of resistance welding, Scheme for AC resistance welding, Ignitron contactor.

UNIT-II

Power Converters: Single phase half wave and full wave-controlled rectifiers, Three phase-controlled rectifiers, Semi converters, Dual converters, Step down & step-up DC-DC converters, AC Voltage controllers.

Power Supplies: Performance parameters of power supplies, Comparison of rectifier circuits, Filters, Regulated power supplies, Switching regulators.

UNIT-III

Power Factor Control: Static power compensation, Shunt reactive power compensator, Applications of static SCR controlled shunt compensators for load compensation, Power factor improvement and harmonic control of converter fed systems.

UNIT – IV

DC Drives: DC motor speed control, Methods of armature control, Field weakening, Semiconductor-controlled drives, Starting, Braking, Controlled rectifier fed dc drives, Chopper-controlled dc drives.

AC Drives: Three phase induction motor starting, braking, transient analysis, speed control from stator and rotor sides, Stator voltage control, Variable frequency control from voltage sources and current sources, Static rotor resistance control.

Textbook(s):

1. Biswanath Paul, “Industrial Electronics & Control”, PHI Learning Private Limited.
2. G. K. Dubey, “Power semiconductor-controlled Drives”, Prentice Hall Inc.

References:

1. M.H. Rashid “Power Electronics: Circuits, Devices & Applications”, Pearson Education.
2. G. K. Dubey, “Electric Drives”, Narosa Publishing House.
3. V. Subrahmanyam, “Electric Drives”, Tata McGraw-Hill.
4. B. K. Bose, “Modern Power Electronics and AC Drives”, PHI Publications.

Industrial Control Electronics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	PED-EAE	PED-EAE-2	PED-318P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Industrial Control Electronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To perform closed loop speed control of a four quadrant DC motor drive.
2. Study of single phase thyristorised full converter fed closed loop speed control of DC motor drive.
3. To simulate three phase fully controlled bridge rectifier with resistive and inductive loads and plot the load voltage and load current waveforms.
4. To study single phase AC voltage regulator with resistive and inductive load.
5. To control the speed of a DC motor using MOSFET based chopper and plot voltage v/s speed graph.
6. To study the MOSFET/IGBT based single phase bridge inverter.
7. To simulate the single-phase half wave-controlled rectifier with R and RL loads and plot the load voltage and load current waveforms.
8. To simulate the single-phase fully controlled rectifier and plot the load voltage and load current waveforms for inductive load.
9. To simulate the single-phase full wave AC voltage controller and plot the load voltage and load current waveforms for inductive load.
10. To compare the various braking methods and their range of braking for an induction motor.
11. To perform closed loop operation for constant v/f control of induction motor drive.
12. To study speed control of a three phase induction motor using a three phase voltage source inverter.

Industrial Data Communication	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-3	ICE-332T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To expose students to the basics of communication
2.	To create awareness about the OSI reference model.
3.	To acquaint the students with the different types of networks at various levels such as sensor level, device network and control network.
4.	To provide sufficient knowledge about the HART and to impart the fundamentals of foundation field bus.

Course Outcomes (CO)

CO 1	Explain the importance of modulation in communication.
CO 2	Examine the importance of OSI,TCP/IP model, various networking components
CO 3	Compare the different types of networks at various levels of field communication
CO 4	Establish Foundation fieldbus communication.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	-	-	-	2	-	-	2	-	3
CO 2	3	2	-	-	-	-	2	-	-	2	-	3
CO 3	3	3	2	2	-	-	3	-	2	3	2	3
CO 4	3	3	3	3	-	-	3	-	3	3	3	3

Unit I

Introduction to Communication System: Elements of communication system, Noise in communication Systems. Amplitude Modulation: Introduction, Time and frequency domain analysis, Frequency Modulation, Phase Modulation, Effect of noise in FM. Digital Modulation, PAM, PPM, PWM, FSK, QPSK.

Unit II

Introduction to Networks: OSI reference model, TCP/IP model, Transmission media, UTP-STP cable, co-axial cable, N/W components: Repeaters, bridge, hub, switch, router, gateways. Open Control N/W: RS232, RS422, EIA485 Modbus Structure, Implementation, GPIB. Proprietary Control N/W:Modbus Plus

Unit III

Networks at Different Levels

Sensor level network: AS-i, CAN, Devicenet, Interbus and LON
Device networks: Foundation Fieldbus H1-HART Profibus-PA
Control Network: BACnet, control-net, FF-HSE, Profibus-DP, Ethernet, TCP/IP

Unit IV

HART and Foundation Filedbus

HART: Introduction - Evolution of Signal standard - HART Communication protocol - Communication modes - HART Commands – HART and the OSI model. Field Bus: Introduction - General Field bus architecture - basic requirements of field bus standard - field bus topology - Interoperability - Interchangeability.

Fieldbus requirement, features, advantages, fieldbus components, types, architecture–physical, data link, application layer, system and network management, wiring, segment functionality checking, installation in safe and hazardous area and troubleshooting

Textbooks:

1. Deon Reynders, Steve Mackay, Edwin Wright, Practical Industrial Data Communications, 1st ed Elseveir, 2005.
2. Lawrence M Thompson, Industrial Data Communication, 2nd edition, 1997.

References:

1. Daniel T Miklovic, Real Time Control Networks, ISA 1993.
2. Bela G Liptak, Process Software and Digital Networks, 3rd edition, 2002.
3. Behrouz A. Forouzan, Data Communications and Networking, 2nd update edition, Tata McGraw Hill, 2000.

Industrial Data Communication Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-3	ICE-332P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Industrial Data Communication) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To Study the various modulation techniques (AM,FM,PWM)
2. To Study the networking components
3. To understand LAN
4. To study HART Protocol.
5. To calibrate various transmitters using HART
6. To study the components of Foundation Field Bus.
7. Configure the fieldbus wiring
8. Prepare the termination for Foundation Fieldbus
9. Install and Configure HART point-to-point communication Network
10. Connect HART handheld communicator to HART network

Industrial Electric Drives	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-3	ICE-334T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To make student capable in design and analyze various power converter circuits.
2.	To make student capable in analyzingthe operation, application and control of power conversion systems employing electric drive to cater to industrial needs
3.	To familiarize the operation principles, and design of starting, braking, and speed control arrangements for electric motors and their applications
4.	To provide strong foundation to asses performance of different industrial drives considering issues such as, energy efficiency, power quality, and practical viabilities.

Course Outcomes (CO)

CO 1	Remember the basics of stepper motor drives, and Industrial Drives
CO 2	Understand the basic operation of Electric Drives and used in industries.
CO 3	Analyse different schemes of speed control of DC motor.
CO 4	Design power electronics converter-controlled induction motor and synchronous motor drives, and to find the scope of automations in industries.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	-	-	-	-	3	-	-	-	-	3
CO 2	3	2	-	-	-	-	3	-	-	-	-	3
CO 3	3	3	-	-	-	-	3	3	3	-	-	3
CO 4	3	3	3	2	3	3	3	3	3	2	-	3

UNIT I

Electrical Drives, Advantages of Electrical Drives. Parts of Electrical Drives, Choice of Electrical Drives, Status of dc and ac Drives.

Dynamics of Electrical Drives: Types of loads, Fundamental Torque Equations, Energy Loss in Transient Operations, Steady State Stability, equalization of load, steady state stability, closed loop control of drives, selection of motor power rating, class of duty.

UNIT II

Direct Current Motor Drives: DC motor speed control, semiconductor controlled drives, starting, braking, transient analysis, controlled rectifier fed dc drives, chopper controlled dc drives, Single Phase Fully Controlled

Rectifier Control of dc Separately Excited Motor, Single Phase Half Controlled Rectifier Control of dc Separately Excited Motor, Three Phase Fully Controlled Rectifier Control of dc Separately Excited Motor, Multiquadrant Operation of dc Separately Excited Motor Fed Form Fully Controlled Rectifier.

UNIT III

Induction Motor Drives: Analysis and Performance of Three Phase Induction Motors, three phase induction motor starting, braking, transient analysis. speed Control Techniques-Stator Voltage Control, Variable Voltage Frequency Control from Voltage Sources, slip power recovery, static Scherbius and static Kramer drive.
Synchronous Motor Drives: Operation from fixed frequency supply-starting, Variable frequency control,Voltage source inverter fed synchronous motor drive, Brushless dc Motor Drives, Permanent Magnet ac (PMAC) Motor Drives.

UNIT IV

Stepper Motor Drives: Variable Reluctance, Permanent Magnet, Important Features of Stepper Motors, Torque Versus Stepping Rate Characteristics, Drive Circuits for Stepper Motor.
Industrial Drives: Textile Mills, Steel Rolling Mills, Cement mills, Paper mills, Cranes and Hoists, Machine Tools.

Textbooks:
1. G K Dubey, Principle of Electrical Drives, Narosa Publishing House
2. Vedam Subrahmanyam, Electrical Drives, Tata McGraw-Hill

References:
1. Bimal K Bose, “Modern Power Electronics and AC Drives”, PHI Publications.
2. Ned Mohan, “Electrical Machines and Drives” Wiley India Publication
3. R Krishnan, “Electrical Motor Drives” PHI Publications.
4. Bimal K Bose, “Power Electronics and Variable Frequency Drives” Wiley India Publication

Industrial Electric Drives Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-3	ICE-334P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Industrial Electric Drives) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Single phase thyristorised full converter fed closed loop speed control of DC motor drive.
2. Closed loop speed control of 4 quadrant DC motor drive.
3. Closed Loop constant v/f speed control of Induction motor drive.
4. Closed Loop speed control through static rotor resistance controlled slip ring Induction motor.
5. Chopper fed DC motor drive simulation using MATLAB
6. Speed control DC Motor using BJT-H bridge simulation using MATLAB.
7. To study speed control of single phase induction motor using micro controller.
8. To study closed loop speed control of brushless DC (BLDC) motors drive.
9. To study closed loop speed control of Switched Reluctance Motor (SRM) drive.
10. To study closed loop Angular Position Control of Stepper Motor drive.

Industrial Engineering	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME/MAE	5	PC	PC	MEC-309

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand Production System used in Industries and Apply various techniques for forecasting and Inventory control.
2.	To apply the concept of work study and method study and implement the knowledge of control charts for Quality for quality improvement.
3.	To understand the concept of network models and flow shop scheduling.
4.	To interpret the concept of Industrial relations, Industrial disputes, Dispute settlement machineries and factory legislation.

Course Outcomes (CO)

CO 1	Understand Production System used in Industries and Apply various techniques for forecasting and Inventory control.
CO 2	Perform work & Method Study and Implement the knowledge of control charts for Quality in quality improvement
CO 3	Apply the concept of network models and flow shop scheduling in production
CO 4	Interpret the concept of Industrial relations, Industrial disputes, Dispute settlement machineries and factory legislation.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	-	3	3	3	-	3	2	2
CO 2	3	2	2	2	-	3	3	3	-	3	3	2
CO 3	3	2	2	-	-	3	3	3	-	2	2	2
CO 4	3	2	3	-	-	3	3	3	-	2	2	2

UNIT-I

Introduction: Production functions, Management systems, production and productivity.
Plant Organization: Principles of organization, Organization structure-line and staff organization.
Production Planning & Control: Types of products, demand, demand forecasting, scheduling and control of scheduling production control. Inventory Models – Deterministic manufacturing and purchase models – quantity discounts Queueing models – Poisson arrival and exponential service times – Single server and multi-server modelSimulation –Monte Carlo simulation – Numerical problems.

UNIT-II

Method Study: Definition and concepts, method study procedures, symbols, advantages, Operation process chart, Flow process charts, Two hand process chart, Motion study, micro motion, SIMO charts, Systems Concepts, Classification analysis techniques, Principle of motion economics.
Work Measurement: Definition, objectives & techniques, Time study equipment, performance rating, allowances, standard time, work sampling, PMTS.
Quality Management- Quality, Control Charts, Taguchi Philosophy. Service Quality. Total Quality Management (TQM), Six Sigma,

UNIT – III

Network Models- Project Networks- CPM / PERT- Project Scheduling – crashing networks and cost considerations – Resource leveling and smoothing, shortest route problem, Game theory – mixed strategies – dominance property – 2 x n and m x 2 games.
Flow shop scheduling– Johnsons algorithm for n jobs and two machines and n jobs and m machines.

UNIT-IV

Trade Unionism- Definition, Origin, Objectives of Trade Unions. Methods of Trade unions. Size and finance ofIndian Trade unions-size, frequency distribution, factors responsible for the small size. Finance-sources ofincome, ways of improving finance
Industrial relations- Definition and main aspects. Industrial disputes and strikes. Collective bargaining. Labour Legislation- Labour management cooperation/worker 's participation in management. Factory legislation. International Labour Organization.

Textbook(s):
1. Ravi Shankar, Industrial Engg. & Management, Galgotia Publications
2. S.K. Sharma, Industrial Engg. & Operation Management, S.K. Kataria & Sons.

References:

1. Joseph S. Martinich, Production & Operation Management, John Wiley & Sons.
2. Harold T. Amrine, John A. Ritchey, Colin L. Moodie, Joseph F. Kmec, Manufacturing organization and Management, Pearson publication, 6th edition
3. S. Anil Kumar, N. Suresh, Production and operations management, New age International, 2nd Ed.
4. M. Mahajan, Industrial Engg. & Production Management, Dhanpat Rai & Co.
5. Srivastava, S.C. (2012), Industrial Relations and Labour Laws, Vikas Publishing
6. Telsang, M. (2006), Industrial Engineering and Production Management. S.Chand
7. Thukaram, Rao (2004), M.E. Industrial Management. Himalaya Publishing House.
8. Sinha, P.R.N., Sinha I.B. and ShekharS.M. (2013), Industrial Relations, Trade Unions and Labour Legislation. Pearson Education
9. Chary, S.N. (2012), Production and Operations Management. Tata McGraw Hill

Industrial Robotics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CADM-EAE	CADM-EAE-5	CADM-405T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Ability to analyze and design the motion for robotic system.
2.	Ability to acquire the knowledge on robot dynamics, various actuation mechanisms and gripper/tool selection criteria.
3.	Ability to understand the robot kinematics and differential motion through manipulator Jacobian.
4.	Ability to have knowledge about the different applications of robots in industries i.e. inspection techniques and material handling.

Course Outcomes (CO)

CO 1	Define and relate the relationship between mechanical structures of robot and predict their operational workspace.
CO 2	Estimate and compute the spatial transformation to demonstrate robot kinematics thorugh Jacobian matrix.
CO 3	Associate and apply knowledge of robot dynamics and outline the gripper/tool selection criteria.
CO 4	Recognize and summarize the applications of robot in industries i.e. inspection techniques and material handling.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	3	3	1	2	3
CO 2	3	3	3	3	3	3	3	3	3	1	2	3
CO 3	3	3	3	3	3	3	3	3	3	2	2	3
CO 4	3	3	3	3	3	3	3	3	3	3	2	3

UNIT-I

Fundamentals of robot technology: Robot anatomy. Work volume. Drive systems. Control systems and dynamic performance. Accuracy and repeatability. Sensors in robotics. Robot reference frames and coordinates and robot kinematics. Path control.

UNIT-II

Grippers for Robotics: Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper systems. Tools as end effectors. Robot and effector interface. Gripper selection and design. Introduction to robot languages. Mechanical and other types of grippers. Tools as end effectors. Robot and effector interface.

Sensors and Actuators for Robotics: Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control of a robot. Actuating systems, characteristics and types of actuators.

UNIT-III

Robot Kinematics: Homogeneous transformations, Matrix representation. Homogeneous transformations. Forward and inverse kinematics, Linear and Angular velocity of rigid link, Velocity along link, Manipulator Jacobian, Statics: Use of Jacobian.

Robot Dynamics: Differential motions of a frame. Jacobian, static force analysis, Lagrangian Mechanics, Lagrangian Formulation and numericals. Dynamics, Newton-Euler Recursive Algorithm, Simulation. Euler-Lagrange Equations of motion, Basics of Trajectory planning: Joint-space and Cartesian space trajectories.

UNIT - IV

Applications for Manufacturing: Flexible automation. Robot cell layouts. Machine interference. Other considerations in work cell design. Work cell control, interlocks. Robot cycle time analysis. Typical applications of robots in material transfer, machine loading/unloading; processing operations; assembly, and inspection.

Textbook(s):

1. Saeed B. Niku, "Introduction to Robotics analysis, Systems & Applications", Pearson, 2002.
2. R.K. Mittal, I.J. Nagrath, "Robotics & Control," Tata McGraw & Hills, 2005.

References:

1. Robert J. Schilling, "Fundamentals of Robotics, analysis & Control", Prentice Hall of India P. Ltd., 2002.
2. John J.Craig; "Introduction to Robotics Mechanics & Control", Pearson Education, 2004.
3. M. Murray, M., Li, Zexiang, Sastry, S.S., "A Mathematical Introduction to Robotic Manipulation," CRC Press, 1994.
4. Saha, S.K., Introduction to Robotics, 2nd Edition, McGraw-Hill Education, New Delhi, 2014.
5. S.R. Deb, "Robotic Technology and Flexible Automation", Tata McGraw Hill Publishing Co. Ltd., 2003.

Industrial Robotics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CADM-EAE	CADM-EAE-5	CADM-405P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Industrial Robotics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Robo Analyzer and WorkSpace 5.0
2. To make solids objects, modify them in Workspace 5.0 by importing a robot in workspace.
3. To create an auxiliary axis, robot mechanism and new robot in Workspace 5.0.
4. To Understand the Coordinate Frames and Transformations in Robo Analyzer.
5. To understand the robot forward kinematics in Robo Analyzer.
6. To understand the robot inverse kinematics in Robo Analyzer.
7. To understand the robot dynamics in Robo Analyzer.
8. To study various Virtual Models of Industrial Robots in Robo Analyzer.
9. To select the robot in virtual robot module and learn about joint level jogging of robots.
10. To select the robot in virtual robot module and learn about Cartesian controlled jogging of robots.
11. Write a program for joint trajectories of 2- link arm in SCILAB.

Industrial Tribology	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	DMS-EAE	DMS-EAE-1	DMS-312T
EAE	7	DT-EAE	DT-EAE-5	DT-427T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To be able to understand the Wear, friction processes and behaviour of metals & non-metals.
2.	To be able to understand the lubricants, lubrication and instruments for measuring lubricant's properties.
3.	To have a broad understanding of theory of lubrication and will be able to determine the performance parameters of hydrodynamic bearings, squeeze film bearings, Hydrostatic bearings.
4.	To be able to understand lubrication of rolling element bearings and to solve lubrication issues of industry.

Course Outcomes (CO)

CO 1	To understand the Wear, friction, and lubrication theories.
CO 2	To analyse the working of the wear, friction and lubricant properties measuring instruments.
CO 3	To determine the performance parameters of hydrodynamic bearings, squeeze film bearings, Hydrostatic bearings.
CO 4	To solve lubrication issues of industry.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	3	-	2	-	-	-	-	2	2
CO 2	3	3	3	3	-	2	-	-	-	-	2	2
CO 3	3	3	3	3	-	2	-	-	-	-	2	2
CO 4	3	3	3	3	-	2	-	-	-	3	2	2

UNIT I

Introduction: Friction, Wear and Lubrication, Engineering Surfaces – Properties and Measurement; Typical surface layers, Measurement Methods (Surface Profilometry, Optical Microscopy, Electron Microscopy), Surface Contact. Friction: Measurement Methods, Adhesion, Deformation, Friction Theories, Stick-slip, Rolling Friction, Friction of Metals, Friction of Non-Metallic Materials.

UNIT II

Wear: Types of Wear and its Mechanisms (Adhesive Wear, Abrasive Wear, Erosive Wear, Corrosive/Oxidative Wear, Fatigue Wear), Wear of Metals, Wear of Ceramics, Wear of Polymers, Wear Test (Pin on Disc Tribometer, Reciprocating Tribometer), Wear reduction methods. Lubricants and Lubrication: Lubricants and their types, Purpose of Lubrication, General Properties of Liquid Lubricants, Animal and Vegetable Oils, Mineral oils, Synthetic oils, Blended Oils, Lubricant Additives, Semi Solid Lubricant or Greases, Solid Lubricants, Testing of Lubricants (Viscometer, Four Ball Tester).

UNIT III

Lubrication regimes, Viscosity and the rheology of lubricants. Mechanics of Lubricant Film: Momentum equation, Navier-Stokes equation, Continuity equation, Energy equation, Reynolds equation, Lubricant flow, Shear forces, Reynolds equation for power law fluids. Hydrodynamic Lubrication: Hydrodynamic Thrust Pad Bearing (ILA and ISA), Hydrodynamic Journal Bearing (ILA & ISA), Finite Bearing, Mechanism of hydrodynamic instability, Dynamic characteristics of hydrodynamic journal bearings.

UNIT IV

Squeeze film Lubrication: Squeeze film of planer, non-planer, and finite surfaces. Hydrostatic Lubrication: Circular step externally pressurized thrust bearing (capillary and orifice compensated), Externally pressurized multi-recess journal bearing with short and large sill dimensions. Elasto-hydrodynamic Lubrication: Introduction, EHL under Line and Point contact, Different regimes in EHL contacts, Mixed Lubrication.

Textbook(s):
1. M. K Ghosh, B C Majumdar, Mihir Sarangi, “Theory of Lubrication”, Tata McGraw Hill, 1st ed, 2013.
2. Gwidon W. Stachowiak and Andrew W. Batchelor, “Engineering Tribology”, 4th Edition, 2014.

Reference(s):
1. M MKhonsari and E R Booser, Applied Tribology-Bearing Design and Lubrication, John Wiley & Sons, 3rd edition, 2017.
2. Bernard J. Hamrock, Steven R. Schmid, Bo O. Jacobson, “Fundamental of Fluid Film Lubrication” Boca Raton, CRC Press, 2nd Edition, 2004.

Industrial Tribology Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	DMS-EAE	DMS-EAE-1	DMS-312P
EAE	7	DT-EAE	DT-EAE-5	DT-427P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Industrial Tribology) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Analysis of Journal bearing system.
2. Methods to improve the wear and frictions.
3. Effect of lubricating oil blends on wear and friction behaviour
4. Study of properties of used lubricating oil.
5. Qualitative Analysis of Wear Debris using Ferrography.
6. Measurement of wear and coefficient of friction using Pin on Disk.
7. Viscosity Measurement of lubricant.
8. Flash Point and Fire Point Measurement of Lubricating oil
9. Water Content Measurement of Lubricating oil
10. Simulation and Modelling of Tribo Pairs
11. Software analysis of wear measurement
12. Optical analysis of wear surfaces.
13. Quantitative Analysis of Wear Particles Using Software
14. Experimental study on Nanolubricants.

Information Theory and Coding	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-CS	6	PC	PC	CS-310T
EAE	6	CS-EAE	CS-EAE-1	CS-310T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the efficient, error-free and secure delivery of information using binary streams.
2.	To have in-depth knowledge of error-control coding.
3.	To learn the process of encoding and decoding of digital data streams.
4.	To learn and apply the methods of generation of these codes and evaluate the performance of them over the noisy communication channels.

Course Outcomes (CO)

CO 1	To be able to understand the principles behind an efficient and secure transmission of digital data stream.
CO 2	To be able to demonstrate the knowledge of channel capacity and coding.
CO 3	To be able to implement the knowledge of encoding and decoding of digital data stream using Linear & Cyclic Codes.
CO 4	To be able to analyse the encoding and decoding of digital data stream using Convolutional codes.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	1	1	1	-	-	-	2	-	3	-	1
CO 2	3	3	3	3	1	1	-	2	-	2	-	2
CO 3	3	3	3	3	3	1	-	2	-	2	-	2
CO 4	3	3	3	3	3	1	-	2	-	2	-	2

UNIT-I

Introduction to Information Theory, Uncertainty & Information, Mutual Information, Average mutual information, Entropy, Relative Entropy, Extension of an Information source and Markov Source, Maximum Entropy Principle, Information measure of Continuous random Variables, Maximum Entropy Principle, Jensen's Inequality, Fano's Inequality, Introduction to lossless coding, Source coding theorem Block code and its properties, Instantaneous code and its properties, Kraft-Mcmillan equality, Huffman Coding, Shannon Fano coding, Lempel Ziv Algorithm.

UNIT-II

Introduction to discrete information channels, Equivocation and Mutual Information, Properties of different information channels, Reduction of information channels, Noiseless channel, Properties of Mutual information, Introduction to channel capacity, Shannon's Channel Coding theorem, Bandwidth – S/N Trade Off, Channel capacity theorem, Shannon Limit, Channel capacity for MIMO system

UNIT-III

Definition of Terms: Redundancy, code efficiency, systematic codes, Hamming distance, Hamming Weight, Hamming Bound, Types of Code: Parity check codes, Hamming codes, Linear Block Codes, Generator and Parity Check matrix, Syndrome decoding. Introduction to Cyclic Codes, Generation and detection of cyclic codes.

UNIT – IV

Burst Error Detecting and correcting codes, Convolutional codes, Code Tree, Trellis and State diagram, Decoding of convolutional codes, Viterbi's Algorithm, Sequential Decoding, Transfer function and Distance properties of convolutional codes, Bound on bit error rate, Coding Gain.

Textbook(s):
1. Ranjan Bose, "Information Theory Coding & Cryptography", 3rd Edition, McGraw Hill, 2017.
2. T.M. Cover and J.A Thomas, "Elements of Information Theory", 2nd Edition, Wiley India Pvt Ltd, 2013.

References:
1. Salvatore Gravano, Introduction to Error Control Codes, Oxford University Press, 2017.

Information Theory and Coding Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-CS	6	PC	PC	CS-310P
EAE	6	CS-EAE	CS-EAE-1	CS-310P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Information Theory and Coding) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a MATLAB program to compute entropy and mutual information for Noise Free and Noisy Channel.
2. Write a MATLAB program to compute entropy and mutual information for Error Free and Binary Symmetric Channel.
3. Write a MATLAB program to implement algorithm for generation and evaluation of Shannon- Fano coding and decoding. Compute entropy, average length and coding efficiency.
4. Write a MATLAB program to implement algorithm for generation and evaluation of Huffman coding and decoding. Compute entropy, average length and coding efficiency.
5. Write a MATLAB program to implement algorithm for generation and evaluation of Lempel Ziv dictionary method. Compute entropy, average length and coding efficiency.
6. Write a MATLAB program to implement the algorithm for encoding and decoding of Linear Block Code.
7. Write a MATLAB program to implement the algorithm for encoding and decoding of Cyclic Code.
8. Write a MATLAB program to implement the algorithm for generating Convolutional code by Code Tree.
9. Write a MATLAB program to implement the algorithm for generating Convolutional code by Code Trellis.
10. Write a MATLAB program to implement the algorithm for encoding and decoding of BCH Code.

Injection Moulding and Mould Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	CADM-EAE	CADM-EAE-2	CADM-304T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about different types of injection moulding machines and their components.
2.	To understand the constructional details and working features of injection molding process.
3.	To understand the process of mould design in injection moulding.
4.	To understand the applications of injection moulding.

Course Outcomes (CO)

CO 1	Understand the Injection Moulding process.
CO 2	Understand different constructional feature of Injection Machine Component.
CO 3	Set up the different parameters of Injection Moulding machine.
CO 4	Operate Injection Moulding Machine.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Introduction to Polymer processing, properties of polymers and their compounds, Injection Machine Operations, working of Injection moulding Machine, types of injection moulding machines, modern trends in injection moulding, gas assisted injection moulding, water injection technique, powder metal injection moulding. Types of Injection Machine by Injection Component, Different Terminologies

UNIT-II

Constructional features: Injection moulding machinery and systems, Hopper**,** Barrel, Bimetallic Barrel, Grooved Barrel, Screw and its Types, Plastification, melting zone, Standard Nozzle, Needle Type Nozzle, Nylon Nozzle, temperature distribution in nozzle, mould filling, Melt Mechanism, filling stage-control of filling process, control of metering process, jetting, heat transfer in mould cavity.

UNIT-III

Mould Design: - Key parameters for mould design- end use, part size, tooling cost, family moulds, Mould for injection moulding, mould parts, types of mould, feed system design , ejection mechanism, multi material Injection moulding, multi cavity moulds, hot and cold runner system, mould cooling, surface finish, venting, flash trimming dies and design consideration for injection moulds.

UNIT – IV

Auxiliaries for injection moulding machine, Hopper Dryers, Ovens, Hopper loaders, Granulators, Mould Temperature Regulators, Conveyors furnaces and Mould maintenance.
Defects in injection moulding, Bubbles and Voids, Crazing, Discoloration, Flashing, Flow Marks, Silver Streaks, Nozzle Drooling, Short Shots-Sink Marks, Sprue Sticking, Cavity Sticking, Surface Sticking, Warping, Weld Lines.

Textbook(s):
1. Irwin I. Rubin “Injection Moulding” Wiley publication.
2. Kazmer “Injection mould design engineering.” Hanser publications.

References:
1. Musa R. Kamal &Avram L. Isayev and Shih-Jung Liu “Injection Moulding. Technology and Fundamentals.”
2. Johannaber “Injection moulding machine.”
3. Bolur“A Guide to Injection Moulding of Plastics.”
4. John F Monk “Thermosetting Plastics: Moulding Materials and Processes by John Wiley and sons.

Injection Moulding and Mould Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	CADM-EAE	CADM-EAE-2	CADM-304P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Injection Moulding and Mould Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study and analyse the general injection molding process sequence on an injection molding machine.
2. To study and analyse the properties of injection molding compound and products.
3. To study and analyze of simple Plunger machine.
4. To study and analyze of different types of nozzle used in injection molding machine.
5. To study and analyse the measurement of temperature distribution in casting.
6. To organise an industrial visit to a plant using injection molding machine.
7. To study and analysis of heat transfer in injection molding.
8. To study and analyse the requirements of a sound mold design.
9. To study and analyse the working of hot and cold runner mold system.
10. To study and do analysis of microstructure of injection molded parts.
11. To study and analyse the feed system design in injection molding.
12. To study and compare horizontal and vertical injection molding machines.
13. To study construction and working of powder metal injection molding machine.
14. To study the working of various auxiliaries used in injection molding machine.
15. To study and analyze the causes for defects in Injection molding.
16. To do a case study on the installation cost of Injection molding machine.

Instrumentation Devices	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-3	ICE-326T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the fundamentals of measurements & Instrumentation
2.	Students should be capable of analyzing various indicating and sensing elements.
3.	Ability of student to apply CRO for measuring various quantities.
4.	Ability to remember design principles of various digital and recording Instruments.

Course Outcomes (CO)

CO 1	understand and explain the fundamentals of measurements & Instrumentation system.
CO 2	analyze various Indicating & sensing elements
CO 3	To apply CRO for measuring various quantities.
CO 4	To study design principles ofvarious digital and Recording Instruments.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	-	-	-	-	-	3	1	-	-	3
CO 2	3	3	-	-	-	-	2	3	3	-	-	3
CO 3	3	-	-	-	-	-	2	2	3	-	-	3
CO 4	3	-	3	-	-	-	2	2	1	-	-	3

Unit I

Fundamentals of Measurement: Need for Instrumentation, General Instrumentation system, static & dynamic characteristics of Measurement systems loading effects in instruments, Fundamentals of measurements, Types of errors, Calibration of Instruments.

Unit II

Analog Indicating Instruments & Sensing Elements: PMMC and Moving Iron Instruments, voltmeters, ammeters, ohmmeters Extension of range instruments, AC Indicating Instruments: EDM type Instruments, EDM Wattmeter, (single phase) and errors present,
Sensors: Velocity sensor, Temp sensor, Pressure sensor, humidity sensor

Unit III

Oscilloscpe: Introduction, General purpose oscilloscope block diagram, Digital storage oscilloscope: Basic block diagram, working, Cathode ray tube, horizontal and vertical deflection, vertical amplifier time base generator, horizontal amplifier, attenuator, delay line and specifications.

Unit IV

Digital & Recording Instruments: Introduction to digital Instruments, Advantage of digital Instruments over analog instruments, Digital multimeter, Digital Tachometer, Ultrasonic distance meter, Digital Thermometer Recording Instruments: classification of recorders, principle and working of strip chart and X-Y recorders, application of recorders, waveform generation methods: Function generator.

Textbooks:

1. Sawhney A.K., Electrical and Electronics Measurements and Instruments
2. W.D.Cooper & A.D. Helfrick, ‘Electronic Instrumentation and Measurement Techniques’, PHI, 4th Ed 1987.

References:

1. David Bell, ‘Electronic Instrumentation and Measurements’, PHI, 2 ed.
2. Anand M.M.S., ‘Electronic Instruments and Instrumentation Technology’, PHI, 2004.
3. Kalsi H.S., ‘Electronic Instrumentation’, TMH, 3rd Ed, 22010.
4. Measurement Systems Application & Design- E.O. Doeblin (4/e), Mc Graw-Hill, International, NY.

Instrumentation Devices Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-3	ICE-326P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Instrumentation Devices) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Loading effect of shunt or series connected instrument.
2. Measurement of power using wattmeter (single phase)
3. Measurement of power using energy meter (single phase)
4. To measure the response time of a relay using DSO.
5. Study of X-Y, Y-T recorders.
6. To measure unknown frequency by Z modulation.
7. Measurement of Voltage, phase and frequency using CRO
8. Calibration of Voltmeter & Ammeter.
9. Study of L.T and H.T panels
10. Study of modern energy meters.

Instrumentation System Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-5	ICE-413T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To familiarize with flow measurement and temperature measurement devices.
2.	To impart design knowledge of controller, control valve and transmitter.
3.	To obtain adequate knowledge of Electronic product design.
4.	To acquire the knowledge of Control Panel design.

Course Outcomes (CO)

CO 1	member the basics of control valves and actuators.
CO 2	derstand the working of temperature and flow measurement system for process application.
CO 3	Analyse different types control panels, Wiring accessories and Control Room.
CO 4	Design electronic based product

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	-	-	-	3	-	-	-	-	3
CO 2	3	2	-	-	-	-	3	-	-	-	-	3
CO 3	3	3	-	-	-	-	3	3	3	-	-	3
CO 4	3	3	3	2	3	3	3	3	3	2	-	3

Unit I

Measurement of Flow: Design of Orifice meter, Electromagnetic flow meter, Ultrasonic flow meter, Rotameter. **Temperature Measurement:** Design of the RTD measurement circuit, cold junction compensation circuit for thermocouple, linearization of thermistor characteristics and design of temperature transmitter.

Unit II

Valves: Control valves - design of actuators and positioners - types of valve bodies - valve characteristics-materials for body and trim - sizing of control valves - selection of body materials and characteristics of control valves for typical applications.

Valve selection and sizing for liquid service, gas or vapor service, flashing liquids, mixed phase flow. Control valve noise. Control valve cavitations. Actuator sizing. Design of safety relief valves and rupture discs. Review of flow equations.

Unit III

Electronic Based design: Electronic P+I+D controllers - design - adjustment of set point, bias and controller settings. Enclosure Design: Packing and enclosures design guidelines, Grounding and shielding, front panel and cabinet design of an electronic product.
Microcontroller Based Design: Design of logic circuits for alarm and annunciator circuits, interlocks - design of microcontroller based system for data acquisition - design of microprocessor based P+I+D controller.

Unit IV

Control Panel Design: Panel selection-size, type, construction and IP classification. GA Diagrams, Power wiring and distribution, Typical wiring diagrams for AI, DI, AO, DO, RTD, and T/C modules. Wiring accessories- ferules, lugs, PVC ducts, spiral etc. Earthing scheme. Panel ventilation, cooling and illumination. Control Room Design: Layout and environment.

Textbooks:
1. Bela G. Liptak, Instrument Engineer's Hand Book – Process Control, Chilton Company, 3rd Edition, 1995.
2. Anderson N.A., Instrumentation for Process Measurement and Control, Routledge, 3rd Edition, 1997.
3. Considine D.M., Process Instruments and Controls Handbook, McGraw-Hill., 5th Edition2009.
4. AlokBaura, Fundamentals of Industrial Instrumentation, Wiley India Pvt. Ltd (2011).

References:
1. R. W. Zape, Valve selection hand book third edition, Jaico publishing house,
2. Les Driskell, Control valve sizing, ISA.
3. Curtis Johnson, Process Control Instrumentation Technology, PHI /Pearson Education 2002.
4. Kim R Fowler, Electronic Instrument Design, Oxford University- 1996.

Instrumentation System Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-5	ICE-413P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Instrumentation System Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Design of Instrumentation amplifier.
2. Design of active filters – LPF, HPF and BPF.
3. Design of Control valve (sizing and flow-lift characteristics)
4. Design of PID controller (using operational amplifier and microprocessor)
5. Calibration of Mcleod gauge for low pressure.
6. Calibration of Resistance Temperature Detector (RTD) for temperature measurement.
7. Calibration of Thermocouple for temperature measurement.
8. Study and calibration of a Rotameter for flow measurement.
9. Piping and Instrumentation Diagram-case study.
10. Study electronic system design employing microcontrollers.

Intellectual Property Rights	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	7	PCE	PCE-5	CIE-419

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Understand, define and differentiate different types of intellectual properties (IPs) and their roles in contributing to organizational competitiveness and Understanding the Framework of Strategic Management of Intellectual Property (IP).
2.	To Appreciate and appraise different IP management (IPM) approaches and describing how pioneering firms initiate, implement and manage IPM programs.
3.	To Explain how to derive value from IP and leverage its value in new product and service development.
4.	To Expose to the Legal management of IP and understanding of real life practice of IPM.

Course Outcomes (CO)

CO 1	To Identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP and Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development.
CO 2	To Identify activities and constitute IP infringements and the remedies available to the IP owner and describe the precautious steps to be taken to prevent infringement of proprietary rights in products and technology development and Be familiar with the processes of Intellectual Property Management (IPM) and various approaches for IPM and conducting IP and IPM auditing and explain how IP can be managed as a strategic resource and suggest IPM strategy.
CO 3	To be able to anticipate and subject to critical analysis arguments relating to the development and reform of Geographical Indications of goods and their likely impact on creativity and innovation.
CO 4	To be able to demonstrate a capacity to identify, apply and assess ownership rights and marketing protection under intellectual property law as applicable to information, ideas, new products and product marketing

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	-	2	-	1	1	1	-	1	-	-
CO 2	2	1	-	2	-	1	1	-	-	1	-	-
CO 3	2	1	-	-	-	1	1	-	-	1	-	-
CO 4	2	1	-	-	-	1	1	1	-	1	-	-

UNIT-I

Understanding & Overview of IPR Regime & Patents: Introduction, Need of Intellectual Property Rights, Types of Intellectual property, Rationale for protection of IPR, International Organizations, Agencies and Treaties, Importance of Intellectual Property Rights, IPR in India: Genesis and development, Impact of IPR on development, health agriculture and genetic resources in India.

Patents: Definition of TRIPS, Kind of inventions protected by Patent, Process and Product Patent, Double Patent, Legal requirements for patents, Patent Application process, Searching a patent, Drafting and Filling of a Patent, Type of patent applications, Patent Specification and Claim, Management of IP Assets and IP Portfolio, Layers of International Patent System: National, Regional and International options

UNIT-II

Trademarks & Copyrights: Rights of Trademark, Purpose and Function of Trademark, Trademark registration, Trademark Acquisition, Trademark protection, Trademark Registration process.

Law of Copy Rights, Rights and Protection covered by Copyright, Infringement of Copyright under Copyright Act, Distinction between related rights and copyright, Celebrity rights, Academic integrity or Plagiarism

UNIT-III

Geographical Indications of Goods & Traditional Knowledge: Types of Geographical Indications of Goods, Why Geographical Indications of Goods needs protection, How Geographical Indications of Goods gets protection, GI Laws, GI Act in India, Case Study: Three Recent famous registered GIs of India.

Examples of medicinal, bioprospecting and Indigenous knowledge Need for their Protection, Positive protection, Defensive protection and legal aspects.

UNIT – IV

Recent Developments & Institutional Capacity: New Development in Trademark Law, Copyright Law, Patent Law, Intellectual Property Audits, Protection of Computer Programs, Protection of Communication Technologies, Protection of Biotechnology, Reprography and Intellectual Property.

International Trademark law, international copyright law, International Patent law, International Development in Trade Secret Law.

IP Policy making and legislation, Examination and Registration Systems, International Standard Setting: WIPO & WTO.

Textbook(s):

1. Fundamentals of IP for Engineers, K. Bansal & P. Bansal, BS/BSP Books Publications, 2013
2. Intellectual Property Rights, Deborah. E. Bouchoux, 5th Edition, Delmar Cengage Learing, 2017.

References:

1. Intellectual Property Rights– Unleashmy The Knowledge Economy, Prabuddha Ganguli, Tate Mc-Graw Hill Publishing Company Ltd, 2001.

Intelligent and Expert Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI	7	PC	PC	AI-405T
EAE	7	AI-EAE	AI-EAE-5	AI-405T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To study the idea of intelligent agents and search methods.
2.	To study about representing knowledge.
3.	To study the reasoning and decision making in uncertain world.
4.	To study the concepts of expert systems.

Course Outcomes (CO)

CO 1	Able to understand the idea of intelligent agents and search methods.
CO 2	Able to represent knowledge using various knowledge representation techniques.
CO 3	Able to apply reasoning for decision making in uncertain world.
CO 4	Able to understand the concepts of expert systems and implement expert systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	2	-	-	-	-	2
CO 2	3	3	3	3	3	2	2	-	-	-	-	2
CO 3	3	3	3	3	3	2	2	-	-	-	-	2
CO 4	3	3	3	3	3	2	2	-	-	-	-	2

UNIT-I

Introduction to AI: Intelligent agents – Perception – Natural language processing – Problem – Solving agents – Searching for solutions: Uniformed search strategies – Informed search strategies.

UNIT-II

Knowledge and Reasoning: Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents: Propositional logic – First order logic – Syntax and semantics – Using first order logic – Inference in first order logic.

UNIT-III

Uncertain Knowledge and Reasoning: Uncertainty – Acting under uncertainty – Basic probability notation – Axioms of probability – Baye's rule – Probabilistic reasoning – Making simple decisions.

Learning: Learning decision trees – Knowledge in learning – Neural networks – Reinforcement learning – Passive and active.

UNIT-IV

Expert Systems: Definition – Features of an expert system – Organization – Characteristics – Prospector – Knowledge Representation in expert systems – Expert system tools – MYCIN – EMYCIN.

Textbooks:

1. Stuart Russel and Peter Norvig, 'Artificial Intelligence A Modern Approach', 2nd Edition, Pearson, 2003.
2. Donald A.Waterman, 'A Guide to Expert Systems', Pearson Education.

References:

1. George F.Luger, 'Artificial Intelligence – Structures and Strategies for Complex Problem Solving', 4th Ed, Pearson Education, 2002.
2. Elain Rich and Kevin Knight, 'Artificial Intelligence', Second Edition Tata McGraw Hill, 1995.
3. Rich and Knight, "Artificial Intelligence", Tata McGraw Hill, 1992

Intelligent and Expert Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI	7	PC	PC	AI-405P
EAE	7	AI-EAE	AI-EAE-5	AI-405P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Intelligent and Expert Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of PROLOG. Write the following programs using PROLOG / LISP
2. Write simple fact for the statements using PROLOG
    a. Ram likes mango.
    b. Seema is a girl.
    c. Bill likes Cindy.
    d. Rose is red.
    e. John owns gold.
3. Write predicates, one converts centigrade temperatures to Fahrenheit, the other checksif a temperature is below freezing using PROLOG.
4. Write a program to solve 8 queens problem
5. Solve any problem using depth first search.
6. Solve any problem using best first search.
7. Solve 8-puzzle problem using best first search
8. Solve Robot (traversal) problem using means End Analysis
9. Solve traveling salesman problem.
10. Experiment based on knowledge representation.
11. Experiment based on reasoning
12. Study of Expert System – MYCIN.

Intelligent Transportation System	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	GTSE-EAE	GTSE-EAE-4	GTSE-431

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn the fundamentals of ITS
2.	To study the ITS functional areas
3.	To have an overview of ITS implementation in developing countries
4.	To Understand ITS for Transportation Planning

Course Outcomes (CO)

CO 1	Understand the concepts of Intelligent transport systems
CO 2	Acquire the basic knowledge on data collection using ITS.
CO 3	Understand the concept of telecommunication in ITS
CO 4	Know about the various functional areas of ITS

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	1	2	-	2	-	-	3	-	-	3
CO 2	2	-	1	2	-	3	-	-	-	-	-	1
CO 3	3	2	1	2	-	1	-	-	-	-	-	3
CO 4	3	-	1	3	-	-	-	-	2	-	-	3

UNIT-I

Introduction to ITS: History of traffic congestion, Traditional approach to addressing demand vs. capacity. Development of a modern ITS approach. Costs and benefits. Definition, objectives, and significance of ITS, Benefits of ITS, Challenges and opportunities in ITS.
ITS significance in modern transportation systems, ITS technologies and components, and data analysis tools, Systems engineering in ITS and ITS architecture.

UNIT-II

Data Collection Techniques: ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.
Telecommunications in ITS: Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System.

UNIT-III

ITS Functional Areas: ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveller Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS), Connected and autonomous vehicles (C&AV), Supporting ITS Technologies, ITS standards and specifications, Indian Smart Cities Mission, ITS Case studies.

UNIT – IV

Traffic Management and Automation: ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Freight and Commercial Vehicle Operations, Personal transportation, Rural and regional transportation, Sustainable transportation, Emergency Management, Advanced Vehicle safety systems, Information Management, Mobile Applications; Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

Textbook(s):

1. Ghosh, S., Lee, T.S. Intelligent Transportation Systems: New Principlesand Architectures, CRC Press, 2000.
2. Mashrur A. Chowdhury, and Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, Inc., 2003.

References:

1. Sussman, J.M. Perspectives on Intelligent Transportation Systems, Springer, Berlin, 2010.
2. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001.
3. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill, 1992.
4. E.Turban,"Decision Support and Export Systems Management Support Systems", Maxwell Macmillan, 1998.

Internet of Things Frameworks	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-IoT	7	PC	PC	IOT-447T
EAE	7	IOT-EAE	IOT-EAE-5B	IOT-447T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concepts of Internet of Things and the application of IoT.
2.	To Determine the Market perspective of IoT.
3.	To Understand the vision of IoT from a global context
4.	To Understand the basic framework of IoT

Course Outcomes (CO)

CO 1	Demonstrate basic concepts and principles of IoT Framework
CO 2	Use of Devices, Gateways and Data Management in IoT.
CO 3	Design IoT applications in different domain and be able to analyze their performance
CO 4	Implement basic IoT applications on embedded platform.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	2	3	-	-	2	-	-	3	1	2	-
CO 2	-	-	-	1	-	-	-		1	2	1	2
CO 3	1	-	-	-	-	-	-	-	2	-	-	2
CO 4	1	-	2	-	3	-	-	-	-	2	3	-

UNIT-I

IoT & Web Technology, The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

UNIT-II

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT-III

IoT Architecture -State of the Art – Introduction, State of the art, Architecture. Reference Model Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT - IV

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Textbook(s):

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things: (A Hands-on Approach)", Universities Press (INDIA) Private Limited 2014, 1st Edition.

References:

1. Michael Miller "The Internet of Things" by Pearson
2. Raj Kamal "Internet of Things", McGraw-Hill, 1st Edition

Internet of Things Frameworks Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-IoT	7	PC	PC	IOT-447P
EAE	7	IOT-EAE	IOT-EAE-5B	IOT-447P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Internet of Things Frameworks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Sense the Available Networks Using Arduino
2. Measure the Distance Using Ultrasonic Sensor and Make Led Blink Using Arduino
3. Detect the Vibration of an Object Using Arduino.
4. Connect with the Available Wi-Fi Using Arduino
5. Sense a Finger When it is Placed on Board Using Arduino
6. Temperature Notification Using Arduino
7. LDR to Vary the Light Intensity of LED Using Arduino
8. MySQL Database Installation in Raspberry Pi
9. SQL Queries by Fetching Data from Database in Raspberry Pi
10. Switch Light On and Off Based on the Input of User Using Raspberry Pi

Internet of Things Industrial and Medical Case Studies	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IOT-EAE	IOT-EAE-5A	IOT-445T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Overview of IoT
2.	To make students know the IoT ecosystem
3.	The course will also develop skills on IoT technical planning.
4.	To understand the case studies of medical and Industrial applications

Course Outcomes (CO)

CO 1	To understand the basics of Networking and Security.
CO 2	To understand predecessor of IoT technology and emergence of Internet of Things
CO 3	To understand architecture for Internet of Things
CO 4	To recognize various devices, sensors, actuators, and various processing paradigms for IoT.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	2	1	2	3	-	-	3	3	2	1
CO 2	2	1	1	2	-	2	-	-	2	2	2	-
CO 3	2	1	2	-	1	-	-	-	2	2	1	2
CO 4	3	2	-	2	3	1	-	-	1	3	2	1

UNIT-I

Fundamentals of IoT: Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M

UNIT-II

IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model, and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT-III

IoT Sensing and Actuation & IoT Processing Topologies and Types: Introduction, Sensors, Sensor Characteristics, SensorialDeviations, SensingTypes, Sensing Considerations, Actuators, Actuators Types, Actuator Types, Actuator Characteristics, Data Formats, Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading, Offload location, Offload decision making, Offloading considerations.

UNIT - IV

IoT Case Studies: Agricultural IoT, Components of an agricultural IoT, Advantages of IoT in agriculture, Case Studies, Vehicular IoT, Components of vehicular IoT, Advantages of vehicular IoT, Healthcare IoT, Components of healthcare IoT, Advantages and risk of healthcare IoT, Case Studies, Evolution of New IoT Paradigms, Challenges Associated with IoT, Emerging Pillars of IoT. .

Textbook(s):

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017

References:

1. Michael Miller "The Internet of Things" by Pearson
2. Raj Kamal "Internet of Things", McGraw-Hill, 1st Edition

Internet of Things Industrial and Medical Case Studies Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IOT-EAE	IOT-EAE-5A	IOT-445P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Internet of Things Industrial and Medical Case Studies) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Arduino programming.
2. Introduction to Arduino Uno R3
3. To blink the LED with Arduino.
4. To interface push button with Arduino.
5. To interface LCD with Arduino.
6. To read the analog voltage using ADC on Arduino.
7. To detect occupancy of an area using PIR sensors
8. To interface real time clock IC DS1307 with Arduino.
9. To measure the distance of an object using ultrasonic sensor
10. To display temperature and humidity data.

Introduction to Analog Electronics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	ECE-OAE	ECE-OAE-1B	OECE-344T
OAE	6	EE-OAE	EE-OAE-1B	OEE-346T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of a PN junction diode and its various applications.
2.	To impart the knowledge about various semiconductor transistors.
3.	To impart the knowledge about Op-Amp and design its application circuits.
4.	To impart the knowledge regarding principles of oscillations and about classification of power amplifiers.

Course Outcomes (CO)

CO 1	To understand various properties of a PN junction diode. Design and analyses special diodes and the circuits using these diodes for various applications.
CO 2	Classify the concepts of various semiconductor transistors.
CO 3	Understand the characteristics of Op-Amp and design its application circuits.
CO 4	Analyse principles of oscillations and classification of power amplifiers.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	1	1	1	-	1	2	1	3
CO 2	3	3	3	3	2	1	1	-	1	2	1	3
CO 3	3	3	3	3	2	1	1	-	1	2	1	3
CO 4	3	3	3	3	1	1	1	-	1	2	1	3

UNIT I

Review of semiconductor physics, p-n Junction diode: Physical operation, I-V characteristic and diode equation, Large-signal model, Concept of load line, drift and diffusion current, p-n junction capacitances (depletion and diffusion), Breakdown in p-n diodes, Zener diode.
Diode Applications: Rectifier circuits, Zener diode-based voltage regulators, limiting and clamping circuits, voltage multipliers, switching behaviour of p-n diode.

UNIT II

Bipolar Junction Transistor (BJT): Physical structure and modes of operation, BJT current components, BJT characteristics in CB, CE & CC mode, operating point, AC/DC Load Line, The Ebers-Moll model, BJT characteristics, and large-signal equivalent circuit.

Metal oxide semiconductor Field Effect Transistors MOSFET: Physical structure and V-I characteristics of Enhancement/Depletion- type MOSFETs (n/p-channel), Biasing in MOS amplifier circuits, small signal equivalent circuit of MOSFET, MOSFET as an analog switch

UNIT III

Introduction to Op-Amp: Differential amplifier using BJT, Block diagram of op-amp, characteristics of ideal Op-Amp, ideal voltage transfer curve, Op-Amp ac and dc parameters. Differential amplifier using single and two op-amp, virtual ground.
Circuits using Op-Amps: Comparators, adder, subtractor, integrator, differentiator.

UNIT IV

Principles of oscillations, Barkhausen criterion, Frequency stability, Various types of oscillators.
Output stage and Power Amplifiers: Classification of output stages, class A, B and AB output stages, Biasing the class AB circuit, variations on the class AB configuration, Power BJTs, MOS power transistors, IC power amplifiers.

Textbook(s):

1. Boylestad & Nashelsky, Electronic Devices & Circuit Theory, Pearson Publication.
2. Salivahanan, Suresh Kumar, Vallavaraj, Electronic devices and circuits TMH, 1999.
3. J. Millman and Halkias, Integrated Electronics, Analog & Digital Circuits & Systems TMH – 2000
4. Op - Amps and Linear Integrated Circuits, Ramakant A Gayakwad, PHI.

References:

1. Sedra & Smith, Micro Electronic Circuits, Oxford University Press, 2000
2. B.Kumar & Shail Bala Jain, Electronic Devices And Circuits, PHI

Introduction to Analog Electronics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	ECE-OAE	ECE-OAE-1B	OECE-344P
OAE	6	EE-OAE	EE-OAE-1B	OEE-346P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Analog Electronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To plot V-I characteristics of a semiconductor diode and reverse characteristics of Zener diode.
2. To study half wave and full wave rectifiers and calculate ripple factor, efficiency and voltage regulation.
3. To design clipper and clamper circuits.
4. Design and set up the BJT common emitter amplifier using voltage divider bias with and without feedback.
5. To design and test a Darlington emitter follower circuit.
6. To draw the drain and transfer characteristics of a given FET.
7. To study the Op-Amp (IC 741) as inverting and noninverting amplifier and calculate its gain.
8. To study the Op-Amp (IC 741) as adder, subtractor, integrator and differentiator.
9. To study Wien Bridge oscillator measurement of frequency and amplitude of oscillations using Op-Amp.
10. To design a crystal oscillator to oscillate at the specified crystal frequency.
11. Set-up and study the working of complementary symmetry class B push pull power amplifier and calculate the efficiency.

Introduction to CAD/CAM	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-2	MEE-326T
EAE	6	CADM-EAE	CADM-EAE-1	CADM-302T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Impart knowledge of computer-aided design (CAD) techniques.
2.	Impart knowledge of computer-aided manufacturing (CAM) techniques.
3.	Develop programming and operating skills for computer numerical control (CNC) machines.
4.	Enable students understand various stages of product development and their management.

Course Outcomes (CO)

CO 1	Understanding the scope and need of computer aided design & manufacturing and computer numeric technology.
CO 2	Applying the techniques to generate solid model and curves
CO 3	Develop the Skills to program the Computer Numerical Control of Machine Tools
CO 4	Apply the concepts of Automated Material Handling Systems and Advanced Manufacturing Systems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	1	3	2	1	2	2	2	2	3
CO 2	3	3	3	3	3	1	1	1	2	3	3	3
CO 3	3	2	2	3	3	2	1	2	3	3	3	3
CO 4	3	2	3	1	3	2	2	2	3	3	3	3

UNIT- I

Introduction: Definition and scope of CAD/CAM, Introduction to design process and role of computers in the design process.
Mapping of Geometric Models: Translation, Rotational, General, Changes of Coordinate System, Numerical problems. Three Dimensional Transformations: Point representations, Transformation Matrices, Scaling, Translation, Rotation, Reflection.
Curves: Representation of Space Curves, Cubic Spline, Normalized Cubic Splines, Bezier Curves, B-spline Curves, Numerical problems. Surface Generation: Plane Surfaces, Ruled Surfaces, Surface of Revolution, Sweep Surface, Bezier Surface, Cubic Surface Patch, B-Spline Surface, Composite Surface, Numerical problem.

UNIT II

Solid modeling: Solid models, Fundamentals of solid modeling, Different solid representation schemes, Half -

spaces, Boundary representation (B-rep), Constructive solid geometry (CSG), Sweep representation, Perspective, Parallel projection, Hidden line removal algorithms.

CAD/CAM Data Exchange Formats: Types of file formats & their exchange, Graphics standards.

UNIT III

Need of NC technology, Fundamental concepts in numeric control: structure and functions of NC System, advantages of NC technology over conventional manufacturing.

NC Machine Tools: Types, Definition and designation of control axes,Special constructional and design characteristics of NC machine tools, Standard tooling used for NC turning and milling centres. NC Part Programming: Work holding and tool setting procedure for NC turning and milling centres, Tool zero presetting, Block formats and introduction to ISO based G & M codes for NC part programming, Concepts of tool length and radius compensation, Standard canned cycles used in CNC turning and milling centres, Introduction to automatic NC part program generation from CAD models using standard CAD/CAM software for machining of surfaces, moulds and dies etc.

UNIT IV

Computer Numerical Control of Machine Tools: Types and functions of computer numeric control (CNC), Types and functions of direct numeric control (DNC), Need of adaptive control types, functions and types of adaptive control, its uses & benefits, Advantages of combined CNC/DNC systems.

Automated Material Handling Systems and Advanced Manufacturing Systems: Industrial Robots, Conveyors, AGVs, Automatic Storage and Retrieval Systems; Lean Manufacturing Systems.

Textbook(s):

1. Ibrahim Zeid, CAD/CAM Theory and Practice, Tata McGraw-Hill Publishing Company Limited. 2nd Ed.
2. S.K. Sinha, CNC Programming, Galgotia Publications 2003.
3. David F. Rogers and J. Alan Adams, Mathematical Elements for Computer Graphics, Tata McGraw-Hill.
4. T.K. Kundra, P. N.Rao & N.K.Tiwari, Numerical Control and Computer Aided Manufacturing, TMH

References:

1. Mikell P. Groover, Emory W.Zimmers, “CAD/CAM”, Pearson Education, 2001.
2. P.N. Rao, “CAD/CAM Principles and Applications”, Tata McGraw Hill, 2003.

Introduction to CAD/CAM Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-2	MEE-326P
EAE	6	CADM-EAE	CADM-EAE-1	CADM-302P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to CAD/CAM) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the characteristic features of CNC machine.
2. Part programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine.
3. Part programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine.
4. Part programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine.
5. Experiment on Robot and programs.
6. Experiment on Transfer Line/Material Handling.
7. Experiment on study of system devices such as motors and feedback devices.
8. Experiment on Mechatronics and Controls.
9. Experiment based on CAD part of the syllabus.

Introduction to Circuits and Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	ECE-OAE	ECE-OAE-1A	OECE-312T
OAE	6	EE-OAE	EE-OAE-1A	OEE-316T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the LTI system and wave form synthesis.
2.	To understand mathematical modelling of circuit.
3.	To understand two port parameter and transfer function.
4.	To understand realization of passive network and filter.

Course Outcomes (CO)

CO 1	Ability to determine function from waveform.
CO 2	Ability to determine transient respond of circuit.
CO 3	Ability to determine two port parameter of circuit.
CO 4	Ability to realize the circuit from their transfer function.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT-I

Introduction to signals, their classification and properties, different types of systems, LTI systems and their properties, periodic waveforms and signal synthesis, properties and applications of Laplace transform of complex waveform.

UNIT-II

System modeling in terms of differential equations and transient response of R, L, C, series and parallel circuits for impulse, step, ramp, sinusoidal and exponential signals by classical method and using Laplace transform.

UNIT-III

Graph theory: concept of tree, tie set matrix, cut set matrix and application to solve electric networks.

Two port networks: Introduction of two port parameters and their interconversion, interconnection of two 2-

port networks, open circuit and short circuit impedances and ABCD constants, relation between image impedances and short circuit and open circuit impedances. Network functions, their properties and concept of transform impedance, Hurwitz polynomial.

UNIT IV

Positive real function and synthesis of LC, RC, RL Networks in Foster's I and II, Cauer's I& II forms, Introduction of passive filter and their classification, frequency response, characteristic impedance of low pass, high pass, Band Pass and Band reject prototype section.

Textbook(s):
1. W H Hayt "Engineering Circuit Analysis" TMH Eighth Edition
2. Kuo, "Network analysis and synthesis" John Weily and Sons, 2nd Edition.

Reference Books:
1. S Salivahanan, "Circuit Theory ", Vikas Publishing House, 1st Edition, 2014
2. Van Valkenburg, "Network analysis", PHI, 2000.
3. Bhise, Chadda, Kulshreshtha, "Engineering network analysis and filter design", Umesh Publication, 2000.
4. D. R. Choudhary, "Networks and Systems", New Age International, 1999
5. Allan H Robbins, W.C.Miller, "Circuit Analysis theory and Practice", Cengage Learning Pub, 5th Edition 2013
6. Bell, "Electric Circuit", Oxford Publications, 7th Edition.

Introduction to Circuits and Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	ECE-OAE	ECE-OAE-1A	OECE-312P
OAE	6	EE-OAE	EE-OAE-1A	OEE-316P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Circuits and Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to MATLAB and its basic commands.
2. Plot unit step, unit impulse, unit ramp, exponential, parabolic functions and sinusoidal signals
3. Study the transient response of series RLC circuit for different types of waveforms on CRO and verify using MATLAB
4. Study the time response of a simulated linear system and verify the unit step and square wave response of first order and second order, type 0,1 system
5. Using MATLAB determine current in various resistors connected in network using mesh current and node voltage analysis.
6. To determine Z and Y parameters of the given two port network.
7. To determine ABCD parameters of the given two port network.
8. To verify Reciprocity Theorem for the given two port network.
9. To determine Hybrid parameters of the given two port network.
10. To design Cascade Connection and determine ABCD parameters of the given two port network.
11. To design Series-Series Connection and determine Z parameters of the given two port network.
12. To design Parallel-Parallel Connection and determine Y parameters of the given two port network.
13. To design Series-Parallel Connection and determine h parameters of the given two port network
14. Study the frequency response of different filter circuits.

Introduction to Computer Networks	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	CSE-OAE	CSE-OAE-5A	OCSE-411T
OAE	7	ECE-OAE	ECE-OAE-5B	OECE-425T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	ild an understanding of the fundamental concepts of computer networking.
2.	Familiarize the student with the basic taxonomy and terminology of the computer networking area.
3.	Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
4.	Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Course Outcomes (CO)

CO 1	Independently understand basic computer network technology.
CO 2	Understand and explain Data Communications System and its components.
CO 3	Understand and implements the network topology and ip addressing, subnetting.
CO 4	Enumerate the layers of the OSI model and TCP/IP.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1	3	1	-	-	-	-	-	3
CO 2	3	2	1	1	3	1	-	-	-	-	-	3
CO 3	3	2	1	1	3	1	-	-	-	-	-	3
CO 4	3	2	1	1	3	1	-	-	-	-	-	3

UNIT-I

Data Communications: Components, Networks, The Internet, Protocols and Standards, Network Models: The OSI Model, TCP/IP Protocol Suite , A Comparison of the OSI and TCP/IP Reference Models, Addressing, Physical Layer: Analog and Digital Signals, Transmission modes, Transmission Media: Guided Media, Unguided Media, Switching: Circuit switching, packet switching), message switching.

UNIT-II

Data Link Layer: Design issues, Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC

Medium Access Sub layer: Channel allocation problem, Controlled Access, Channelization, multiple access protocols, IEEE standard 802.3 & 802.11 for LANS and WLAN, high-speed LANs, FDDI based LAN, Network

Devices-repeaters, hubs, switches bridges.

UNIT-III

Network Layer: Design issues, Routing algorithms, Congestion control algorithms, Host to Host Delivery: Internetworking, addressing and routing, IP addressing (class full & Classless), Subnet, Network Layer Protocols: ARP, IPV4, ICMP, IPV6 ad ICMPV6.

UNIT - IV

Transport Layer: Process to Process Delivery: UDP; TCP, Congestion Control, Error and Flow Control. Application Layer: Client Server Model, Domain Name System (DNS): Electronic Mail (SMTP), file transfer (FTP), HTTP and WWW.

Textbook(s):
1. Behrouz A. Forouzan, “Data Communications and Networking”, Tata McGraw-Hill.

References:
1. A. S. Tannenbum, D. Wetherall,, “Computer Networks”, Prentice Hall, Pearson.
2. Fred Halsall, “Computer Networks”, Addison – Wesley.
3. Tomasi, “Introduction To Data Communications & Networking”, Pearson.

Introduction to Computer Networks Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	CSE-OAE	CSE-OAE-5A	OCSE-411P
OAE	7	ECE-OAE	ECE-OAE-5B	OECE-425P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Computer Networks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Networking Simulation Tools: Wireshark, Cisco Packet Tracer.
2. To understand the operation of TELNET by accessing the router in server room from a PC in IT office.
3. To implement an IP Addressing Scheme and Subnetting in small networks using Cisco Packet Tracer.
4. To implement the static routing using Cisco Packet Tracer.
5. To implement the DHCP onto the Network Topology using Cisco Packet Tracer.
6. To implement the DNS, Email Services in the Network using Cisco Packet Tracer.
7. To implement the Dynamic Routing Protocols: RIP, IGRP using Cisco Packet Tracer.
8. To construct multiple router networks and implement the EIGRP Protocol.
9. To implement the Network Address Resolution (NAT) using Cisco Packet Tracer.
10. Conducting a Network Capture and Monitoring with Wireshark Simulation Tool.

Introduction to Control Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE/EE/EEE/ICE	5	PC	PC	EEC-307

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide an understanding about the concepts of transfer unction and its evaluation.
2.	To expose the students to time response of control systems
3.	To understand the frequency response of control systems
4.	To study compensators and controllers

Course Outcomes (CO)

CO 1	Ability to define, understand various terms related to control system and evaluation of transfer function
CO 2	Ability to apply knowledge of various types of signals in time response of systems
CO 3	Ability to analyse frequency response of systems
CO 4	Ability to design compensators and controllers

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT I

Control Systems: Basics & Components Introduction to basic terms, classifications & types of Control Systems, Mathematical modelling of real life systems, block diagrams & signal flow graphs. Transfer function, determination of transfer function using Block diagram reduction techniques and Mason's Gain formula. Control system components: Electrical/ Mechanical/Electromechanical/A.C./D.C. Servo Motors, Stepper Motors, Tacho Generators, Synchros, Magnetic Amplifiers, Servo Amplifiers.

UNIT II

Time: Domain Analysis of real life problems, Time domain performance specifications, transient response of first & second order systems, steady state errors and static error constants in unity feedback control systems, response with P, PI and PID controllers, limitations of time domain analysis.

UNIT III

Frequency Domain Analysis frequency domain specifications and performance of LTI systems, minimum/non minimum phase systems, Polar and inverse polar plots, Logarithmic plots (Bode plots), gain and phase margins, relative stability. Correlation with time domain performance, closed loop frequency responses from open loop response. Limitations of frequency domain analysis.

UNIT IV

Stability & Compensation Techniques Concepts, absolute, asymptotic, conditional and marginal stability, Routh–Hurwitz and Nyquist stability criterion, Root locus technique and its application. Concepts of compensation, series/parallel/ series-parallel/feedback compensation, Lag/Lead/Lag-Lead networks for compensation, compensation using P, PI, PID controllers.

Textbooks:

1. B. C. Kuo, “Automatic control system”, Prentice Hall of India, 7th edition 2001.
2. Nagrath Gopal, “Control Systems Engineering -Principles and Design” New Age Publishers

References:

1. Norman S. Nise, “Control systems engineering” John Wiley & Sons (Asia) Singapore.
2. B. S. Manke, Linear Control System, Khanna publication.
3. K. Ogata, “Modern control engineering”, Pearson 2002.
4. A. K. Jaurath , Problems And Solutions Of Control Systems: With Essential Theory (CBS Problems and Solutions Series)

Introduction to Control Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE/EE/EEE/ICE	5	PC	PC	EEC-355

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Control Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Determination of step & impulse response for a second-order unity feedback system.
2. To study the speed-torque characteristics of SERVO MOTOR.
3. Experiment to draw synchro pair characteristics.
4. To determine the Transfer Function of the DC Machine.
5. Plot unit step response of the given transfer function and finds delay time, rise time, and peak overshoot.
6. Plot the pole-zero configuration in the s-plane for the given transfer function.
7. To determine the characteristics of Magnetic Amplifiers.
8. Linear System Analysis (Time Domain Analysis, Error Analysis) Using MATLAB.
9. To observe the effect of P, PI, PID, and PD Controller for open loop and closed loop of second order system.
10. To analyze the frequency response of a system by plotting Root locus, Bode plot, and Nyquist plot using MATLAB software.
11. Experiment to draw the frequency response characteristics of the lag–lead compensator network and determination of its transfer function.
12. Temperature Controller Using PID Controller.
13. Study of operation of a stepper motor interface with a microprocessor.

Introduction to Data Communication and Networking	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-2	EEE-324T
EAE	6	ES-EAE	ES-EAE-1B	ES-308T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To build an understanding of the fundamental concepts of data communication.
2.	To familiarize the student with the basic taxonomy of data link layer.
3.	To understand and implement the network routing, IP addressing, subnetting.
4.	To enumerate the functions of transport layer and application layer.

Course Outcomes (CO)

CO 1	Understand basic concepts of data communications.
CO 2	Understand and explain various functions of data link layerr.
CO 3	Understand and implements the network routing, IP addressing, subnetting.
CO 4	Enumerate the functions of transport layer and application layer.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1	3	1	-	-	-	-	-	3
CO 2	3	2	1	1	3	1	-	-	-	-	-	3
CO 3	3	2	1	1	3	1	-	-	-	-	-	3
CO 4	3	2	1	1	3	1	-	-	-	-	-	3

UNIT- I

Data Communications : Components, protocols and standards, Network and Protocol Architecture, Reference Model ISO-OSI, TCP/IP-Overview ,topology, transmission mode, digital signals, digital to digital encoding, digital data transmission, DTE-DCE interface, interface standards, transmission media- guided and unguided, transmission impairment, Performance, wavelength and Shannon capacity.
Switching: Circuit switching, packet switching, message switching.

UNIT- II

Data Link Layer: Design issues, Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC
Medium Access Sub layer: Channel allocation problem, Controlled Access, Channelization, multiple access protocols, IEEE standard 802.3 & 802.11 for LANS and WLAN, high-speed LANs, Network Devices-repeaters, hubs, switches, bridges.

UNIT- III

Network Layer: Design issues, Routing algorithms, Congestion control algorithms,
Host to Host Delivery: Internetworking, addressing and routing, IP addressing, Subnet, Network Layer Protocols: ARP, IPV4, ICMP, IPV6 ad ICMPV6.

UNIT- IV

Transport Layer: Process to Process Delivery: UDP; TCP, congestion control.
Application Layer: Client Server Model, Domain Name System (DNS): Electronic Mail (SMTP), file transfer (FTP), HTTP and WWW.

Textbooks:

1. A. S. Tanenbaum, D. Wetherall, “Computer Networks”, Prentice Hall, Pearson, 5th Ed
2. Behrouz A. Forouzan, “Data Communications and Networking”, Tata McGraw-Hill, 4th Ed

References:

1. Fred Halsall, “Computer Networks”, Addison – Wesley Pub. Co. 1996.
2. Larry L Peterson and Bruce S. Davie, “Computer Networks: A system Approach”, Elsevier, 4th Ed
3. W. Tomasi, “Introduction To Data Communications & Networking”, Pearson 7th impression 2011
4. William Stallings, “Data and Computer Communications”, Pearson, 9th Ed.
5. Y. Zheng , “Network for Computer Scientists & Engineers”, Oxford University Press
6. Data Communications and Computer Networks: White, Cengage Learning, 8th Ed

Introduction to Data Communication and Networking Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-2	EEE-324P
EAE	6	ES-EAE	ES-EAE-1B	ES-308P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Data Communication and Networking) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Computer Network laboratory
   Introduction to Discrete Event Simulation
   Discrete Event Simulation Tools - ns2/ns3, Omnet++
2. Using Free Open Source Software tools for network simulation – I Preliminary usage of the tool ns3
   Simulate telnet and ftp between N sources - N sinks (N = 1, 2, 3). Evaluate the effect of increasing data rate on congestion.
3. Using Free Open Source Software tools for network simulation - II
   Advanced usage of the tool ns3
   Simulating the effect of queueing disciplines on network performance - Random Early Detection/Weighted RED / Adaptive RED (This can be used as a lead up to DiffServ / IntServ later).
4. Using Free Open Source Software tools for network simulation - III
   Advanced usage of the tool ns3 Simulate http, ftp and DBMS access in networks
5. Using Free Open Source Software tools for network simulation - IV
   Advanced usage of the tool ns3
   Effect of VLAN on network performance - multiple VLANs and single router.
6. Using Free Open Source Software tools for network simulation - IV
   Advanced usage of the tool ns3
   Effect of VLAN on network performance - multiple VLANs with separate
   multiple routers.
7. Using Free Open Source Software tools for network simulation - V
   Advanced usage of the tool ns3
   Simulating the effect of DiffServ / IntServ in routers on throughput enhancement.
8. Using Free Open Source Software tools for network simulation - VI
   Advanced usage of the tool ns3
   Simulating the performance of wireless networks
9. Case Study I: Evaluating the effect of Network Components on Network Performance
   To Design and Implement LAN With Various Topologies and To Evaluate Network Performance Parameters for DBMS etc.
10. Case Study II: Evaluating the effect of Network Components on Network Performance
    To Design and Implement LAN Using Switch/Hub/Router As Interconnecting Devices For Two Different LANs and To Evaluate Network Performance Parameters.
11. Mini project - one experiment to be styled as a project of duration 1 month (the last month)

Introduction to Database Management Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	SD-OAE	SD-OAE-2B	OSD-336T
OAE	7	CSE-OAE	CSE-OAE-3	OCSE-407T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce basic concepts, architecture and characteristics of database systems.
2.	To introduce relational model concepts and PL/SQL programming.
3.	To introduce relational database design and Normal forms based on functional dependencies.
4.	To introduce concepts of object oriented & distributed databases.

Course Outcomes (CO)

CO 1	Ability to understand advantages of database systems.
CO 2	Ability to use SQL as DDL, DCL and DML.
CO 3	Ability to design database and manage transaction processing.
CO 4	Understand object oriented & distributed databases systems and use them.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT – I

Basic concepts: database & database users, characteristics of the database systems, concepts and architecture, date models, schemas & instances, DBMS architecture & data independence, data modelling using the entity-relationship approach.
SQL – DDL, DCL & DML views and indexes in SQL. Basics of SQL, DDL, DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator.

UNIT - II

Enhanced ER Concepts: Specialization/Generalization, Aggregation, Mapping of ER model to Relational Model.
SQL – Functions - aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types. Transaction control commands – Commit, Rollback, Save point.

UNIT - III

Relational Model: Concepts, relational model constraints, relational algebra.
Relational Database Design: functional dependencies & normalization for relational databases, normal forms based on functional dependencies, (1NF, 2NF, 3NF & BCNF), lossless join and dependency preserving decomposition.
Database Programming – control structures, exception handling, stored procedures, Triggers.

UNIT - IV

Properties of Transaction, Transaction states, Transaction Schedule, Serializability, Concurrency control techniques, locking techniques, Recoverable schedules, Deadlock detection and Recovery, recovery techniques: recovery concepts.
Concepts of Object Oriented Database Management systems & Distributed Database Management Systems

Textbooks:
1. R. Elmsari and S. B. Navathe, "Fundamentals of database systems", Pearson Education, 7th Edition, 2018
2. V. M. Grippa and S. Kumichev, "Learning MySQL", O'Reilly, 2021.
3. SQL/ PL/SQL, The programming language of Oracle, Ivan Bayross, 4th Edition BPB Publications

References:
1. A. Silberschatz, H. F. Korth and S. Sudershan, "Database System Concept", McGraw Hill, 6th Edition,2013.
2. Date, C. J., "An introduction to database systems", 8th Edition, Pearson Education, 2008.
3. Desai, B., "An introduction to database concepts", Galgotia publications, 2010
4. H. Garcia-Molina, J. D. Ullman, J. Widom, "Database System: The Complete Book", PH.
5. Oracle and MySQL manuals.

Introduction to Database Management Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	SD-OAE	SD-OAE-2B	OSD-336P
OAE	7	CSE-OAE	CSE-OAE-3	OCSE-407P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Database Management Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Experiments based on DDL commands – CREATE, ALTER, DROP and TRUNCATE.
2. Apply the integrity constraints like Primary Key, Foreign key, Check, NOT NULL, etc. to the tables.
3. Experiments based on basic DML commands – SELECT, INSERT, UPDATE and DELETE.
4. Write the queries for implementing Built-in functions, GROUP BY, HAVING and ORDER BY.
5. Write the queries to implement the joins.
6. Write the queries to implement the subqueries.
7. Write the queries to implement the set operations.
8. Write the queries to create the views and queries based on views.
9. Demonstrate the concept of Control Structures.
10. Demonstrate the concept of Exception Handling.
11. Demonstrate the concept of Functions and Procedures.
12. Demonstrate the concept of Triggers.

Introduction to Digital Signal Processing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-3	CIE-354T
EE/EEE	6	PCE	PCE-1	EEE-312T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic knowledge of DFT, its properties, FFT and its applications.
2.	To impart the knowledge of designing and realization of FIR filters.
3.	To impart the knowledge of designing and realization of IIR filters.
4.	To impart the knowledge of quantization errors in Digital Signal Processing and the concept of Multirate signal processing.

Course Outcomes (CO)

CO 1	To understand the basic concept of DFT and FFT.
CO 2	To Acquire a clear idea of FIR filter designing techniques and realization methods.
CO 3	Understand the IIR filter designing techniques and realization methods and the stability.
CO 4	To understand the quantization errors in Digital Signal Processing and the concept of Multirate signal processing.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Review of Discrete Time Fourier Transform, Z- transform and Discrete Fourier Transform,Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs,concept of circular convolution,computation of circular convolution by graphical and matrix form, relationship between linear convolution and circular convolution, computation of linear convolution from circular convolution, , linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Save and Overlap-Add methods

UNIT II

Efficient Computation of the DFT: Complexity analysis of direct computation of DFT, Concept of Fast Fourier Transfor, Radix-2 computation of FFT using decimation-in-time and decimation-in-frequency algorithms, signal flow graphs, Butterflies, computations of FFT in one place using both algorithms, bit-reversal process, examples for DIT & DIF FFT Butterfly computations.

UNIT III

Design & Structure of FIR Filters: Characteristics of practical frequency-selective filters, Basic concepts of IIR and FIR filters, Gibbs Phenomenon, Symmetric and Anti-symmetric FIR filters, Design of Linear-phase FIR filters using windows- Rectangular, Hamming, Hanning, Bartlett windows, FIR differentiator, FIR Hilbert Transformer. Design of FIR filters using frequency sampling method. Structure for FIR Systems: Direct form, Cascade form and Lattice structures.

UNIT IV

Design & Structure of IIR Filters: Concept of IIR digital filter, recursive and non-recursive systemanalog to digital domain transformation- Approximation of derivatives ,impulse invariant method and bilinear transformation and their properties, limitations of bilinear transformation, frequency warping and prewarping, methods to find out the order of IIR filter, mapping of poles and zeroes of filter in analog domain, computation of filter transfer function in analog domain, digital filter realization techniques, procedure to design Butterworth and Chebyshev digital IIR filters. Direct, Cascade, Parallel, Signal Flow graph and transposed structure, Lattice structures, Lattice and Lattice-Ladder Structures, Schur - Cohn stability Test for IIR filters.

Textbook(s):

1. Oppenheim & Schafer, Digital Signal Processing, PHI, Latest edition.
2. Proakis and Manolakis, Digital Signal Processing, PHI.

References:

1. S. K. Mitra, Digital Signal Processing, TMH, 2006
2. Johny. R. Johnson, Introduction to Digital Signal Processing, PHI, 1989
3. R.Babu, Digital Signal Processing, ScitechPublication.

Introduction to Digital Signal Processing Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-3	CIE-354P
EE/EEE	6	PCE	PCE-1	EEE-312P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Digital Signal Processing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write Program to compute N point DFT of a given sequence and to plot magnitude and phase spectrum.
2. To implement Parseval theorem of DFT
3. To implement Time shifting and time reversal property of DFT
4. To find linear convolution of two given sequences.
5. To find circular convolution of two given sequences
6. To perform linear convolution from circular convolution and vice versa
7. To design LP FIR filter using windowing techniques
8. To design HP FIR filter using windowing techniques
9. To design LP IIR Butterworth filter for given specifications
10. To design LP IIR Chebyshev type-1 filter for given specifications
11. To verify the decimation of a given sequence
12. To verify the interpolation of a given sequence

Introduction to Electrical Machines	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	EE-OAE	EE-OAE-2	OEE-318T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the concepts of DC Machines.
2.	To impart the concepts of Transformers.
3.	To impart the concepts of Induction Motors.
4.	To impart the concepts of Synchronous Motors.

Course Outcomes (CO)

CO 1	Ability to understand working and applications of DC Motors.
CO 2	Ability to understand working and analysis of Transformers.
CO 3	Ability to understand working and applications of Induction Motors.
CO 4	Ability to understand working and applications of Synchronous Machines

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	-	2	1	-	2
CO 2	3	3	1	3	3	2	1	-	3	1	-	2
CO 3	3	3	3	3	3	3	1	-	2	1	-	1
CO 4	3	3	3	3	3	2	1	-	2	1	-	2

UNIT- I

Principles of Electromechanical Energy Conversion.DC machines: construction, armature windings, induced EMF equation, torque production, magnetization curve. Types of generators and motors, characteristics, commutation and interpoles, armature reaction, Speed control of dc motor and starting.

PMDC machine: Introduction and need of brushless motors

UNIT- II

Transformers: construction, ideal and practical transformer, equivalent circuits, voltage regulation, maximum efficiency criterion. Open circuit and short circuit tests. Phasor diagrams on no load, full load, lagging and leading power factor loads. Three phase transformer.

Introduction to polyphase induction machines, production of rotating magnetic flux vector, principle of operation, importance of air gap, comparison with transformer, types of rotor.

UNIT- III

Induction motors: Development of an equivalent circuit, estimation of parameters, no load and block rotor tests. Torque slip characteristics, starting of induction motors methods, deep bar and double cage rotor, power relations, speed control of induction motors.

Single phase induction motor, double field revolving theory, starting methods of single phase induction motors, universal motor and introduction to switched reluctance motor.

UNIT- IV

Synchronous Machine: construction, pitch factor and distribution factor, induced emf equation, equivalent circuits and phasor diagrams, power relations, OCC and SCC characteristics for voltage regulation of alternator, salient pole and cylindrical rotor machines and phasors. Effect of excitation and V curves. Power factor correction and parallel operation of synchronous generator.

Textbook(s):

1. I.J Nagrath and D.P.Kothari, “Electrical Machines”, Tata Mc Graw Hill, 2010, Fourth Edition.
2. Bhag S. Guru, Huseyin R. Hiziroglu, “Electric Machinery and Transformers”, Oxford Pub., 3rd Ed.

References:

1. M. V. Deshpande, “Electrical Machines” PHI.
2. PC Sen, “Principles of Electric Machinery and Power Electronics”, Wiley and Sons, Third Edition.
3. Ashfaq Hussain, “Electrical Machines”, Dhanpat Rai.
4. Fitzgeral, A.E., C.Kingslay & Umans, “Electrical Machines”, Mc Graw Hill.
5. Ghosh, “Electrical Machines”, Pearson.

Introduction to Electrical Machines Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	EE-OAE	EE-OAE-2	OEE-318P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Electrical Machines) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To obtain magnetization characteristics of DC shunt generator and determine critical field resistance and critical speed.
2. To perform load test on DC shunt generator and determine the characteristics.
3. To perform speed control of DC shunt motor by field and armature control.
4. To perform the load test on D.C. shunt motor and to draw the performance characteristics.
5. To perform the Swinburne’s test on a D.C. shunt Machine and to pre determine its efficiency when running as a motor as well as generator and also draw the characteristic curves.
6. To perform Open circuit and short circuit tests on single phase transformer for parameter estimation of the transformer.
7. To obtain star-star, star-delta and delta-delta connections for three phase transformers.
8. To perform parallel operation of two single phase transformers.
9. To perform block rotor test and no load test on induction motor(single phase) for parameter estimation.
10. To perform block rotor test and no load test on induction motor (three phase) for parameter estimation.
11. To perform SCC and OCC of an alternator and calculate voltage regulation at UPF, .8 leading and .8 lagging pf.
12. To perform load test on alternator.

Introduction to Industrial Instrumentation

L	P	C
3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	ICE-OAE	ICE-OAE-4	OICE-435T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To expose the students to various measurement techniques used for measuring industrial process variables
2.	To expose the students to Principles and working of Humidity, Moisture, temperature , pressure, flow and level measuring
3.	To make the students to understand the selection of temperature, flow, pressure and level measuring device for specific process measurement.
4.	To impart knowledge on signal conversion and conditioning methods for measurement of industrial variables

Course Outcomes (CO)

CO 1	ility to understand various measurement techniques used for measuring industrial process variables
CO 2	ility to apply knowledge of temperature, pressure, flow, level, humidity for industrial applications
CO 3	Ability to analyze the electrical and non-electrical methods of temperature, flow, pressure, level measurement
CO 4	Ability to design signal conditioning circuit for various sensors and transducers used for measurement of industrial variables

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	-	-	2	-	-	-	2	-	3
CO 2	3	3	2	2	-	2	-	-	2	2	-	3
CO 3	3	3	3	3	-	2	-	-	2	3	2	3
CO 4	3	3	3	3	-	2	-	2	2	3	2	3

Unit I

Temperature Measurements: Introduction; Definitions, standards, unit systems, points calibration of thermometers, study of filled in system thermometer, bimetallic thermometers, 3 and 4 wire RTD, high temperature measurement techniques, Radiation fundamentals -Radiation methods of temperature measurement, Total radiation pyrometers, Optical pyrometers, Bolometers

Level Measurements: Introduction, level measurement- differential pressure method, Electrical types of level gauges using resistance, capacitance, nuclear radiation and ultrasonic sensors

Unit II

Pressure Measurements: Introduction, Definition of absolute pressure, gauge pressure and vacuum, their relation and units of pressure, Non-Electric type pressure measurement: manometers: U-tube, well type, Elastic type pressure gauge: Bourdon tube, Diaphragm and Bellows, Electrical methods: elastic elements with LVDT, strain gauges, capacitive type transducers for pressure measurement, Measurement of vacuum: McLeod gauge, thermal conductivity gauges, Ionization gauge, Electrical pressure transmitter.

Unit III

Flow Measurements: Introduction, units of flow measurement, classification of flow meters, variable head flow meters- orifice plate, venturi tube and flow nozzle, variable area flow meters- Rotameter, Electro Magnetic flow meters and ultrasonic flow meters, turbine and open channel flow meters.

Unit IV

Force and Torque Measurement: Electric balance - Different types of load cells - Hydraulic, Pneumatic, strain gauge, Piezoelectric load cells, Different methods of torque measurement- Types of dynamometers, Absorption dynamometer- Prony brake and rope brake dynamometer.

Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell.
Moisture: Different methods of moisture measurements – Thermal Conductivity and Capacitive sensors, Application of moisture measurement - Moisture measurement in solids.

Textbooks:
1. Patranbis D, ”Principles of Industrial Instrumentation, Tata McGraw Hill Pub., New Delhi (1991)
2. A.K. Sawhney and Puneet Sawhney, “Mechanical Measurements and Instrumentation and Control”, Dhanpat Rai & Co. (P) Limited, 2015.
3. S.K. Singh, “Industrial Instrumentation and Control”, Tata McGraw Hill Publishing Ltd., New Delhi

References:
1. Ernest.O. Doebelin and Dhanesh.N. Manik, Doebelin’s Measurement Systems, McGraw Hill, 6th Ed, 2011.
2. Douglas M. Considine, Process / Industrial Instruments & Controls Handbook, 5th Edition, McGraw Hill, Singapore, 1999
3. Bela G. Liptak, Instrument Engineers' Handbook, Volume One: Process measurement and analysis, CRC Press, 4th Edition, 2003.

Introduction to Industrial Instrumentation Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	ICE-OAE	ICE-OAE-4	OICE-435P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Industrial Instrumentation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Measurement of Temperature using RTD
2. Measurement of level using electrical sensor
3. Measurement of pressure using electrical method
4. Measurement of flow using variable area technique
5. Measurement of force using load cell
6. Measurement of humidity using hygrometer.
7. Measurement of flow using variable flow technique
8. Measurement of vaccum pressure using simulation software
9. Measurement of high temperature based on radiation principle using simulation software
10. Measurement of pressure using pressure transducer level using simulation software

Introduction to Information and Coding Theory	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-2	ECE-332
EE/EEE	6	PCE	PCE-3	EEE-366

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the efficient, error-free and secure delivery of information using binary streams.
2.	To have in-depth knowledge of error-control coding.
3.	To learn the process of encoding and decoding of digital data streams.
4.	To learn and apply the methods of generation of these codes and evaluate the performance of them over the noisy communication channels.

Course Outcomes (CO)

CO 1	To be able to understand the principles behind an efficient and secure transmission of digital data stream.
CO 2	To be able to demonstrate the knowledge of channel capacity and coding.
CO 3	To be able to implement the knowledge of encoding and decoding of digital data stream using Linear & Cyclic Codes.
CO 4	To be able to analyse the encoding and decoding of digital data stream using Convolutional codes.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	1	1	-	-	-	2	-	3	-	1
CO 2	3	3	3	3	1	1	-	2	-	2	-	2
CO 3	3	3	3	3	3	1	-	2	-	2	-	2
CO 4	3	3	3	3	3	1	-	2	-	2	-	2

UNIT-I

Introduction to Information Theory, Uncertainty & Information, Mutual Information, Average mutual information, Entropy, Relative Entropy, Extension of an Information source and Markov Source, Maximum Entropy Principle, Information measure of Continuous random Variables, Maximum Entropy Principle, Jensen’s Inequality, Fano’s Inequality, Introduction to lossless coding, Source coding theorem Block code and its properties, Instantaneous code and its properties, Kraft-Mcmillan equality, Huffman Coding, Shannon Fano coding, Lempel Ziv Algorithm.

UNIT-II

Introduction to discrete information channels, Equivocation and Mutual Information, Properties of different information channels, Reduction of information channels, Noiseless channel, Properties of Mutual information, Introduction to channel capacity, Shannon's Channel Coding theorem, Bandwidth – S/N Trade Off, Channel capacity theorem, Shannon Limit, Channel capacity for MIMO system

UNIT-III

Definition of terms: Redundancy, code efficiency, systematic codes, Hamming distance, Hamming Weight, Hamming Bound, Types of Code: Parity check codes, Hamming codes, BCH Codes, RS Codes, Linear Block Codes, Generator and Parity Check matrix, Syndrome decoding, LDPC Codes, MDS codes.
Introduction to Cyclic Codes, Polynomials, division algorithm for polynomials, Generation and detection of cyclic codes, Matrix Description of cyclic codes, Golay Codes, CRC Codes, Circuit implementation of cyclic codes.

UNIT – IV

Burst Error Detecting and correcting codes, Convolutional codes, Time domain and frequency domain approaches, Code Tree, Trellis and State diagram, Decoding of convolutional codes, Viterbi's Algorithm, Sequential Decoding, Transfer function and Distance properties of convolutional codes, Bound on bit error rate, Coding Gain.

Textbook(s):
1. Ranjan Bose, "Information Theory Coding & Cryptography", 3rd Edition, McGraw Hill, 2017.
2. T.M. Cover and J.A Thomas, "Elements of Information Theory", 2nd Edition, Wiley India Pvt Ltd, 2013.

References:
1. Salvatore Gravano, Introduction to Error Control Codes, Oxford University Press, 2017.

Introduction to Information and Communication Theory	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	6	PCE	PCE-3	CIE-360T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the basics of probability theory, Digital Information and Communication theory.
2.	To learn the knowledge of error-control coding.
3.	To learn the process of encoding and decoding of digital data streams.
4.	To learn the methods of generation of these codes.

Course Outcomes (CO)

CO 1	To be able to understand the basic principles of probability theory.
CO 2	To be able to demonstrate the knowledge information and basic communication theory.
CO 3	To be able to implement the knowledge of encoding and decoding of digital data stream using Linear Block Codes.
CO 4	To be able to analyse the encoding and decoding of digital data stream using Convolutional codes.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	1	1	-	-	-	2	-	3	-	1
CO 2	3	3	3	3	1	1	-	2	-	2	-	2
CO 3	3	3	3	3	3	1	-	2	-	2	-	2
CO 4	3	3	3	3	3	1	-	2	-	2	-	2

UNIT-I

Probability and Random Process: Introduction, Probability, Random variables, Statistical Averages, Random Processes, Mean, Correlation and Covariance function, Ergodic Process, Power Spectral Density, Gaussian process, Information measure of Continuous random Variables, Jensen’s Inequality, Fano’s Inequality.

UNIT-II

Introduction to Information Theory, Uncertainty & Information, Mutual Information, Average mutual information, Entropy, Relative Entropy, Introduction to lossless coding, Source coding theorem, Block code and its properties, Kraft-Mcmillan equality, Huffman Coding, Shannon Fano coding, Lempel Ziv Algorithm.
Communication Process, Primary Communication resources, Sources of Information, Communication Networks and Communication Channels.

UNIT-III

Definition of terms: Redundancy, code efficiency, systematic codes, Hamming distance, Hamming Weight, Hamming Bound, Types of Code: Parity check codes, Hamming codes, BCH Codes, RS Codes, Linear Block Codes, Generator and Parity Check matrix, Syndrome decoding.
Introduction to Cyclic Codes, Matrix Description of cyclic codes, Golay Codes, CRC Codes, Circuit implementation of cyclic codes.

UNIT – IV

Burst Error Detecting and correcting codes, Convolutional codes, Time domain and frequency domain approaches, Code Tree, Trellis and State diagram, Decoding of convolutional codes, Viterbi’s Algorithm, Sequential Decoding, Bound on bit error rate, Coding Gain.

Textbook(s):
1. Ranjan Bose, “Information Theory Coding & Cryptography”, 3rd Edition, McGraw Hill, 2017.
2. T.M. Cover and J.A Thomas, “Elements of Information Theory”, 2nd Edition, Wiley India Pvt Ltd, 2013.
3. Simon Haykins and Michael Moher, “Communications Systems”, 5th Edition, John Wiley & Sons Inc, 2009.

References:
1. Salvatore Gravano, Introduction to Error Control Codes, Oxford University Press, 2017.

Introduction to Information and Communication Theory Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	6	PCE	PCE-3	CIE-360P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Information and Communication Theory) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a MATLAB program to compute entropy and mutual information for Noise Free Channel.
2. Write a MATLAB program to compute entropy and mutual information for Binary Symmetric Channel.
3. Write a MATLAB program to implement algorithm for generation and evaluation of Shannon- Fano coding and decoding.
4. Write a MATLAB program to implement algorithm for generation and evaluation of Huffman coding and decoding.
5. Write a MATLAB program to implement algorithm for generation and evaluation of Lempel Ziv dictionary method.
6. Write a MATLAB program to implement the algorithm for encoding and decoding of Linear Block Code.
7. Write a MATLAB program to implement the algorithm for encoding and decoding of Cyclic Code.
8. Write a MATLAB program to implement the algorithm for generating Convolutional code by Code Tree.
9. Write a MATLAB program to implement the algorithm for generating Convolutional code by Code Trellis.
10. Write a MATLAB program to implement the algorithm for encoding and decoding of BCH Code.

Introduction to Internet of Things	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-2	CIE-330T
ICE	6	PCE	PCE-3	ICE-328T
CSE-IoT/CSE-ICB	6	PC	PC	IOT-324T
EAE	6	IOT-EAE	IOT-EAE-1A	IOT-324T
EAE	6	ICB-EAE	ICB-EAE-1A	IOT-324T
ECE	7	PCE	PCE-5	ECE-429T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Describe what IoT is and how it works today
2.	Recognise the factors that contributed to the emergence of IoT
3.	Design and program IoT devices
4.	Define the infrastructure for supporting IoT deployments

Course Outcomes (CO)

CO 1	Demonstrate basic concepts, principles and challenges in IoT.
CO 2	Illustrate functioning of hardware devices and sensors used for IoT
CO 3	Analyze network communication aspects and protocols used in IoT
CO 4	Apply IoT for developing real life applications using Ardunio programming.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	1	-	-	-	1	-	-	2	-	3	-
CO 2	1	-	2	-	3	-	-	-	-	1	-	2
CO 3	-	2	2	-	-	1	-	-	2	-	-	2
CO 4	2	1	-	-	2	-	-		-	1	1	-

UNIT-I

Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples. Design Principles for Connected Devices: IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and affordability

UNIT-II

Hardware for IoT: Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, NetArduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex.

UNIT-III

Network & Communication aspects in IoT: Wireless Medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

UNIT - IV

Programming the Ardunio: Ardunio Platform Boards Anatomy, Ardunio IDE, coding, using emulator, using libraries, additions in ardunio, programming the ardunio for IoT.

Textbook(s):
1. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things key applications and protocols”, Willey
2. Jeeva Jose, Internet of Things, Khanna Publishing House

References:
1. Michael Miller, “The Internet of Things”, Pearson
2. Raj Kamal, “Internet of Things”, McGraw-Hill, 1st Edition

Introduction to Internet of Things Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-2	CIE-330P
ICE	6	PCE	PCE-3	ICE-328P
CSE-IoT/CSE-ICB	6	PC	PC	IOT-324P
EAE	6	IOT-EAE	IOT-EAE-1A	IOT-324P
EAE	6	ICB-EAE	ICB-EAE-1A	IOT-324P
ECE	7	PCE	PCE-5	ECE-429P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Internet of Things) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Start Raspberry Pi and try various Linix commands in command terminal window: ls, cd, touch, mv, rm, man, mkdir, rmdir, tar, gzip, cat, more, less, ps, sudo, cron, chown, chgrp, ping etc
2. Run some python programs on Pi like: a) Read your name and print Hello message with name b) Read two numbers and print their sum, difference, product and division. c) Word and character count of a given string. d) Area of a given shape (rectangle, triangle and circle) reading shape and appropriate values from standard input.
3. Run some python programs on Pi like: a) Print a name 'n' times, where name and n are read from standard input, using for and while loops. b) Handle Divided by Zero Exception. c) Print current time for 10 times with an interval of 10 seconds. d) Read a file line by line and print the word count of each line.
4. Light an LED through Python program
5. Get input from two switches and switch on corresponding LEDs.
6. Flash an LED at a given on time and off time cycle, where the two times are taken from a file.
7. Flash an LED based on cron output (acts as an alarm)
8. Switch on a relay at a given time using cron, where the relay's contact terminals are connected to a load.
9. Get the status of a bulb at a remote place (on the LAN) through web.
10. Push sensor data to cloud and Control an actuator through cloud.

Introduction to Metrology and Instrumentation	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	7	PC	PC	MAC-407

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Design of part, tolerances and fits.
2.	Principles of measuring instruments and gauges and their uses.
3.	Determine error and analysing uncertainty in the measurements.
4.	Evaluation and inspection of surface roughness and textures.

Course Outcomes (CO)

CO 1	Explain the basic knowledge of measurements, metrology, and measuring devices.
CO 2	Understand the fundamentals and the working of comparators.
CO 3	Understand the fundamentals of various methods for the measurements of screw threads and the working of optical measuring instruments.
CO 4	Understand various advanced measuring devices and machine tool metrology and describe application of principle of metrology and measurements in industries.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	3	3	3	2	2	-	3	-	-	-	2
CO 2	2	3	2	3	2	3	-	3	-	-	-	2
CO 3	2	3	2	2	2	3	-	3	-	-	-	2
CO 4	3	3	3	2	2	3	-	3	--	-	-	2

UNIT-I

Principles of Measurement: Definition of Metrology, the difference between precision and accuracy. Sources of errors: Controllable and Random Errors, Effects of Environment and Temperature, Effects of support, alignment errors, application of Least Square principles, and errors in measurement of quality which is the function of other variables.

Length Standards: Line standards, end standards, and wavelength standards, transfer from line standards to end standards. Numerical based on line standards. Slip gauges – its use and care, methods of building different heights using different sets of slip gauges.

Limits, Fits, and Tolerances: Various definitions, IS919-1963, different types of fits, and methods to provide these fits. Numerical to calculate the limits, fits, and tolerances as per IS 919- 1963. ISO system of limits and fits; Gauges and their types, limit gauges – plug and ring gauges. Gauge Design – Taylor's Principle, wear allowance on gauges. Different methods of giving tolerances on gauges, Numerical.

UNIT-II

Comparators: Mechanical Comparators: JohansonMikrokator and Sigma Mechanical Comparator. Mechanical-optical comparator. Principles of Electrical and electronic comparators. Pneumatic comparators – advantages, systems of Pneumatic Gauging:- Flow type and back pressure type, Principle of working of back pressure gauges, different types of sensitivities and overall magnification, Solex Pneumatic gauges and differential comparators. Numerical based on pneumatic comparators.

UNIT-III

Straightness and Flatness: Definition of Straightness and Flatness error. Numerical based on the determination of straightness error of straight edge with the help of spirit level and auto collimator. Numerical based on the determination of flatness error of a surface plate with the help of spirit level or auto-collimator.
Screw Thread Measurement: Errors in threads, Measurement of elements of screw threads – major dia, minor dia, pitch, flank angle, and effective diameter (Two and three-wire methods). Effect of errors in pitch and flank angles and its mathematical derivation. Numericals.

UNIT – IV

Instrument Calibration Methods: Introduction, Definition of Calibration, Need for Calibration, Characteristics of Calibration, Calibration Overall Requirements and Procedures, Calibration Methods/Procedures, Calibration Laboratory Requirements, Industry Practices and Regulations, Calibration and Limitations of a Digital System, Verification and Calibration of CNC Machine Tool, Inspection of the Positioning Accuracy of CNC Machine Tools, CNC Machine Error Assessment and Calibration, Calibration of 3-axis CNC Machine Tool, Calibration of a Coordinate Measuring Machine (CMM)
Surface Texture: Introduction, different types of irregularities, standard measures for assessment and measurement of surface finish.

Textbook(s):

1. R.K. Jain, “Engineering Metrology”, Khanna Publishers, Delhi.
2. I.C. Gupta, “Engineering Metrology”, Dhanpat Rai Publications, Delhi.

References:

1. F.W. Galyer& C.R. Shotbolt, “Metrology for Engineers”, ELBS edition.
2. Samir Mekid, “Metrology and Instrumentation - Practical Applications for Engineering and Manufacturing”, John Wiley & Sons, Inc. and ASME Press, 2022.

Introduction to Metrology and Instrumentation Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	7	PC	PC	MAC-459

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Metrology and Instrumentation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of Slip Gauges along with their usage i.e. wringing of Slip Gauges
2. Study and working of simple measuring instruments: Vernier calipers and micrometer.
3. To study bore gauge diameter with bore gauge.
4. Measurement of angle using sine bar and slip gauges, Study of limit gauges.
5. Study and angular measurement of a given piece using bevel protractor. Study of dial indicator & its constructional details.
6. Measurement of effective diameter of a screw thread using 3 wire method.
7. To measure major diameter, minor diameter and pitch of screw thread using Profile Projector.
8. To measure major diameter, minor diameter and pitch of screw thread using Tool Maker's microscope.
9. To measure the surface roughness using MAHR Pocket Surf instrument.
10. To find the flatness error in surface plate.
11. Study of various equipment(s) viz. Laser Distance measuring device, micro weighing device, sound level meter, etc.

Introduction to Mobile Ad Hoc Networks	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	7	PCE	PCE-5	CIE-427

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Build an understanding of the fundamental concepts of Mobile Ad hoc Networks.
2.	To Understand the advanced concepts and various Ad Hoc Routing Protocols.
3.	To Understand the issues in designing Ad hoc Networks and its solutions.
4.	To create the awareness of QoS in Ad-hoc Networks.

Course Outcomes (CO)

CO 1	Understand the fundamental concepts of Mobile Ad hoc Networks.
CO 2	Understand the advanced concepts and various Ad Hoc Routing Protocols.
CO 3	Analyse the issues in designing Ad hoc Networks and build its solutions.
CO 4	Create the awareness of QoS in Ad-hoc Networks.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	2	3	2	2	3	-	-	-	3	2	3	3
CO 2	2	3	2	3	2	-	-	-	3	3	2	3
CO 3	2	2	2	3	3	-	-	-	3	3	3	3
CO 4	2	3	2	3	3	-	-	-	3	3	3	3

UNIT-I

Introduction to ad-hoc networks – definition, characteristics features, applications. Characteristics of wireless channel, ad-hoc mobility models: indoor and outdoor models.

UNIT-II

Overview of Ad Hoc Routing Protocols: Table-Driven Approaches, Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), Cluster Switch Gateway Routing (CSGR), Source-Initiated On – Demand Approaches. Ad Hoc On-Demand Distance Vector Routing (AODV), Dynamic Source Routing (DSR), Temporally Ordered Routing Algorithm (TORA), Signal Stability Routing (SSR), Location-Aided Routing (LAR) , Power – Aware Routing (PAR), Zone Routing Protocol (ZRP), Source Tree Adaptive Routing (STAR) , Relative Distance Micro diversity Routing (RDMAR) , Multicast Routing in Mobile Ad Hoc Networks, Existing Ad Hoc Multicast Routing Protocols, ABAM : Associativity-Based Ad Hoc Multicast.

UNIT-III

Issues in designing – Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols. Classification of transport layer solutions, TCP over Adhoc wireless networks (TCP-F, TCP-BUS, ATCP, SPLIT-TCP)

UNIT – IV

Quality of service in Mobile Adhoc Networks: Introduction, Issues and Challenges in providing QoS in Ad hoc networks, Classification of QoS solutions, MAC layer solutions (Cluster TDMA), network layer solutions (Ticket based, TDR, QoS enables AoDV, OQR)

Textbook(s):

1. C. Siva Ram Murthy & B.S. Manoj, Adhoc Wireless Networks Architectures and Protocols, ISBN: 978-81-317-0688-6, 2014

References:

1. Stefano Basagni, Marco Conti, Silivia Giordano and Ivan Stojmenoic, Mobile Adhoc Networkin, ISBN: 978-0-471-65688-3, 2010.
2. C.K.Toh: Adhoc Mobile Wireless Networks- Protocols and Systems, Prentice-Hall, 2007

Introduction to Power Electronics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-354T
OAE	7	EE-OAE	EE-OAE-5	OEE-431T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn the operation characteristics and firing circuits of power electrons devices.
2.	To acquire knowledge of controlled rectifier and choppers control DC Motors
3.	To get the exposure of square wave, Quashi square wavePWM and multilevel inverters there use to control AC drives
4.	apply AC controllers cycloconverter and matrix converter to control induction motors

Course Outcomes (CO)

CO 1	Understand the operation characteristics and firing circuits of power electronic devices
CO 2	Gain the knowledge of controlled rectifier, choppers and their use to control DC Motors
CO 3	Analyse and design square wave, quashi wave, and multilevel inverters to control AC drive
CO 4	Design AC converter,AC controller,cyclo converter and matrix converter to control induction motor

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	2	3	3	1	1	1	2	3
CO 2	3	3	3	3	3	3	3	1	1	1	2	3
CO 3	3	3	3	3	3	3	3	1	1	1	2	3
CO 4	3	3	3	3	3	3	3	1	1	1	2	3

UNIT- I

Introduction: Characteristics and switching behaviour of Power Diode, SCR, UJT, TRIAC, DIAC, GTO, MOSFET, IGBT, MCT and power BJT, two-transistor analogy of SCR, firing circuits of SCR and TRIAC, SCR gate characteristics, SCR ratings. Protection of SCR against over current, over voltage, high dV/dt, high dI/dt, thermal protection, Snubber circuits, Methods of commutation, series and parallel operation of SCR, Driver circuits for BJT/MOSFET.

UNIT- II

A.C. to D.C. Converter: Classification of rectifiers, single and three phase controlled rectifiers, fully controlled and half controlled rectifiers and their performance parameters, single-phase and three phase dual converter.
D.C. to D.C. Converter: Classification of choppers as type A, B, C, D and E, principle of operation, switching mode regulators: Buck, Boost, Buck-Boost, Cuk regulators.

DC Motor Drives: DC motor speed control, controlled rectifier fed dc drives, chopper controlled dc drives.

UNIT- III

D.C. to A.C. Converter: single phase single pulse inverter: Square wave, quasi square. Three phase single pulse inverters (120° and 180° conduction) Modulation Techniques and reduction of harmonics, PWM techniques, SPWM techniques, SVM, Carrier less modulation. , PWM Inverter, Bidirectional PWM converters, voltage source inverters and current source inverter, Multi level Inverter: cascaded and NPC Inverters. Introduction of AC drives

UNIT-IV

A.C. to A.C. Converter: AC voltage Controllers**,** Cyclo-converters : single phase to single phase, three phase to single phase, three phase to three phase Cyclo-converter circuit and their operation, Matrix converter.
Induction Motor Drives: Three phase induction motor starting, braking, , speed control from stator and rotor sides, stator voltage control, variable frequency control from voltage sources and current sources

Textbooks:

1. M.H. Rashid, "Power Electronics: Circuits, Devices and Applications" Pearson Publications.
2. Daniel W. Hart, "Power Electronics "Tata McGraw-Hill
3. H.C. Rai, "Power Electronics Devices, Circuits, Systems and Application", Galgotia Publications, 3rd Edition

References:

1. Singh, Kanchandani, "Power Electronics", Tata McGraw-Hill.
2. Ned Mohan, Tore M. Undeland and Robbins, "Power Electronics: Converters, Applications and Design" Wiley India Publication
3. V R Moorthi, "Power Electronics: Devices, Circuits and Industrial Applications", Oxford Publication.
4. Kassakian, Schlecht, Verghese, "Principles of Power Electronics" , Pearson Publications
5. M.S. Jamil Asghar, "Power Electronics" PHI Publication
6. P. S. Bimbhra "Power Electronics", Khanna Publishing.

Introduction to Power Electronics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-354P
OAE	7	EE-OAE	EE-OAE-5	OEE-431P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Power Electronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study and analyze V-I characteristics of SCR and TRIAC.
2. To study the switching characteristics of MOSFET and IGBT
3. To study R and RC and UJT based firing circuits using SCR.
4. To study single phase Semi-converter and Full converters feeding R and RL load
5. To study A.C phase control using SCR (half and full wave) using DIAC and TRIAC for dimmer application.
6. To study single-phase cyclo- converter feeding R and RL loads.
7. To study the operation and duty cycle control of buck and boost converter feeding R loads.
8. To study the operation and duty cycle control of Type-C chopper.
9. To study the THD in operation of single phase Square wave and Quasi square wave Inverter.
10. To study the operation of SPWM Inverter.

Introduction to Robotics Engineering	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-5	ECE-433

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To develop the knowledge in various robot structures and their workspace.
2.	To develop the skills in performing kinematics analysis of robot systems.
3.	To provide the knowledge of the dynamics associated with the operation of robotic systems.
4.	To understand material handling and robot applications in industries.

Course Outcomes (CO)

CO 1	To understand characteristic features of robots and usage of different grippers for industrial Applications.
CO 2	To understand direct and inverse kinematics of robot structure.
CO 3	To Illustrate Differential Kinematics of planar and spherical manipulators.
CO 4	To understand classification of robot actuators, robot control and trajectory planning.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	2	3	3	2	1	-	2	2	2
CO 2	3	2	3	3	3	3	-	-	-	2	2	2
CO 3	3	3	3	3	3	2	-	-	-	2	2	3
CO 4	3	3	3	3	3	3	2	2	2	3	3	3

UNIT I

Introduction: Automation and robotic, an over view of robotics, classification by coordinate system and control systems; Components of the industrial robotics: Degrees of freedom, end effectors: Mechanical gripper, magnetic, vacuum cup and other types of grippers, general consideration on Gripper selection and design.

UNIT II

Motion analysis: Basic rotation matrices, composite rotation matrices, Euler angles, equivalent angle and axis, homogeneous transformation, problems; Manipulator kinematics: D-H notations, joint coordinates and world, coordinates, forward and inverse kinematics, problems.

UNIT III

Trajectory planning: Joint space scheme, cubic polynomial fit, avoidance of obstacles, types of motion: Slew motion, joint interpolated motion, straight line motion, problems, Robot actuators and feedback components;

Actuators: pneumatic and hydraulic actuators, Control: joint motion control, feedback control, Computed torque control, Perception, Localisation and mapping.

UNIT IV

Probabilistic robotics, Path planning, BFS; DFS; Dijkstra; A-star; D-star; Voronoi; Potential Field; Hybrid approaches, Introduction to Reinforcement Learning, Electric actuators: DC servo motors, stepper motors, feedback components: position sensors, potentiometers, resolvers and encoders, velocity sensors, tactile sensor; Robot application in manufacturing: Material handling, assembly and inspection.

Textbook(s):
1. Groover M. P, “Industrial Robotics”, TataMcGraw-Hill, 1st Edition, 2013.
2. J.J Criag, “Introduction to Robotic Mechanics and Control”, Pearson, 3rd Edition, 2013.
3. Robert J Schilling, Fundamentals of Robotics, Prentice Hall India.

References:
1. John J Craig, Introduction to Robotics, Prentice Hall International, 2005.
2. Peter Corke, Robotics, Vision and Control, Springer Cham, 2017.
3. Bruno Siciliano, Oussama Khatib, Springer Handbook of Robotics, Springer Berlin, Heidelberg, 2008.

Introduction to Sensors and Transducers	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-IoT/CSE-ICB	6	PC	PC	IOT-326T
EAE	6	IOT-EAE	IOT-EAE-1B	IOT-326T
EAE	6	ICB-EAE	ICB-EAE-1B	IOT-326T
EAE	6	RA-EAE	RA-EAE-2	IOT-326T
EAE	6	CI-EAE	CI-EAE-2	IOT-326T
OAE	6	ICE-OAE	ICE-OAE-1	OICE-320T
EAE	7	ES-EAE	ES-EAE-5B	IOT-409T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide an understanding about the concepts of measurement system its static and dynamic characteristics
2.	To expose the students to various sensors and transducers for measuring mechanical quantities and their applications.
3.	To teach the basic conditioning circuits for various sensors and transducers.
4.	To introduce about advancements in sensor technology and smart sensors

Course Outcomes (CO)

CO 1	Ability to define, understand various Sensors, their need and properties of sensors
CO 2	Ability to apply knowledge of various types of transducers in domestic and industrial applications
CO 3	Ability to analyse various types of sensors for particular application
CO 4	Ability to design signal conditioning circuit for various sensors and transducers

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	-	-	2	-	-	-	2	-	3
CO 2	3	3	2	2	-	2	-	-	2	2	-	3
CO 3	3	3	3	3	-	2	-	-	2	3	2	3
CO 4	3	3	3	3	-	2	-	2	2	3	2	3

UNIT I

Introduction to sensors and Transducers: General concepts and terminology of measurement systems and its functional elements, transducer classification, static and dynamic characteristics of a measurement system, criteria for transducer selection; Resistive Transducers: Principles of operation, construction, theory, signal conditioning circuits and applications of resistance potentiometers, strain gauges (metallic and semi-conductor type), resistance thermometer, thermistors, photo transistors

UNIT II

Displacement Sensors and Transducers: Capacitive Transducers: Types of capacitive transducer, Principles of operation, construction, theory, signal conditioning circuits and applications of capacitive transducers
Inductive Transducers: Types of Inductive transducer, Principles of operation, construction, signal conditioning circuits and applications of various variable inductive transducers, LVDT, RVDT, Eddy current sensors, Synchros

UNIT III

Temperature and Radiation Sensors: Active Transducers: Principle of operation, construction, theory, signal conditioning and applications of Piezo-electric transducer, Magneto-strictive transducer, Hall effect transducer, Photo-voltaic transducer and Thermocouple; Optical transducers: photo-emissive, photo-conductive and Photovoltaic cells, photomultipliers; Digital Transducers: Optical encoders translational and rotary encoders (absolute position and incremental position encoders) and magnetic pickups

UNIT IV

Smart Sensors: Other transducers: Ultrasonic sensors, Vibration pickups and accelerometers and its dynamic response, stroboscope, sound and humidity sensors, Microelectromechanical system (MEMS), Biosensors: Glucometer, Oxymeter, Nanosensors and its application, Smart sensor system

Textbooks:
1. D. Patranabis, Sensors and Transducers, PHI Learning Pvt. Ltd., 2nd edition
2. D V S Murty, Transducers and Instrumentation, PHI Learning Pvt. Ltd.

References:
1. E.O. Doebelin, Dhanesh N Manik, Measurement Systems, 6th Edition, McGraw Hill
2. John P. Bentely, Principles of Measurement System, 4th Edition, Pearson Prentice Hall

Introduction to Sensors and Transducers Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-IoT/CSE-ICB	6	PC	PC	IOT-326P
EAE	6	IOT-EAE	IOT-EAE-1B	IOT-326P
EAE	6	ICB-EAE	ICB-EAE-1B	IOT-326P
EAE	6	RA-EAE	RA-EAE-2	IOT-326P
EAE	6	CI-EAE	CI-EAE-2	IOT-326P
OAE	6	ICE-OAE	ICE-OAE-1	OICE-320P
EAE	7	ES-EAE	ES-EAE-5B	IOT-409P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Sensors and Transducers) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of static and dynamic characteristics of sensors.
2. Measurement of displacement using LVDT
3. Measurement of strain using strain gauge transducer.
4. Measurement of displacement using potentiometer.
5. Measurement of temperature using RTD and plot the characteristics of RTD.
6. Measurement of temperature using thermister.
7. Measurement of pressure using Load cell.
8. Measurement of speed using magnetic sensor.
9. Measurement of speed using photoelectric sensors.
10. Measurement of pressure using pressure transducer
11. Measurement of liquid level using capacitive sensor.

Introduction to Software Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	CSE-OAE	CSE-OAE-5B	OCSE-413T
OAE	7	SD-OAE	SD-OAE-4B	OSD-451T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the basic concepts of the software development processes, Software requirements and specifications
2.	To impart knowledge of Software Project Planning and various Software design techniques
3.	To understand Software Metrics, Software Reliability, and Reliability Models
4.	To impart the knowledge and use of software engineering processes and tools in analysis, design, implementation, software testing, documentation, and maintenance for software systems.

Course Outcomes (CO)

CO 1	Ability to have an understanding of SDLC Models, Techniques for Requirement Elicitation, and SRS Document.
CO 2	To be able to explain Software Project Planning and various methods for software design
CO 3	To Understand Software Metrics, Software Reliability, and Quality assurance
CO 4	Ability to have an understanding of Software testing, documentation and maintenance.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT-I

Introduction: Introduction to Software Engineering, Importance of software engineering as a discipline, Software applications, Software Crisis, Software Processes & Characteristics, Software life cycle models, Waterfall, Prototype, Evolutionary and Spiral Models.

Software Requirements analysis & specifications: Requirement engineering, requirement elicitation techniques like FAST, QFD & Use case approach, requirements analysis using DFD, Data dictionaries & ER Diagrams, Requirements documentation, Nature of SRS, Characteristics & organization of SRS, Requirement Management, IEEE Std. for SRS.

UNIT-II

Software Project Planning: Size Estimation like lines of Code & Function Count, Cost Estimation Models, COCOMO, Putnam resource allocation model, Risk Management.
Software Design: Cohesion & Coupling, Classification of Cohesiveness & Coupling, Function Oriented Design, Object Oriented Design.

UNIT-III

Software Metrics: Software measurements: What & Why, Token Count, Halstead Software Science Measures, Data Structure Metrics, Information Flow Metrics.
Software Reliability: Importance, Hardware Reliability & Software Reliability, Failure and Faults, Software Quality Models, CMM & ISO 9001.

UNIT – IV

Software Testing: Testing process, Design of test cases, Introduction to functional testing & Structural testing, Unit Testing, Integration and System Testing, Debugging, Alpha & Beta Testing.
Software Maintenance: Management of Maintenance, Maintenance Process, Maintenance Models, Regression Testing, Reverse Engineering, Software Re-engineering, Configuration Management, Documentation.

Textbook(s):
1. K. K. Aggarwal and Yogesh Singh, “Software Engineering”, New Age International, 3rd Ed., 2005.
2. R. S. Pressman, “Software Engineering – A Practitioner's Approach”, McGraw Hill Int., 5th Ed., 2001.
3. Pankaj Jalote, “An Integrated Approach to Software Engineering”, Narosa, 3rd Ed., 2005.

References:
1. Stephen R. Schach, “Classical & Object Oriented Software Engineering”, IRWIN, 1996.
2. James Peter, W. Pedrycz, “Software Engineering: An Engineering Approach”, John Wiley & Sons.
3. I. Sommerville, “Software Engineering”, Addison Wesley,8th Ed., 2009.
4. Frank Tsui and Orlando Karan, “Essentials of Software Engineering”, Joes and Bartlett, 2nd Ed., 2010.
5. Kassem A. Saleh, “Software Engineering”, Cengage Learning, 2009.
6. Rajib Mall, “Fundamrntal of Software Engineering”, PHI, 3rd Ed., 2009.
7. Carlo Ghizzi, Mehdi Jazayeri and Dino Mandrioli, “Fundamental of Software Engineering”, PHI, 2nd Ed., 2003.
8. Carol L. Hoover, Mel Rosso-Llopart and Gil Taran, “Evaluating Project Decision Case Studies in Software Engineering”, Pearson, 2010.

Introduction to Software Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	CSE-OAE	CSE-OAE-5B	OCSE-413P
OAE	7	SD-OAE	SD-OAE-4B	OSD-451P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Introduction to Software Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write down the problem statement for a suggested system of relevance.
2. Do requirement analysis and develop Software Requirement Specification Sheet (SRS) for suggested system.
3. To perform the function oriented diagram: Data Flow Diagram (DFD).
4. Draw the entity relationship diagram for the suggested system.
5. To perform the user’s view analysis for the suggested system: Use case diagram.
6. To draw the structural view diagram for the system: Class diagram, object diagram.
7. To draw the behavioral view diagram: State-chart diagram, Activity diagram
8. To perform the behavioral view diagram for the suggested system: Sequence diagram, Collaboration diagram
9. To perform the implementation view diagram: Component diagram for the system.
10. To perform the environmental view diagram: Deployment diagram for the system.
11. To perform various testing using the testing tool unit testing, integration testing for a sample code of the suggested system.
12. Perform Estimation of effort using FP Estimation for chosen system.
13. To prepare time line chart/Gantt Chart/PERT Chart for selected software project.

Introduction to Transmission Lines, Waveguides and Antenna Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-2	EEE-336T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To familiarise the various types of transmission lines and to deliberate the losses associated.
2.	To communicate information about waveguide concepts
3.	To impart the understanding of characteristics of different types of high frequency resonators.
4.	To impart the knowledge to define different terminologies of antenna parameters.

Course Outcomes (CO)

CO 1	To Understand the primary model of wave propagation in Transmission Lines and Analyze the various line parameters and Apply smith chart for line parameter and impedance calculations.
CO 2	Discuss the fundamental concepts of wave propagation in rectangular and circular waveguides and evaluate their characteristics.
CO 3	Understand the characteristics of resonance frequency of different types of resonator and its modes configuration.
CO 4	To describe the basic parameters of antenna and interpret to solve the radiation components

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Microwave Transmission Lines: Transmission-Line Equations, Solutions of Transmission-Line Equations. Reflection Coefficient, Transmission Coefficient. Standing Wave, Standing-Wave Ratio, Line Impedance, Line Admittance, Open and short circuited lines. Smith Chart Impedance Matching: Single-Stub Matching, Double-Stub Matching. Losses in transmission lines. Lines of different lengths – λ/2, λ/4, λ/8 lines; Introduction to Microstrip transmission line.

UNIT II

Introduction Rectangular Waveguides: Solutions of Wave Equations in Rectangular Coordinates, TE Modes in Rectangular Waveguides, TM Modes in Rectangular Waveguides, Power Transmission in Rectangular Waveguides, Losses in Rectangular Waveguides, Excitations of Modes in Rectangular Waveguides.
Circular Waveguides: Solutions of Wave Equations in Cylindrical Coordinates, TE Modes in Circular Waveguides, TM Modes in Circular Waveguides, Excitations of Modes in Circular Waveguides.

UNIT III

Microwave Resonators: Series and Parallel Resonant Circuits: Series Resonant Circuit, Parallel Resonant Circuit, Loaded and Unloaded *Q.;* Transmission Line Resonators: Short-Circuited λ/2 line, Open-Circuited λ/2, Short-Circuited λ/4Line; Rectangular Waveguide Cavities: Resonant Frequencies, *Q* of the TE_{10l} Mode; Circular Waveguide Cavities: Resonant Frequencies, Q of the TE_{nml}Mode. Dielectric Resonators: Resonant Frequencies, *Q* of the $TE_{01\delta}$Mode. Excitation of Resonators: Critical Coupling, A Gap-Coupled Microstrip Resonator.

UNIT IV

Antennas: Introduction, Types of Antennas, Radiation Mechanism, Introduction monopole and dipole antenna.
Fundamental Parameters: Introduction, Radiation Pattern, Radiation Power Density, Radiation Intensity, Beamwidth, Directivity, Antenna Efficiency, Gain, Realized Gain, Beam Efficiency, Antenna Radiation Efficiency, Friis Transmission Equation and Radar Range Equation

Textbook(s):
1. M. N. O. Sadiku , "Elements of Electromagnetics", Oxford University Press 2007
2. S.Y Liao, "Microwave devices and Circuits" Pearson publications
3. D.M Pozar, "Microwave Engineering", Wiley Publications.
4. Antenna for all Application-John D Kraus, third edition-TMH publication
5. Antenna Theory-Constantine A. Balanis -Third edition-Wiley Publication

References:
1. E. C. Jordon, K. G. Balman, "Electromagnetic Waves & Radiation System" Prentice Hall, India
2. Antennas and Wave Propagation–G. S. N. Raju (Pearson)
3. Foundations of Antenna Theory and Techniques – Vincent F. Fusco(Pearson)

Introduction to Transmission Lines, Waveguides and Antenna Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-2	EEE-336P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Introduction to Transmission Lines, Waveguides and Antenna Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the microwave test bench.
2. To measure the frequency and wavelength using a slotted line section and frequency meter.
3. To measure VSWR and reflection coefficient of different loads.
4. To measure an unknown impedance using a microwave test bench.
5. To plot the radiation pattern of a horn antenna using a microwave test bench.
6. To measure unknown impedance using Smith Chart.
7. To design and simulate a rectangular microstrip patch antenna.
8. To design and simulate a circular patch antenna.
9. 9 .To design and simulate a rectangular microstrip patch antenna array.
10. To design and simulate a circular microstrip patch antenna array.
11. To design and simulate a coaxial cable/microstrip line.

Note: These experiments may be performed using simulation software like HFSS, CST and IE3D.

IoT with Arduino, ESP and Raspberry Pi	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-IoT/CSE-ICB	7	PC	PC	IOT-441T
EAE	7	IOT-EAE	IOT-EAE-3	IOT-441T
EAE	7	ICB-EAE	ICB-EAE-4	IOT-441T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Overview of IoT
2.	To get Familiar with the Concept of Arduino
3.	Overview of ESP Module
4.	To get Familiar with the working of Raspberry Pi

Course Outcomes (CO)

CO 1	Demonstrate basic concepts, principles and challenges in IoT.
CO 2	Illustrate functioning of Arduino used for IoT
CO 3	Analyze the working and communication setup of ESP for IoT
CO 4	Applying the IoT networking using Raspberry Pi

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	2	1	2	3	-	-	3	3	2	1
CO 2	2	1	1	2	-	2	-	-	2	2	2	-
CO 3	2	1	2	-	1	-	-	-	2	2	1	2
CO 4	3	2	-	2	3	1	-	-	1	3	2	1

UNIT-I

Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT-II

Arduino Simulation Environment , Arduino Uno Architecture, Setup the IDE, Writing Arduino Software , Arduino Libraries , Basics of Embedded C programming for Arduino, Interfacing LED, push button and buzzer with Arduino, Interfacing Arduino with LCD, Interfacing of Actuators with Arduino, Interfacing of Relay Switch and Servo Motor with Arduino.

UNIT-III

Basics of Wireless Networking, Introduction to ESP8266 Wi-Fi Module, Various Wi-Fi library, Web server-introduction, installation, configuration , Posting sensor(s) data to web server, M2M vs. IOT , Communication Protocols

UNIT - IV

Introduction to Raspberry Pi, Comparison of various Rpi Models, Understanding SoC architecture and SoCs used in Raspberry Pi, Pin Description of Raspberry Pi, On-board components of Rpi, Projects using Raspberry Pi .

Textbook(s):

1. Olivier Hersent,David Boswarthick, Omar Elloumi, “The Internet of Things key applications and protocols”, Willey
2. Jeeva Jose, Internet of Things, Khanna Publishing House

References:

1. Michael Miller “The Internet of Things”, Pearson
2. Raj Kamal, “Internet of Things”, McGraw-Hill, 1st Edition

IoT with Arduino, ESP and Raspberry Pi Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-IoT/CSE-ICB	7	PC	PC	IOT-441P
EAE	7	IOT-EAE	IOT-EAE-3	IOT-441P
EAE	7	ICB-EAE	ICB-EAE-4	IOT-441P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (IoT with Arduino, ESP and Raspberry Pi) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to sense the available network using Arduino.
2. Write a program to make LED blink using Arduino.
3. Write a program to detect vibration with a sensor using Arduino.
4. Write a program to connect with the available WiFi using Arduino.
5. Write a program to sense a finger when it is placed on Arduino board.
6. Write a program to get temperature notification using Arduino.
7. Write a program to vary light intensity of LED using Arduino
8. Write a program to install MySQL database in Raspberry Pi.
9. Write a program to work with basic MySQL queries by fetching data from database in Raspberry Pi.
10. Write a program to switch light ON and OFF using Raspberry Pi.

Irrigation Engineering and Design of Hydraulic Structures	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	6	PCE	PCE-1	CEE-308

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the principles and requirements of irrigation scheme involving canals
2.	To design the irrigation channel and develop a knowledge of irrigation water requirement and its distribution.
3.	To analyze water head works and design canal regulation structures.
4.	To design hydraulic structures and analyze them under various loading conditions.

Course Outcomes (CO)

CO 1	Define irrigation techniques and hydraulic structures.
CO 2	Explain water requirement, canal regulation structures, components of dam and river training structures
CO 3	Develop expression for irrigation water requirement, forces exerted on gravity dam, and it's stability analysis.
CO 4	Design a hydraulic structures with due consideration to all safety factors.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	1	1	-	1	1	1	-	-	-	-
CO 2	2	2	1	1	-	-	-	1	-	1	-	-
CO 3	2	2	2	1	-	-	-	-	-	-	-	-
CO 4	3	3	3	2	1	-	-	1	-	-	-	-

UNIT-I

Major and medium irrigation schemes of India, Command area development, Types of Soils and their suitability for irrigation, Root Zone soil water, Irrigation requirements, Irrigation water quality, Irrigation canal system, Duty of water, Canal losses, Estimation of design discharge of a canal, canal outlets, Canal regulation, Water logging, causes, effects and remedial measures.

Alluvial channels carrying clear water and Sediment-Laden water, Evaporation and seepage losses in channels, Cross section of irrigation channels, Berms, Freeboard and service road, Silting of channels.

UNIT-II

Sheet pile cut-off walls, Khosla's theory and its applications, Correction for Floor Thickness, Correction for Mutual Interference of sheet piles, Correction for the slope of the floor, Method for determination of exit

gradient, Uplift force on the floor of canal structure.
Canal regulation structures, Canal Fall, Types of canal fall, Cistern element, Vertical/ Horizontal/Inclined-impact Cisterns, No-Impact Cisterns, Roughening measures for energy dissipation such as Friction Block, Ribbed pitching and Provisions such as baffle wall/ deflector/dentated cill etc at the Downstream end of cistern system
Distributary Head Regulator and Cross Regulator and their Design criteria, Control of Sediment Entry into an offtaking channel.

UNIT-III

Cross Drainage Structure, their need and types, Design of Transitions for canal waterway using Hind's Method, Upiri Method and Vittal and Chiranjeevi's method,
Canal Headworks, Selection of the site, Weir or Barrage, Undersluices, Divide Wall, Fish Ladder, Canal Head Regulator, Sediment Excluders and Sediment Ejector.

UNIT - IV

Types of dams, Factors and General Design Criteria for Embankment Dams, Freeboard, Suitability of Foundation, Slope protection, Factors and General Design Criteria for Gravity Dams, Forces on gravity Dam, Causes of failure of a gravity Dam, Stability Analysis of Gravity Dams, Galleries and outlets.
Introduction to Spillway, Types of spillways, energy dissipaters, Cavitation erosion on spillway surface
Classification/ behaviour of rivers, Cutoffs, Aggradation and Degradation, River Training and its objectives, River training Methods such as Levees, Spurs, Guide Banks.

Textbook(s):
1. S.K.Garg- Irrigation Engineering and Hydraulic Structures, Khanna Publishers, Delhi
2. B.C. Punmia and Pande B.B. Lal- Irrigation and Water Power Engineering, Laxmi Publications (P) Ltd., Delhi.

References:
1. Ralph A.Wurbs, Wisley P.James- Water Resources Engineering, PHI, New Delhi.
2. R.K.Sharma and T.K.Sharma- Irrigation Engineering. S.Chand and Company Ltd., New Delhi.
3. Satya Narayana Murty Challa-Water Resources Engineering: Principles and Practice, NewAge Intl.
4. Applied Hydrology - Ven T Chow, David R Maidment, Larry W Mays, McGraw-Hill, New Delhi.
5. Bharat Singh, Fundamentals of Irrigation Engineering, Nem Chand and Brothers, Roorkee.

IT Project Management	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CST	6	PCE	PCE-2	CIE-340

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn detailed information and knowledge about successfully managing complex IT projects.
2.	To learn self-learn and upskill one-self to apply advanced techniques and concepts in managing and completing IT projects
3.	To learn required maturity to manage the information security aspect of IT projects
4.	To learn necessary confidence and experience to predict challenges and risks and address these to prevent impact on project outcomes

Course Outcomes (CO)

CO 1	Explore the appropriate methods to initiate, plan, execute, control and close projects.
CO 2	Demonstrate the knowledge and understanding of concepts, theories, and principles of IT project management.
CO 3	Demonstrate the knowledge of IT projects, risk management and application of techniques to manage risks and deliver value.
CO 4	Analyse different project constraints and their impact on achieving IT project goals.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	3	-	-	-	2	2	2	3
CO 2	3	3	2	2	3	-	-	-	2	2	2	3
CO 3	3	3	2	2	3	-	-	-	2	2	2	3
CO 4	3	3	2	2	3	-	-	-	2	2	2	3

UNIT-I

Introduction to Project Management: What Is a Project?, Program and Project Portfolio Management, The Role of the Project Manager, The Project Management Profession, The Project Management and Information Technology Context: A Systems View of Project Management, Understanding Organizations, Stakeholder Management, Project Phases and the Project Life Cycle, The Context of Information Technology Projects, Recent Trends Affecting Information Technology Project Management, The Project Management Process Groups: A Case Study: Project Management Process Groups, Mapping the Process Groups to the Knowledge Areas Developing an Information Technology Project, Management Methodology, Case Study.

UNIT-II

Project Integration Management: What Is Project Integration Management?, Strategic Planning and Project Selection, Developing a Project Charter, Developing a Project Management Plan, Directing and Managing Project Execution, Monitoring and Controlling Project Work, Performing Integrated Change Control, Closing Projects or Phases, Using Software to Assist in Project Integration Management, Project Scope Management: What Is Project Scope Management?, Collecting Requirements, Defining Scope, Creating the Work Breakdown Structure, Verifying Scope, Controlling Scope, Using Software to Assist in Project Scope Management.

UNIT-III

Project Time Management: The Importance of Project Schedules, Defining Activities, Sequencing Activities, Estimating Activity Resources, Estimating Activity Durations, Developing the Schedule, Controlling the Schedule, Using Software to Assist in Project Time Management, Project Cost Management: The Importance of Project Cost Management, Basic Principles of Cost Management, Estimating Costs, Determining the Budge, Controlling Costs, Using Project Management Software to Assist in Project Cost Management.

UNIT – IV

Project Quality Management: The Importance of Project Quality Management, Planning Quality, Performing Quality Assurance, Performing Quality Control, Tools and Techniques for Quality Control, Modern Quality Management, Improving Information Technology Project Quality, Using Software to Assist in Project Quality Management, Project Human Resource Management: The Importance of Human Resource Management, What Is Project Human Resource Management?, Keys to Managing People, Developing the Human Resource Plan, Acquiring the Project Team, Developing the Project Team, Managing the Project Team, Using Software to Assist in Human Resource Management,

The Importance of Project Communications Management, The Importance of Project Risk Management, The Importance of Project Procurement.

Textbook(s):

1. Kathy Schwalbe, "Managing Information Technology Projects", Sixth Edition, Course Technology, 2011.
2. Ramesh Behl, "Information Technology for Management", Mc Graw Hill.

References:

1. Bob Hughes and Mike Cotterell, "Software Project Management", Fourth Edition, Tata McGraw-Hill.
2. Jack T Marchewka, "Information Technology Project Management", 4Th Edition, John Wiley.
3. Marchewka J.T., Information Technology Project Management Providing Measurable Organizational Value (Pb 2003), DB JWO.

Lean Construction Technology and Management	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	7	PCE	PCE-5	CEE-411
EAE	7	CTM-EAE	CTM-EAE-4	CEC-415

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Comprehend the principles and concepts in Lean Construction and Projects and apply them.
2.	To Learn the techniques used for planning, scheduling and control of construction projects and cost analysis.
3.	To Learn the principles of Contract and tenders
4.	To Learn about the Construction equipment and the entire project life cycle from planning to execution through PRIMAVERA

Course Outcomes (CO)

CO 1	To Apply the application of lean construction in real world through sustainable development
CO 2	To Apply the techniques used for planning, scheduling and control of construction projects and cost analysis.
CO 3	To analyse the principles and concepts of Contract and Tenders.
CO 4	To evaluate the techniques for a real-world project and demonstrate the learning.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	-	1	-	2	1	-	-	1	3	2	1
CO 2	-	3	1	1	1	-	1	-	2	-	1	1
CO 3	2	-	3	2	-	2	-	-	-	3	-	1
CO 4	2	-	-	1	1	-	2	-	-	1	2	1

UNIT-I

Lean Construction and safety, Lean Construction, and sustainable development, Lean and Green, Issues in lean implementation in the construction industry, case studies.

Project Cycle, Organisation, Planning, Scheduling, Monitoring, updating and Management System in Construction.

UNIT-II

Network Techniques: Bar Chart, Milestone chart, work breakdown structure, and preparation of networks. Network techniques like PERT and CPM.

Project Cost Control: Cost Planning, Direct Cost, Indirect Cost, Total Cost Curve, Cost Slope. Time Value of

Money, Present Economy studies, Equivalence Concept, financing of projects, Economic comparisons present worth method, Equivalent annual cost method, discounted cash flow method. Depreciation and break even cost analysis of construction projects**.**

UNIT-III

Contract Management:

Contracts: -Legal Aspects of Contracts, laws related to contracts, land acquisition, labour safety and welfare, Different types of contracts,

Tenders: - Elements of Tender Preparation, Process of tendering, pre qualifications of contracts, Evaluation of tenders, contract negotiation and award of work, monitoring of contract, settlement of disputes, arbitration, and commissioning of project**.**

UNIT – IV

Equipment Management: Earth moving, hauling equipment, hoisting equipment, Conveying Equipment, Concrete Production equipment, Tunnelling equipment, Batching Plant and RMC equipment.

PRIMAVERA: Creating a Project, creating a Work Breakdown Structure, Adding Activities, Assigning Calendars, Creating Relationships, Scheduling, Assigning Constraints, Creating Layouts, Understanding Roles and Resources, Optimising the Project Plan.

Textbook(s):

1. Construction Project Management: planning and scheduling by Henry F.W. Naylor- Delmar Pub.
2. Project Planning and Control Using Primavera P6, Harris, P.E., Eastwood Harris Pty Ltd, 2010.

References:

1. Modern Construction-Lean project delivery and integrated practices. Forbes, L., Ahmed, S, CRC Press, 2011.
2. Construction Equipment and Management, S. C. Sharma, Khanna Publishing, 2019, First Edition.
3. Danny Myers, Construction Economics: A New Approach, Taylor and Francis Publisher, 2016

Linux System Administration	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	6	PCE	PCE-3	CIE-362T
CSE-NET	6	PC	PC	NET-346T
EAE	6	NET-EAE	NET-EAE-2	NET-346T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1. Familiarize students with the Linux environment, and able to run commands on a standard Linux operating system.
2. Provide the skills needed to develop and customize Linux shell programs and to make effective use of a wide range of standard Linux programming and development tools.
3. Design Able to write moderate C programs utilizing common system calls.
4. Design Able to write moderate C programs utilizing common system calls.

Course Outcomes (CO)

CO 1 derstand the basic commands of Linux operating system and can write shell scripts
CO 2 eate file systems and directories and operate those using programs.
CO 3 eate file systems and directories and operate those using programs.
CO 4 entify and use Linux utilities to create and manage simple file processing operations

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	3	3	2	-	-	1	3	-	3
CO 2	3	2	-	3	3	2	-	-	1	3	-	3
CO 3	3	2	-	3	3	2	-	-	1	3	-	3
CO 4	3	2	-	3	3	2	-	-	1	3	-	3

UNIT-I

Introduction to Linux, Linux Distributions, Operating system and Linux, History of Unix and Linux, Linux Software’s, Internet Servers, Accessing Linux System, Linux documentation, Unix editor vi, Windows Access and Applications, The Shell: History, Filename Expansion, Standard Input/Output and Redirection, Jobs: Background, Kills, and Interruptions, Ending Processes, Types of Shell. The Shell Scripts and Programming: Shell Variables, Shell Scripts: User-Defined Commands, Environment Variables and Subshells, Control Structures, Shell Initialization and Configuration Files

UNIT-II

Linux Files, Directories, and Archives: Linux Files, The File Structure, Listing, Displaying, and Printing Files, Managing Directories, File and Directory Operations, The mtools Utilities, Archiving and Compressing Files. Network Tools: Network Tools, Network Talk and Messenger Clients, RSH, Kerberos, and SSH Remote Access Commands.

UNIT-III

Basic System Administration: Superuser Control: The Root User, System Time and Date, Scheduling Tasks, System Run Levels, System Directories, Configuration Directories and Files, System Logs, The Linux Auditing System, Performance Analysis Tools and Processes, Grand Unified Bootloader, Managing Users: GUI User Management Tools, User Configuration Files, The Password Files, Managing User Environments, Adding and Removing Users with useradd, usermod, and userdel, Managing Groups, Controlling Access to Directories and Files, Disk Quotas, Lightweight Directory Access Protocol.

UNIT - IV

File Systems: File System Hierarchy Standard, Mounting File Systems, File System Information, Journaling, Mounting File Systems Automatically, Mounting File Systems Manually, Creating File Systems, CD-ROM and DVD-ROM Recording, Mono and .NET Support, Backup Management: Individual Backups, BackupPC, Amanda, Backups with dump and restore.

Textbook(s):
1. Richard Petersen, “The Complete Reference: Linux”, McGraw Hill.
2. Tom Adelstein and Bill Lubanovi , “Linux System Administration”, O’ Reilly.

References:
1. EVI Nemeth, Garth Snyder, Trent R. Hein and Ben Whaley “Unix and Linux System Administration”, Pearson.
2. Sumitabha Das, “Unix Concept and Applications”, The McGraw Hill.

Linux System Administration Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	6	PCE	PCE-3	CIE-362P
CSE-NET	6	PC	PC	NET-346P
EAE	6	NET-EAE	NET-EAE-2	NET-346P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Linux System Administration) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of LINUX operating system.
2. Introduction to various commands in Linux.
3. Study of directory related commands in Linux.
4. Study of various commands to perform operations on files in Linux.
5. Study of process related and other commands in Linux.
6. Study about vi editor and its various modes.
7. Write a program in vi editor to find greatest of three number.
8. Write a program in vi editor to find whether the given number is even or odd.
9. Write a program in vi editor to find factorial of a given number.
10. Write a program in vi editor to find number is prime or not.

Logic and Distributed Control	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-3	ICE-330T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the importance of process automation techniques.
2.	To impart knowledge in PLC based programming.
3.	To implement the concept of introduce distributed control system and different communication protocols. Data manipulation instruction
4.	To have adequate information with respect to interfaces used in DCS

Course Outcomes (CO)

CO 1	derstand the process automation technologies
CO 2	derstand latest communication technologies like HART and Field bus protocol
CO 3	Able to apply different security design approaches, engineering and operator interface issues for designing of Distributed Control System.
CO 4	Able to design and develop a PLC ladder programming for simple process applications

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	-	-	3	1	2	-	-	2	-	3
CO 2	3	2	1	1	3	3	-	3	3	-	2	3
CO 3	3	3	2	2	3	2	2	3	-	1	-	3
CO 4	3	2	3	3	3	3	-	3	3	3	-	3

Unit I

Review of Computers in Process Control: Data loggers, Data Acquisition Systems (DAS), Direct Digital Control (DDC). Supervisory Control and Data Acquisition Systems (SCADA), sampling considerations.Functionalblock diagram of computer control systems.Distributed Control System (DCS) architecture and Comparison withrespect to different performance attributes.

Unit II

Programmable Logic Controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies and isolators. General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions, PLC Basic Functions, register basics, timer functions, counter functions. PLC Installation, troubleshooting and maintenance.

Unit III

PLC Data manipulation instruction - Arithmetic and comparison instruction- Skip, Master Control Reset (MCR) and Zone Control Last state (ZCL) instruction. PLC Advanced intermediate functions: Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Alternate programming languages, Analog PLC operation, networking of PLC, PLC-PID functionsDesign of alarm and interlocks, networking of PLC – Case studies using above instruction sets.

Unit IV

LCU communication Facilities - Communication system requirements, Architectural Issues, Operator Interfaces, Engineering Interfaces. Development of Field Control Unit (FCU) diagram for simple control applications. Interfacing Smart field devices (wired and wireless) with DCS controller, HART and Field bus protocol.Introduction to Object Linking and Embedding (OLE) for Process Control, Automation in the cloud with case studies.

Textbooks:

1. John.W. Webb Ronald A Reis, “Programmable Logic Controllers - Principles andApplications”, 4th Ed, PHI
2. Frank D. Petruzella, “Programmable Logic Controllers”, 2nd Edition, McGraw Hill, NewYork

References:

1. Lukcas M.P, “Distributed Control Systems”, Van Nostrand Reinhold Co., New York
2. Deshpande P.B and Ash R.H, “Elements of Process Control Applications”, ISA Press,New York
3. Krishna Kant, Computer-based Industrial Control, Prentice Hall, NewDelhi, 2nd Edition, 2011.
4. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, 3rd Edition, 2010.
5. Curtis D. Johnson, Process Control Instrumentation Technology, Pearson New International, 8th Ed, 2013.
6. D. Popovic and V.P. Bhatkar, Distributed Computer Control for Industrial Automation, Marcel Dekker, 1990.

Logic and Distributed Control Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-3	ICE-330P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Logic and Distributed Control) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study hardware and software platforms for DCS.
2. To study the MATLAB package for simulation of control system design.
3. Study, understand and perform experiments on timers and counters.
4. To control the water level in a Process Tank using Feed forward Control.
5. To control the batch process reactorusing programmable logic controller.
6. To control the lift plant model using programmable logic controller.
7. To study and perform the variation in settling time and peak overshoot by the variation of the PID controller settings.
8. Logic implementation for Bottle Filling Application.
9. To acquire Analog/Digital signal by interfacing NI myDAQ with LABVIEW.
10. To study the performance for the material handling system

Logic Design and Analysis using Verilog	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-4	ECE-435T
EAE	7	ES-EAE	ES-EAE-5C	ES-411T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Learn and understand the architectures of Field-programmable Gate Arrays.
2.	Translate a software application into hardware logic for FPGA architectures
3.	Design synthesizable systems based on industry-standard coding methods
4.	Build testbenches and create data models to verify bit-true accurate designs.

Course Outcomes (CO)

CO 1	Understand the architecture of FPGAs, tools used in modelling of digital design
CO 2	Analyze and design basic digital circuits with combinatorial and sequential logic circuits using Verilog HDL.
CO 3	Model complex digital systems at several levels of abstractions.
CO 4	Design real time applications such as vending machine and washing machines etc.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	-

UNIT-I

Hardware Description Languages, FPGA Boards and Software Tools, Field-Programmable Gate Arrays: Transistor as a Switch, Logic Gates from Switches, FPGA Building Blocks, Layout of the Xilinx Artix-7 XC7A35T FPGA, Input/output Blocks, Configurable Logic Blocks, Interconnect Resources, Block RAM, DSP Slices, Clock Management, The XADC Block, High-Speed Serial I/O Transceivers, Peripheral Component Interconnect Express Interface, FPGA-Based Digital System Design Philosophy, How to Think While Using FPGAs, Advantages and Disadvantages of FPGAs, Usage Areas of FPGAs.

Verilog Fundamentals: Module Representation, Timing and Delays in Modelling, Hierarchical Module Representation, Testbench Formation in Verilog, Structure of a Verilog Testbench File, Displaying Test Results.

Data Types in Verilog, Net and Variable Data Types, Data Values, Naming a Net or Variable, Defining Constants and Parameters, Defining Vectors, Operators in Verilog, Arithmetic Operators, Concatenation and Replication Operators, Application on Data Types and Operators, FPGA Building Blocks Used in Data Types and Operators, Implementation Details of Vector Operations, Implementation Details of Arithmetic Operations.

UNIT-II

Combinational Circuit Analysis, Logic Function Formation between Input and Output, Boolean Algebra, Gate-Level Minimization, Combinational Circuit Implementation, Truth Table-Based Implementation, Combinational Circuit Design.

Combinational Circuit Blocks: Adders in Verilog, Comparators in Verilog, Decoders in Verilog, Encoders in Verilog, Multiplexers in Verilog, Parity Generators and Checkers in Verilog, Applications on Combinational Circuits, Implementing the Home Alarm System, Implementing the Digital Safe System, Implementing the Car Park Occupied Slot Counting System, FPGA Building Blocks Used in Combinational Circuits.

Data Storage Elements: Latches in Verilog, Flip-Flops in Verilog, Register, Memory, Read-Only Memory, ROM in Verilog, ROM Formation Using IP Blocks, Random Access Memory, Application on Data Storage Elements, FPGA Building Blocks Used in Data Storage Elements.

UNIT-III

Sequential Circuit Analysis, State Table, State Diagram, State Representation in Verilog, Timing in Sequential Circuits, Synchronous Operation, Asynchronous Operation, Shift Register as a Sequential Circuit, Shift Registers in Verilog, Multiplication and Division Using Shift Registers, Counter as a Sequential Circuit, Synchronous Counter, Asynchronous Counter, Counters in Verilog, Frequency Division Using Counters, Sequential Circuit Design, Applications on Sequential Circuits.

UNIT – IV

Universal Asynchronous Receiver/Transmitter (UART) in Verilog, UART Applications, Serial Peripheral Interface (SPI) in Verilog, , SPI Application, Inter-Integrated Circuit (I2C) in Verilog, , I2C Application, Video Graphics Array (VGA) in Verilog, VGA Application, Universal Serial Bus (USB) Receiving Module in Verilog, USB Keyboard Application, Ethernet, FPGA Building Blocks Used in Digital Interfacing.

Advanced Applications: Vending Machine, Digital Clock, Moving Wave via LEDs, Translator, Air Freshener Dispenser, Obstacle-Avoiding Tank, Intelligent Washing Machine, Non-Touch Paper Towel Dispenser, Car Parking Sensor System, Digital Table Tennis Game.

Textbook(s):

1. CemUnsalan, Bora Tar “Digital System Design with FPGA Implementation Using Verilog and VHDL” McGraw-Hill Education, 2017
2. Design through Verilog HDL, T.R. Padmanabhan and B. Bala Tripura Sundari, WSE, IEEE Press, 2004.

References:

1. Advanced Digital Design with Verilog HDL –Michael D. Ciletti, PHI, 2005.
2. Fundamentals of Logic Design with Verilog –Stephen. Brown and Zvonko Vranesic, TMH, 2005.
3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition.
4. A Verilog Primer –J. Bhasker, BSP, 2003. .
5. Donald E. Thomas, Philip R Moorby, 'The Verilog Hardware Description Language", Springer, 5th edition.

Logic Design and Analysis using Verilog Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-4	ECE-435P
EAE	7	ES-EAE	ES-EAE-5C	ES-411P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Logic Design and Analysis using Verilog) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write Verilog programs of full adder and full subtractor using dataflow modelling, check the wave forms and the hardware generated.
2. Write Verilog program of 4-bit binary adder using dataflow modeling, check the wave forms and the hardware generated.
3. Write Verilog programs of encoder and decoder using dataflow modelling, check the wave forms and the hardware generated.
4. Write Verilog programs of multiplexer and demultiplexer using dataflow modelling, check the wave forms and the hardware generated.
5. Write Verilog programs of full adder and full subtractor using structural modelling, check the wave forms and the hardware generated.
6. Write Verilog program of 4-bit binary adder/subtractor circuit using structural modelling, check the wave forms and the hardware generated.
7. Write Verilog programs of D-latch and D-flip flop using if-else statement, check the wave forms and the hardware generated.
8. Write Verilog program of asynchronous clear and synchronous load negative edge JK flip flop, check the wave forms and the hardware generated.
9. Write Verilog programs of 4x1multiplexer and 1x4 demultiplexer using behavioural modelling, check the wave forms and the hardware generated.
10. Write Verilog program of Mod-10 up counter using behavioural modelling, check the wave forms and the hardware generated.
11. Write Verilog program of 4-bit synchronous up/down counter using process statement, check the wave forms and the hardware generated.
12. Write Verilog program of Melay state machine having four states two inputs and one output, check the wave forms and the hardware generated.

Low Power VLSI Design	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-5	ECE-419T
EAE	7	VLSI-EAE	VLSI-EAE-5B	VLSI-449T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic principles of low power VLSI design and its need.
2.	To impart the knowledge of low power architecture and various low power design approaches.
3.	To impart the knowledge of different type of low power techniques and low voltage low power adders.
4.	To impart the knowledge of low voltage low power memories in VLSI design.

Course Outcomes (CO)

CO 1	To understand the basic principles of low power VLSI design and its need.
CO 2	To study the low power architecture and various low power design approaches.
CO 3	To provide the knowledge of different type of low power techniques and low voltage low power adders.
CO 4	Understand low voltage low power memories in VLSI design.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	-	2	2	2	3
CO 2	3	3	3	3	3	3	2	-	2	1	2	3
CO 3	3	3	3	3	3	3	2	-	2	1	2	3
CO 4	3	3	3	3	3	2	2	-	2	1	2	2

UNIT I

Introduction to low power VLSI design an overview, Need for low power, low power design Limitations, power supply voltage, Power and Energy basics, Sources of power dissipation-Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering, Gate Induced Drain leakage and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect, threshold voltage, scaling, interconnect wires. CMOS leakage current, static current, basic principles of low power design, probabilistic power analysis, random logic signal-probability and frequency-power analysis techniques.

UNIT II

Low-Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits. To study basics of CMOS. Architectural Level Approach –Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, and Mask level Measures, capacitive power estimation, static state power, gate level capacitance estimation.

UNIT III

Low Power Techniques: Circuit level: Power consumption in circuits. Dynamic Power Optimization: multiple supply voltages, transistor sizing, and Static power Optimization: Multiple thresholds transistor, Flip Flops and Latches design, high capacitance nodes, and low power digital cells library.
Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures Ripple Carry Adders, Carry Look- Ahead Adders, Carry Select Adders, Carry Save Adders.

UNIT IV

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

Textbook(s):

1. Low Power Design Methodologies by J. M. Rabaey, M.Pedram.
2. Low-Power CMOS VLSI Circuit Design by K. Roy and S. C.Prasad.

References:

1. Practical Low Power Digital VLSI Design by Gary K. Yeap, KAP, 2002.
2. Digital Integrated Circuits: A Design Perspective, Second Edition by J. M. Rabaey, A. P. Chandrakasan and B. Nikolic, Pearson.
3. Low-Power CMOS Design, P. Chandrakasan and RW Broderson, IEEE Press.

Low Power VLSI Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-5	ECE-419P
EAE	7	VLSI-EAE	VLSI-EAE-5B	VLSI-449P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Low Power VLSI Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Note: Experiments shall be carried out using Tanner/Mentor Graphics/Cadence

1. Introduction to SPICE (Operating Point Analysis, DC Sweep, Transient Analysis, AC Sweep, Parametric Sweep, Transfer Function Analysis)
2. Study the equivalent circuit model for MOS Transistor.
3. I-V Curves of NMOS and PMOS Transistors.
4. DC Characteristics of CMOS Inverters (VTC, Noise Margin).
5. Dynamic Characteristics of CMOS Inverters (Propagation Delay, Power Dissipation).
6. Schematic Entry/Simulation/ Layout of CMOS Combinational Circuits.
7. To study FET model for calculating Drain Induced Barrier Lowering (DIBL).
8. To study FET model for calculating Gate induced drain leakage (GIDL).
9. CMOS Static / Dynamic logic circuit (register cell).
10. CMOS Latch.
11. Flip Flops.
12. Adders: Ripple Carry Adders, Carry Look- Ahead Adders
13. Memories and State Machines: Read Only Memory (ROM), Random Access Memory (RAM), Mealy State Machine, Arithmetic Multipliers using FSMs.

Machine Design-I	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	5	PC	PC	MAC-303

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand ab-initio design concepts under various constraints, stress concentration and dynamic loading. Also analyse the design of static joints and pipes.
2.	To conceptualise joints for power transmission in rotating parts, suspension parts and in leverage.
3.	To analyse bolted & screwed fastenings and structural plates joining for complex engineering applications under myriad of loads.
4.	To thoroughly understand the design procedure for speed variation effects in toothed elements and power screws.

Course Outcomes (CO)

CO 1	Grasp the systematic design procedure & design principles considering constraints of various methods of manufacture and effect of static & dynamic forces on joints for rods.
CO 2	Synthesis of keyed-coupled shafts and stress analysis of flexible elements & levers.
CO 3	Design analysis of fastening threads and various temporary & permanent joints for plates.
CO 4	Analyse the effect of changing speeds on designed toothed elements and efficient power transmitting devices.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	2	2	1	1	2	3
CO 2	3	3	3	3	3	2	2	2	1	1	2	3
CO 3	3	3	3	3	3	2	2	2	1	1	2	3
CO 4	3	3	3	3	3	2	2	2	1	1	2	3

UNIT-I

Introduction: Systematic Design Process (SDP), Basic principles of mechanical design, Use of standards. Dynamic & fluctuating stresses, Fatigue failure and endurance Strength, Design under combined direct & varying stresses.
Stress concentration, causes and remedies in design. Factor of safety and its affecting factors. Tolerances and fits as per BIS. Materials selection, Designation of steels. Detailed design procedure of Spigot & Socket Cotter joint, Knuckle joint, Pipe joint. Numerical Design Problems.

UNIT-II

Shafts, Keys and Couplings: Transmission Shafts, materials, design of shafts on strength & rigidity basis and under combined torsional and bending loads as per ASME code. Keys, types and applications. Design of rigid and pin bushed flexible couplings.
Levers, types, Design procedure of Bell crank lever.
Springs and their applications, design of close coiled helical springs. Numerical Design Problems

UNIT-III

Riveted Joints: Types of riveted joints, Failure modes, strength equations, joint efficiency, Riveted joint for boiler shells, Riveted joints under direct and eccentric loads.
Welded Joints: strength of parallel, transverse & combined filled welded joints, axially loaded unsymmetrical welded joint, eccentrically loaded welded joints, welded joints subjected to bending moment and torsional moment.
Threaded Joints: Types of screwed fastenings, Initial tightening loads in bolts, Torque requirement, Uniform strength bolt, Direct & eccentrically loaded bolted joints. Numerical Design Problems.

UNIT – IV

Power Screws: Types of threads for power screws - Square, trapezoidal & Acme threads, Torque requirement, efficiency, irreversibility & self-locking, Complete analysis of design of screw jack.
Spur Gear: Classification of Gears, spur gear terminology, Gear tooth failure, Lewis equation for beam strength of tooth, dynamic and wear loads. Numerical Design Problems.

Textbook(s):
1. V.B. Bhandari, “Design of Machine elements”, Tata McGraw Hill Education Private Ltd. Third Edition (2012).
2. Maleeve Hartman and O.P.Grover, “Machine Design”, CBS Publishers & Distributors, Sixth Edition (2015).

References:
1. Mahadevan, “Design Data Book”, CBS Publishers & Distributors.
2. J.E.Shigley& C.R. Mischke, "Mechanical Engineering Design”, Tata McGraw Hill Co. Inc.
3. P.C. Sharma and D.K Aggarwal., “Machine Design”, S.K. Kataria & Sons.
4. Juvinal R C, Marshek K M, “Fundamentals of Machine component Design”, Wiley India.
5. Norton R. l. “Machine Design” Pearson.

Machine Design-I Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	5	PC	PC	MAC-351

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Machine Design-I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To design and draw a Spigot and Socket Cotter Joint for a given load under the allowable stress properties of the part materials.
2. To design and draw a Knuckle Joint for a load under the material properties constraints.
3. To design and draw a pipe joint carrying pressured fluid within safe stress limits of the given material.
4. To design and draw a protected type Rigid Flanged Coupling for connecting two power transmitting perfect coaxial shafts.
5. To design and draw a bushed pin type Flexible Coupling (Ajax) for connecting two slightly misaligned shafts.
6. To design a quadruple riveted double strap butt joint for the longitudinal seam and circumferential seam of a boiler shell.
7. To design and find the size of an eccentrically loaded Welded Joint for a bracket.
8. To design and draw a Screw Jack for lifting a given load.
9. To design a pair of Spur Gear Reducer for transmitting a given power between two shafts.
10. To design a Bell Crank Lever for moving a given load with a given mechanical advantage.
11. To design a closed coiled helical Spring for the valve mechanism of an engine.

Machine Design-II	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	5	PC	PC	MEC-303

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand relative application suitability of various gears, belt drives and chain drives.
2.	To conceptualise the design needs for differential power requirement in a moving object and the means to achieve them.
3.	To study the various methods of supporting a loaded rotating shaft for diverse applications.
4.	To critically analyse the design needs for wire ropes, crane hooks and engine parts.

Course Outcomes (CO)

CO 1	Analyse the effect of changing speeds on varied power transmission mechanical drives with toothed, chained & flexible elements considering centre distances.
CO 2	Design analysis of mechanisms for stoppage, engagement/disengagement of parts with relative motion in vehicles, machines & hoists.
CO 3	Justify the arrangement for support & retainment of rotating parts at diversified application points containing radial, axial & angular loads with lubrications.
CO 4	Evaluate, Design and select system for transmission at long distances and suitably justify design of Engine parts.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	-	-	-	1	1	2	3
CO 2	3	3	2	3	2	-	-	-	2	1	2	3
CO 3	3	3	2	3	2	-	-	-	1	1	2	3
CO 4	3	3	3	3	3	-	-	-	3	1	2	3

UNIT-I

Introduction to Mechanical Drives: Selection criterion of various power transmission drives.
Gear Drive Classification.
Design of **Helical Gears** based on modified Lewis Equation. Dynamic and wear loads. Use in gearbox.
Design of **Bevel Gears**. Dynamic and wear loads.
Design of **Worm & Worm Wheel** Gears. Dynamic and wear loads. Checking for heat dissipation suitability.
Design of **Flat Belt** Drives and Pulleys.

UNIT-II

Friction Clutches and Brakes: Introduction, Classification based on direction of operating Forces. Common Friction Materials.
Clutches Design- Single & Multiple Plate Clutches with uniform pressure and uniform wear theories. Cone Clutch- Design Procedure, Design of Centrifugal Clutch.
Brakes Design: Energy Equations, Single and Multiple Shoe Brake Analysis, Band Brakes.

UNIT-III

Ball & Roller Bearings: Classification &Types, bearing life, Equivalent load, Load-life relationships, Selection of bearings from manufacturer's catalogue based on static and dynamic load carrying capacity. Bearing failures, Bearings with survival probability other than 90%.
Sliding Bearings: Types, Design of journal bearings using McKee's equation, checking bearing suitability, Comparison of rolling and sliding contact bearings, Properties of bearing materials.

UNIT-IV

Hoisting Elements: Introduction to transmission at long distances.
Design procedure of **Wire Ropes**, Classification, designation of wire ropes, Numerical problems.
Design of **Crane Hooks**. Stresses at critical sections.
Introduction to Engine Parts: Design of Piston of I.C Engine and Design of Connecting Rod.

Textbook(s):
1. V.B. Bhandari, "Design of Machine elements", Tata McGraw Hill Education Private Ltd. Third Edition (2012).
2. Maleeve Hartman and O.P.Grover, "Machine Design", CBS Publishers & Distributors, Sixth Edition (2015).

References:

1. Mahadevan, "Design Data Book", CBS Publishers & Distributors.
2. J.E. Shigley & C.R. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Co. Inc.
3. P.C. Sharma and D.K Aggarwal., "Machine Design", S.K. Kataria & Sons.
4. Juvinal R C, Marshek K M, "Fundamentals of Machine Component Design", Wiley India.
5. Norton R. l. "Machine Design" Pearson.

Machine Design-II	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	6	PC	PC	MAC-306

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand relative application suitability of various gears, belt drives and chain drives.
2.	To conceptualise the design needs for differential power requirement in a moving object and the means to achieve them.
3.	To study the various methods of supporting a loaded rotating shaft for diverse applications.
4.	To critically analyze the design needs for wire ropes, crane hooks and engine parts.

Course Outcomes (CO)

CO 1	Analyze the effect of changing speeds on varied power transmission mechanical drives with toothed, chained & flexible elements considering centre distances.
CO 2	Design analysis of mechanisms for stoppage, engagement / disengagement of parts with relative motion in vehicles, machines & hoists.
CO 3	Justify the arrangement for support & retainment of rotating parts at diversified application points containing radial, axial & angular loads with lubrications.
CO 4	Evaluate, Design and select system for transmission at long distances and suitably justify design of Engine parts.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	-	-	-	1	1	2	3
CO 2	3	3	2	3	2	-	-	-	2	1	2	3
CO 3	3	3	2	3	2	-	-	-	1	1	2	3
CO 4	3	3	3	3	3	-	-	-	3	1	2	3

UNIT-I

Introduction to Mechanical drives: Selection criterion of various power transmission drives.
Classification of Gear Drives.
Design of **Helical Gears** based on modified Lewis Equation. Dynamic and wear loads. Use in gearbox.
Design of **Bevel Gears**. Dynamic and wear loads.
Design of **Worm & Worm Wheel** Gears. Dynamic and wear loads. Checking for heat dissipation suitability.
Selection and Design of **Flat and V-Belt Belt** Drives and Pulleys
Design of **Roller Chain Drives**, Applications.

UNIT-II

Friction Clutches and Brakes: Introduction, Classification based on direction of operating Forces. Common Friction Materials.
Clutches Design- Single & Multiple Plate Clutches with uniform pressure and uniform wear theories. Application in 2 & 4 wheeled vehicles. Cone Clutch- Design Procedure. Design of Centrifugal Clutch
Brakes Design: Energy Equations, Single and Multiple Shoe Brake Analysis. Band Brake, Band & Block Brake, internally expanding Brake analysis with leading & lagging shoes.

UNIT-III

Ball & Roller Bearings: Classification &Types, Bearing life, Equivalent load, Load-life relationships, Selection of bearings from manufacturer’s catalogue based on static and dynamic load carrying capacity. Bearing failures, Bearings with survival probability other than 90%.
Sliding Bearings: Types, Design of journal bearings using McKee’s equation, Checking bearing suitability, Types of lubrication, Comparison of rolling and sliding contact bearings, Properties of bearing materials.

UNIT - IV

Hoisting Elements : Introduction to transmission at long distances.
Detailed design procedure of **Wire Ropes**, Classification, designation of wire ropes, applications. Numerical problems.
Design of **Crane Hooks**. Stresses at critical sections. Bending of curved beams of triangular, trapezoidal, circular sections.
Introduction to Engine Parts: Design of **Piston** of I.C.Engine. Design of **Connecting Rod.** Design of **Crankshaft** for single cylinder engine only.

Textbook(s):
1. V.B. Bhandari, “Design of Machine elements”, Tata McGraw Hill Education Private Ltd. Third Edition (2012).
2. Maleeve Hartman and O.P.Grover, “Machine Design”, CBS Publishers & Distributors, Sixth Edition (2015).

References:
1. Mahadevan, “Design Data Book”, CBS Publishers & Distributors.
2. J.E. Shigley & C.R. Mischke, "Mechanical Engineering Design”, Tata McGraw Hill Co. Inc.
3. P.C. Sharma and D.K Aggarwal., “Machine Design”, S.K. Kataria & Sons.
4. Juvinal R C, Marshek K M, “Fundamentals of Machine Component Design”, Wiley India.
5. Norton R. l. “Machine Design” Pearson.

Machine Design-II Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	5	PC	PC	MEC-351
MAE	6	PC	PC	MAC-352

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Machine Design–II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Teeth, PCDs, module, center distances of all gears and gear ratios within ±2% error.
2. Identification and design of a most heavily stressed gear and selection of material for all gears and shafts of the same gear box.
3. To find the size/diameters of input, output & countershaft as per ASTM recommendations and finding support reactions.
4. To select the bearings for all locations, support & retainment of all shafts using SKF bearing manufacturer’s catalogue.
5. To design a double shoe brake for a hoisting mechanism using standard drum sizes and friction materials and check for heat dissipation.
6. To design the bell crank lever, side lever and spring for the designed brake in s.no.5.
7. To design a hook of a crane for hoisting a given load.
8. To design the thrust bearing, bolt size, side plates and central plate for the designed crane hook in s.no.7.
9. To design a connecting rod for an internal combustion engine.
10. To design the big end, small end and cap for the designed connecting rod in s.no.9.

Machine Learning	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-350T
EAE	6	MLDA-EAE	MLDA-EAE-2C	ML-342T
CSE/IT/CST/ITE	7	PCE	PCE-5	CIE-421T
CSE-AIML	7	PC	PC	ML-407T
EAE	7	AIML-EAE	AIML-EAE-3	ML-407T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1. To understand the need of machine learning
2. To learn about regression and feature selection
3. To understand about classification algorithms
4. To learn clustering algorithms

Course Outcomes (CO)

CO 1	To formulate machine learning problems
CO 2	Learn about regression and feature selection techniques
CO 3	Apply machine learning techniques such as classification to practical applications
CO 4	Apply clustering algorithms

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	2	-	-	-	-	2
CO 2	3	3	3	3	3	2	2	-	-	-	-	2
CO 3	3	3	3	3	3	2	2	-	-	-	-	2
CO 4	3	3	3	3	3	2	2	-	-	-	-	2

UNIT-I

Introduction: Machine learning, terminologies in machine learning, Perspectives and issues in machine learning, application of Machine learning, Types of machine learning: supervised, unsupervised, semi-supervised learning. Review of probability, Basic Linear Algebra in Machine Learning Techniques, Dataset and its types,Data preprocessing, Bias and Variance in Machine learning , Function approximation, Overfitting

UNIT-II

Regression Analysis in Machine Learning: Introduction to regression and its terminologies,Types of regression,Logistic Regression

Simple Linear regression: Introduction to Simple Linear Regression and its assumption, Simple Linear

Regression Model Building,Ordinary Least square estimation, Properties of the least-squares estimators and the fitted regression model, Interval estimation in simple linear regression , Residuals
Multiple Linear Regression:Multiple linear regression model and its assumption, **Interpret Multiple Linear Regression Output(R-Square, Standard error, F, Significance F, Cofficient P values), Access the fit of multiple linear regression model (**R squared, Standard error)
Feature Selection and Dimensionality Reduction: PCA, LDA, ICA

UNIT-III

Introduction to Classification and Classification Algorithms: What is Classification? General Approach to Classification, k-Nearest Neighbor Algorithm, Random Forests, Fuzzy Set Approaches
Support Vector Machine: Introduction, Types of support vector kernel – (Linear kernel, polynomial kernel, and Gaussiankernel), Hyperplane – (Decision surface), Properties of SVM, and Issues in SVM.
Decision Trees: Decision tree learning algorithm,ID-3algorithm, Inductive bias, Entropy and information theory, Information gain,Issues in Decision tree learning.
Bayesian Learning - Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm
Ensemble Methods: Bagging, Boosting and AdaBoost and XBoost,
Classification Model Evaluation and Selection: Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value, Lift Curves and Gain Curves, ROC Curves, Misclassification Cost Adjustment to Reflect Real-World Concerns, Decision Cost/Benefit Analysis

UNIT – IV

Introduction to Cluster Analysis and Clustering Methods: The Clustering Task and the Requirements for Cluster Analysis , Overview of Some Basic Clustering Methods:-k-Means Clustering, k-Medoids Clustering, Density-Based Clustering: DBSCAN - Density-Based Clustering Based on Connected Regions with High Density, Gaussian Mixture Model algorithm , Balance Iterative Reducing and Clustering using Hierarchies (BIRCH) , Affinity Propagation clustering algorithm,Mean-Shift clustering algorithm, ordering Points to Identify the Clustering Structure (OPTICS) algorithm, Agglomerative Hierarchy clustering algorithm, **Divisive Hierarchical** , Measuring Clustering Goodness

Textbook(s):

1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (India) Private Limited, 2013.
2. M. Gopal, “Applied Machine Learning”, McGraw Hill Education

References:

1. C. M. BISHOP (2006), “Pattern Recognition and Machine Learning”, Springer-Verlag New York, 1st Edition
2. R. O. Duda, P. E. Hart, D. G. Stork (2000), Pattern Classification, Wiley-Blackwell, 2nd Edition

Machine Learning Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-350P
EAE	6	MLDA-EAE	MLDA-EAE-2C	ML-342P
CSE/IT/CST/ITE	7	PCE	PCE-5	CIE-421P
CSE-AIML	7	PC	PC	ML-407P
EAE	7	AIML-EAE	AIML-EAE-3	ML-407P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Machine Learning) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to JUPYTER IDE and its libraries Pandas and NumPy
2. Program to demonstrate Simple Linear Regression
3. Program to demonstrate Logistic Regression
4. Program to demonstrate Decision Tree – ID3 Algorithm
5. Program to demonstrate k-Nearest Neighbor flowers classification
6. Program to demonstrate Naïve- Bayes Classifier
7. Program to demonstrate PCA and LDA on Iris dataset
8. Program to demonstrate DBSCAN clustering algorithm
9. Program to demonstrate K-Medoid clustering algorithm
10. Program to demonstrate K-Means Clustering Algorithm on Handwritten Dataset

Machine Learning and Data Analytics Case Studies	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
EAE	7	MLDA-EAE	MLDA-EAE-5A	ML-467T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	This course provides the fundamental concepts in data science.
2.	Learn the Basics of statistical data analysis with examples.
3.	Basics of Machine Learning and statistical measures.
4.	Compile and visualize data using statistical functions.

Course Outcomes (CO)

CO 1	Impart the knowledge of data classification, process of big data technology, user roles and skills in data science.
CO 2	Understand how data is analysed and visualized using statistic functions
CO 3	Analyze the methodologies of data science
CO 4	Design the code for the problems related to data science using R

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	2	3	-	2	-	-	-	-	-	-
CO 2	-	3	-	2	-	-	-	-	-	-	2	-
CO 3	-	-	-	3	3	3	-	-	-		2	3
CO 4	-	-	3	2	-	3	-	-	-	-	2	2

UNIT-I

Unsupervised Machine Learning Algorithms: Dimensionality Reduction, Clustering, Supervised Machine Learning Problems: Regression and classification.
Case Study: Balanced Scorecard Model for Measuring Organizational Performance, Employee Attrition in an Organization, Market Capitalization Categories, Performance Appraisal in Organizations, Application of Technology Acceptance Model in Cloud Computing, Prediction of Customer Buying Intention due to Digital Marketing.

UNIT-II

Supervised Machine Learning Algorithms: Naïve Bayes Algorithm, k-Nearest Neighbor's (KNN) Algorithm, Support Vector Machines (SVMs), Decision Trees.
Case Study: Measuring Acceptability of a New Product, Case Study: Predicting Phishing Websites, Fraud Analysis for Credit Card and Mobile Payment Transactions, Artificial Intelligence and Employment.

UNIT-III

Data Analytics- Relation: Data Science, Analytics and Big Data Analytics. Data Science Components – Big data technology – Data Science user- roles and skills- Data Science use cases. Statistical Measures in R: Measures of central tendency – Range- inter quartile range – Mean – Median – variance- Standard deviation – Sampling distribution – probability distributions- hypothesis tests.

UNIT - IV

Mathematics for Data science Probability, Statistics, Linear Algebra, Gradient Descent, Calculus for data science, ANOVA, Hypothesis testing, Data Visualization using GGPLOT2 and Matplotlib, Data Pre-processing, Data Transformation, Data Reduction, Feature Extraction. Univariate and Multi-variate analysis.
Case study: Insurance policy offers, Discount targeting in online shopping.

Textbook(s):
1. Data analytics with R by Dr. Bharti Motwani , Wiley publication
2. V. Bhuvaneswari (2016). Data Analytics with R, Bharathiar University.

References:
1. Nina Zumal, John Mount (2014). Practical Data science in R, Managing Publication Company
2. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (India), 2017

Machine Learning and Data Analytics Case Studies Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	MLDA-EAE	MLDA-EAE-5A	ML-467P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Machine Learning and Data Analytics Case Studies) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Implement a case study mentioned in syllabus by considering following methods.

1. **Define the problem statement:** Clearly articulate the problem you want to solve or the objective you want to achieve using machine learning and data analytics.
2. **Gather and preprocess data:** Collect relevant data for your case study and perform necessary preprocessing tasks such as data cleaning, handling missing values, and feature engineering.
3. **Exploratory data analysis (EDA):** Analyze the dataset to gain insights into the data distribution, identify patterns, and visualize relationships between variables.
4. **Split the data and model training:** Divide the dataset into training, validation, and testing sets and train your models on the training set, tune hyperparameters using the validation set, and evaluate their performance on the testing set.
5. **Model evaluation:** Train the selected machine learning models using the training set and evaluate their performance using appropriate metrics such as accuracy, precision, recall, F1-score, or mean squared error.
6. **Deployment:** Implement the chosen model in a real-world scenario, considering factors such as scalability, performance, and integration with existing systems.
7. **Interpretation and visualization:** Interpret the results of your models and visualize them in a meaningful way. This helps in presenting insights to stakeholders and understanding the impact of different variables on the outcome.
8. **Documentation:** Document your case study, including the problem statement, data sources, preprocessing steps, modeling techniques used, results obtained, and any limitations or assumptions made during the process.
9. **Communication and presentation:** Prepare a clear and concise presentation of your case study findings, highlighting the key insights and recommendations derived from your analysis.
10. **Ethical considerations:** Consider ethical aspects such as data privacy, bias, and fairness throughout the entire process. Ensure that your models and analyses are fair, transparent, and aligned with legal and ethical guidelines.

Machine Learning and Data Analytics Frameworks	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	MLDA-EAE	MLDA-EAE-5B	ML-469T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	This course provides the fundamental concepts in data science.
2.	Learn the Basics of statistical data analysis with examples.
3.	Basics of Machine Learning and statistical measures.
4.	Compile and visualize data using statistical functions.

Course Outcomes (CO)

CO 1	Impart the knowledge of data classification, process of big data technology, user roles and skills in data science.
CO 2	Understand how data is analysed and visualized using statistic functions
CO 3	Analyze the methodologies of data science
CO 4	To Introduce the concepts of data modelling techniques using Machine Learning for Data Analytics

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	2	3	-	2	-	-	-	-	-	-
CO 2	-	3	-	2	-	-	-	-	-	-	2	-
CO 3	-	-	-	3	3	3	-	-	-		2	3
CO 4	-	-	3	2	-	3	-	-	-	-	2	2

UNIT-I

Introduction and Concepts, Differentiating algorithmic and model based frameworks, Regression: Ordinary Least Squares, Ridge Regression, Lasso Regression, Regression: Ordinary Least Squares, Ridge Regression, and Lasso Regression.

UNIT-II

Linear Discriminant Analysis Quadratic Discriminant Analysis, Support Vector Machine (SVM), Bias-Variance Dichotomy Model Validation Approaches, Neural Networks , Clustering, Association Rule Mining ,Deep learning Concepts.

UNIT-III

Data Analytics- Relation: Data Science, Analytics and Big Data Analytics. Data Science Components – Big data technology – Data Science user- roles and skills- Data Science use cases. Statistical methods: Descriptive Statistics Probability Distributions (Binomial, Poisson, Normal) Sampling Distributions (Chi-squared, t, F), Estimation

UNIT - IV

Prescriptive analytics: Creating data for analytics through Active learning, Creating data for analytics through Reinforcement learning, .Test of Hypothesis, ANOVA.

Textbook(s):

1. Data analytics with R by Dr. Bharti Motwani , wiley publication
2. V. Bhuvaneswari (2016). Data Analytics with R, Bharathiar University.

References:

1. Modellind Techniuqes in Predictive Analytics, Thomas W Miller, Pearson
2. Introduction to Machine Learning with Python, A. C. Muller & S. Guido, O'Reilly

Machine Learning and Data Analytics Frameworks Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
EAE	7	MLDA-EAE	MLDA-EAE-5B	ML-469P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Machine Learning and Data Analytics Frameworks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. **R AS CALCULATOR APPLICATION**
   a. Using with and without R objects on console
   b. Using mathematical functions on console
   c. Write an R script, to create R objects for calculator application and save in a specified location in disk.
2. **DESCRIPTIVE STATISTICS IN R**
   a. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars& cars datasets.
   b. Write an R script to find subset of dataset by using subset (), aggregate () functions on iris dataset.
3. **READING AND WRITING DIFFERENT TYPES OF DATASETS**
   a. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location.
   b. Reading Excel data sheet in R.
   c. Reading XML dataset in R.
4. **VISUALIZATIONS**
   a. Find the data distributions using box and scatter plot.
   b. Find the outliers using plot.
   c. Plot the histogram, bar chart and pie chart on sample data.
5. **CORRELATION AND COVARIANCE**
   a. Find the correlation matrix.
   b. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.
   c. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data
6. **REGRESSION MODEL**

   Import a data from web storage. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in an institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not. Require (foreign), require (MASS).

7. **MULTIPLE REGRESSION MODEL**

   Apply multiple regressions, if data have a continuous Independent variable. Apply on above dataset.

8. **REGRESSION MODEL FOR PREDICTION**

   Apply regression Model techniques to predict the data on above dataset.

9. **CLASSIFICATION MODEL**
   a. Install relevant package for classification.
   b. Choose classifier for classification problem.
   c. Evaluate the performance of classifier.

10. **CLUSTERING MODEL**
    a. Clustering algorithms for unsupervised classification.
    b. Plot the cluster data using R visualizations.

Machine Learning for Image and Vision Analysis	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IPCV-EAE	IPCV-EAE-5B	IPCV-461T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge about fundamental concepts of machine learning.
2.	To impart knowledge about supervised and unsupervised machine learning.
3.	To impart knowledge about reinforcement learning.
4.	To impart knowledge about using machine learning in image analysis.

Course Outcomes (CO)

CO 1	Understand fundamental concepts of machine learning.
CO 2	Implement supervised and unsupervised machine learning for small applications.
CO 3	Explain and apply reinforcement learning.
CO 4	Implement machine learning techniques for image related applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Introduction to Machine Learning- Basic concepts, developing a learning system, Learning Issues, and challenges. Feature selection Mechanisms, Discriminative Models: Least Square Regression, Gradient Descent Algorithm, Univariate and Multivariate Linear Regression, Prediction Model, Probabilistic Interpretation.

UNIT II

Supervised Learning- Linear Regression, Multiple Regression, Logistic Regression, Classification; classifier models, K Nearest Neighbour (KNN), Decision Trees, Support Vector Machine (SVM), Random Forest.
Unsupervised Learning- Dimensionality reduction; Clustering; K-Means clustering; C-means clustering; Fuzzy C means clustering, EM Algorithm, Association Analysis- Association Rules in Large Databases, Apriori algorithm, Markov models: Hidden Markov models (HMMs).

UNIT III

Reinforcement Learning- Introduction to Reinforcement Learning, Methods and Elements of Reinforcement Learning, Bellman Equation, Markov Decision Process (MDP), Q Learning, Value Function Approximation, Temporal Difference Learning, Concept of Neural Networks, Concise Discussion on Applications Of Machine Learning E.G. Image Analysis, Medical Diagnostics, Fraud Detection, Email Spam Detection.

UNIT IV

Machine Learning in Image Analysis: Image Segmentation Texture Description, Edges/Boundaries, Object Boundary and Shape Representations, Object Detection, Object Classification, Feature Extraction from Images, Usage of TensorFlow and Keras for Image Related Applications.

Textbook(s):
1. Tom M. Mitchell: Machine Learning, McGraw-Hill, 2010.
2. Ethem Alpaydin: Introduction to Machine Learning, MIT Press, Pearson, Third Edition, 2014.
3. Bishop, Christopher: Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995

References:

1. Ethem Alpaydin: Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press, 2004.
2. T. Astie, R. Tibshirani, J. H. Friedman: The Elements of Statistical Learning, Springer (2nd ed.), 2009.
3. C. Bishop: Pattern Recognition and Machine Learning. Berlin: Springer-Verlag, 2016.

Machine Learning for Image and Vision Analysis Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IPCV-EAE	IPCV-EAE-5B	IPCV-461P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Machine Learning for Image and Vision Analysis) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Python programming fundamentals.
2. Illustration of list, tuple and dictionary in Python.
3. Illustration of exception handling and debugging concepts in python
4. Introduction and application of Panda and Numpy libraries in image analysis
5. Introduction and application of Open CV, PIL (Python Image Library) and other relevant libraries in image processing.
6. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
7. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm.
8. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
9. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
10. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
11. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Materials and Machine Technology	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	ME-OAE	ME-OAE-2	OME-326T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To study crystal structures and understand about diffusion and deformation phenomenon.
2.	To understand different types of fracture and analyze the phase transformation .
3.	To study the construction, working and mechanisms used in lathe machine tool and reciprocating machine tools.
4.	To study the construction, working and mechanisms used in drilling machine and milling machines.

Course Outcomes (CO)

CO 1	Summarize the properties of crystal structures of metallic elements and understand the mechanism of diffusion and deformation.
CO 2	To relate the material behaviour under environmental conditions and interpret the characteristics of steel through iron- iron carbide and TTT diagram.
CO 3	Analyse the working mechanism of lathe and reciprocating machine tools.
CO 4	Explain the operations performed on drilling and milling machine tools.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	3	2	-	-	-	-	-	-	3	3
CO 2	3	2	3	2		-	-	-	-	-	3	3
CO 3	3	3	3	3	3	-	-	-	-	-	3	3
CO 4	3	2	-	-	3	-	-	-	-	-	3	3

UNIT-I

Structure of metal: Crystal structure (BCC, FCC and HCP, Packing factor and density calculation), X-ray diffraction, miller indices, lattices, imperfections, elementary treatment of point and line defects and their relation to mechanical properties**.**

Diffusion: Diffusion mechanisms, steady state and non-steady state diffusion, factors affecting diffusion

Deformation: Slip, twinning, effect of cold and hot working on mechanical properties, principles of recovery, re-crystallization and gain growth.

UNIT-II

Fracture: Types of fracture ductile and brittle, fatigue

Creep: Basic consideration in the selection of material for high and low temperature service, creep curve, effect of material variables on creep properties, brittle failure at low temperature.

Solidification: Phases in metal system, lever rule, solidification of metal and alloys, solid solution, eutectic, eutectoid and inter-metallic compounds, Iron carbon equilibrium diagram, TTT-diagram. Effect of alloying elements on TTT diagram, S-N curve.

UNIT-III

Lathe: Lathe machine and its types. Major sub-assemblies of a lathe: Bed, headstock, tail stock, carriage consisting of saddle, cross-slide, compound slide, tool post and apron. Work holding devices used in lathe. Driving mechanisms, apron mechanism, thread cutting mechanism and calculations, features of half-nut engagement – disengagement, indexing dial mechanism. Operations performed on lathe machine.

Reciprocating Type Machine Tools: Shaper, Planer and Slotter: Constructional features, basic machines and kinematics and related calculations.

UNIT – IV

Drilling Machines: Constructional features of bench drilling machine, radial drilling machine, multi-spindle drilling machine, feed mechanism and work holding devices, Tool – holding devices. Different drilling operations: Drilling, reaming, counter boring and countersinking etc. estimation of drilling time.

Milling Machines: Types of general purpose milling machines and their principal parts. Types of milling cutters and their applications, different milling operations, work-holding devices, Indexing mechanisms and its types. Indexing calculations and machining time calculations. Introduction to machining centres.

Textbook(s):

1. Callister "Materials Science and Engineering": An Introduction, 6th Edition.
2. B.S. Raghuwanshi, "Workshop Technology", Vol.2, Dhanpat Rai & Sons, 2003.

References:

1. Parashivamurthy K.I "Material Science and Metallurgy", Pearson.
2. P.C. Sharma, "A Text Book of Production Engineering", S. Chand, New Delhi, 2004.
3. Bawa H.S., "Workshop Technology", Vol.2, Tata McGraw Hill, 2004.
4. Sidney H Avner," Introduction to Physical Metallurgy", Tata McGraw-Hill, New Delhi-1997.
5. Hazra Chandhari S.K., "Elements of Workshop Technology", Vol.2, Media Promoters, 2003.

Materials and Machine Technology Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
OAE	6	ME-OAE	ME-OAE-2	OME-326P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Materials and Machine Technology) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study crystal structure of a given specimen.
2. To study crystal imperfections in a given specimen.
3. To study microstructure of metals/alloys.
4. To prepare solidification curve for a given specimen.
5. To study heat treatment processes (Hardening and tempering) of a steel specimen.
6. To perform facing, turning and step turning operations on the given work piece as per the drawing and dimensions.
7. To perform drilling, tapping and knurling operations on given work piece as per the drawing and dimensions.
8. To perform threading and undercutting operations on the given work piece as per the drawing and dimensions.
9. To study the apron mechanism of lathe machine tool.
10. To study simple indexing mechanism on the given workpiece using milling machine tool.

Mathematical Analysis of Complex Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	7	PCE	PCE-4	EEE-405T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand and analyze complex systems.
2.	To apply network theory and game theory in complex shstems.
3.	To understand cellular automata and agent-based modeling.
4.	To apply data analysis and machine learning techniques in the analysis of complex systems.

Course Outcomes (CO)

CO 1	Able to understand and analyze complex systems.
CO 2	Able to apply network theory and game theory in complex shstems.
CO 3	Able to understand cellular automata and agent-based modeling.
CO 4	Able to apply data analysis and machine learning techniques in the analysis of complex systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

Unit- I

Introduction to Complex Systems: Definition and characteristics of complex systems, Examples of complex systems in various domains (e.g., physics, biology, economics), Basic concepts of complexity science (e.g., emergence, self-organization)

Dynamical Systems Theory: Introduction to dynamical systems and their behavior, Nonlinear dynamics and chaos theory, Stability analysis and bifurcations in dynamical systems, Lyapunov exponents and fractal dimensions

Unit-II

Network Theory and Complex Networks: Introduction to network theory and graph theory, Basic network metrics (e.g., degree, clustering coefficient), Scale-free networks and small-world networks, Community detection and network motif analysis

Game Theory and Strategic Interactions: Introduction to game theory concepts and principles, Nash equilibrium and other equilibrium concepts, Evolutionary game theory and replicator dynamics, Evolutionary stable strategies and dynamics on networks

Unit- III

Cellular Automata and Agent-Based Modeling: Introduction to cellular automata and their applications in complex systems, Basics of agent-based modeling and simulation, Emergent behavior and self-organization in cellular automata and agent-based models, Parameter space exploration and sensitivity analysis

Fractals and Self-Similarity: Introduction to fractals and their properties, Fractal dimensions and scaling laws, Fractal analysis techniques (e.g., box-counting, dimension calculation), Applications of fractals in complex systems (e.g., geography, finance)

Unit-IV

Optimization Techniques for Complex Systems: Introduction to optimization in complex systems, Genetic algorithms and evolutionary computation, Particle swarm optimization and other metaheuristic algorithms, Multi-objective optimization in complex systems

Data Analysis and Machine Learning: Introduction to data analysis techniques for complex systems, Time series analysis and forecasting, Clustering and classification algorithms for complex systems, Machine learning models for complex systems

Textbooks:

1. “Complex Systems: Chaos and Beyond: A Constructive Approach with Applications in Life Sciences” by Kunihiko Kaneko
2. “Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering” by Steven H. Strogatz

References :

1. “Complexity: A Guided Tour” by Melanie Mitchell
2. “Networks: An Introduction” by Mark Newman
3. “Game Theory: Analysis of Conflict” by Roger B. Myerson

Mathematical Analysis of Complex Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	7	PCE	PCE-4	EEE-405P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Mathematical Analysis of Complex Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study the sensitivity to initial conditions and parameter values, bifurcations, and long-term behavior.
2. Analyze the fractal properties of complex systems using techniques like the box-counting method or the Hausdorff dimension.
3. Build and analyze complex networks, such as social networks or computer networks.
4. Set up and analyze strategic interactions between agents in a complex system using game theory.
5. Design and analyze cellular automata models to study emergent behavior in complex systems.
6. Develop agent-based models to simulate complex systems and analyze their behavior.
7. Analyze time series data from complex systems using tools like Fourier analysis, wavelet analysis, or autoregressive models.
8. Develop and apply optimization methods to find optimal solutions or parameters in complex systems.
9. Apply data analysis techniques, such as clustering, classification, or regression, to analyze complex systems' data.

Mathematical Model for Reliability of Transmission and Distribution	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	7	PCE	PCE-5	EEE-429T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the probability theory and reliability functions
2.	To evaluate reliability indices
3.	To analyse reliability of interconnected systems
4.	To analyse reliability of distributed systems

Course Outcomes (CO)

CO 1	Ability to understand the probability theory and reliability functions
CO 2	Ability to evaluate reliability indices
CO 3	Ability to analyse reliability of interconnected systems
CO 4	Ability to analyse reliability of distributed systems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	2	1	1	1	2	2	3	1
CO 2	3	2	3	3	2	1	1	1	2	2	3	1
CO 3	3	2	3	3	2	1	1	1	2	2	3	1
CO 4	3	2	3	3	2	1	1	1	2	2	3	1

UNIT- I

Basic Probability Theory: Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation – Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution. Definition of Reliability: Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models – Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time between Failures.

UNIT- II

Operating Reserve Evaluation: Basic concepts – risk indices – PJM methods – security function approach – rapid start and hot reserve units – Modelling using STPM approach. Bulk Power System Reliability Evaluation: Basic configuration – conditional probability approach – system and load point reliability indices – weather effects on transmission lines – Weighted average rate and Markov model – Common mode failures.

UNIT- III

Inter Connected System Reliability Analysis: Probability array method – Two inter connected systems with independent loads – effects of limited and unlimited tie capacity – imperfect tie – Two connected Systems with correlated loads – Expression for cumulative probability and cumulative frequency. Distribution System Reliability Analysis – I (Radial configuration): Basic Techniques – Radial networks –Evaluation of Basic reliability indices, performance indices – load point and system reliability indices – customer oriented, loss and energy oriented indices – Examples.

UNIT-IV

Distribution System Reliability Analysis – II (Parallel Configuration): Basic techniques – inclusion of bus bar failures, scheduled maintenance – temporary and transient failures – weather effects – common mode failures –Evaluation of various indices – Examples Substations and Switching Stations: Effects of short-circuits – breaker operation – Open and Shortcircuit failures – Active and Passive failures – switching after faults – circuit breaker model – preventive maintenance – exponential maintenance times.

Textbooks:
1. Reliability Evaluation of Power systems by R. Billinton, R.N.Allan, BS Publications, 2007.
2. Reliability Modeling in Electric Power Systems by J. Endrenyi, John Wiley and Sons, 1978.

References:
1. Reliability Engineering: Theory and Practice by Alessandro Birolini, Springer Publications.
2. An Introduction to Reliability and Maintainability Engineering by Charles Ebeling, TMH Publications.
3. Reliability Engineering by E. Balaguruswamy, TMH Publications.
4. Reliability Engineering by Elsayed A. Elsayed, Prentice Hall Publications.

Mathematical Model for Reliability of Transmission and Distribution Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	7	PCE	PCE-5	EEE-429P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Mathematical Model for Reliability of Transmission and Distribution) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Note: Develop program/Simulink model in MATLAB/SCILAB/PYTHON for the following experiments.

1. Sinusoidal Voltages and Currents
2. Equivalent circuit of a Transformer
3. Determination of voltage and power at the sending end, voltage regulation using medium line model
4. Determination of line performance when loaded at receiving end
5. Formation of bus Admittance matrix
6. Load flow Solution using Gauss Seidel Method
7. Load flow solution using Newton Raphson method in Rectangular Coordinates
8. a) Optimal dispatch neglecting Losses b) Optimal dispatch including Losses
9. Transient Response of an RLC Circuit
10. Three phase short circuit analysis in a Synchronous Machine
11. Unsymmetrical Fault Analysis
12. Zbus Building Algorithm

Mathematics of Modern Cryptography	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	BT-EAE	BT-EAE-1	CS-306T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Ability of students to understand an overview of the evolution of cryptography.
2.	Ability of students to learn real world applications for cryptography.
3.	Ability of students to learn complex formulas and equations needed to master the art of cryptography.
4.	Ability of students to learn information security novice critical encryption skill

Course Outcomes (CO)

CO 1	Understand the concepts of Cryptography and modern protocols with discussion of hashes.
CO 2	Understand Symmetric Ciphers and latest Encryption Methods.
CO 3	Understand cryptanalysis and modern methods.
CO 4	Understand security protocols for protecting data on networks and be able to digitally sign emails and files.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	2	2	-	-	-	-	2	2	2	2
CO 2	3	2	2	1	-	-	-	-	2	2	2	2
CO 3	3	2	2	2	-	-	-	-	2	2	2	2
CO 4	3	2	2	1	-	-	-	-	2	1	2	2

UNIT-I

Cryptography for Data Security: Basic Concepts and Historical Overview, Mathematical Foundations of Cryptography, Substitution Ciphers, Transposition Ciphers, Combinations, Information Entropy, Quantifying Information, Confusion and Diffusion, Hamming Distance, Hamming Weight, Kerchkoff's Principle.

UNIT-II

Symmetric Ciphers and Hashes, Feistel Networks, Cryptographic Keys, S-Box & P-BOX,GOST, Blowfish, Two fish, Skipjack, CAST, FEAL, MARS, Symmetric Methods, ECB, CBC, PCBC, CFB, Substitution, Permutation Networks, Serpent Algorithm: Serpent S-Boxes and Key Schedule.

UNIT-III

Cryptanalysis, Modern Methods: Linear Cryptanalysis, Differential Cryptanalysis, Integral Cryptanalysis, Mod n

Cryptanalysis & RSA, Cryptographic Backdoors, The prevalence of backdoors, The future of Cryptography, Homo morphic Cryptography, Quantum Cryptography.

UNIT – IV

Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA). Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.

Textbook(s):

1. Modern Cryptography: Applied Mathematics for Encryption and Information Security, TMH, 2015.
2. William Stallings, “Cryptography and Network Security: Principals and Practice”, Prentice Hall, New Jersy.

References:

1. Menezes, P. van Oorschot, S. Vanstone. “Handbook of Applied Cryptography”, CRC press, 1997
2. Jeffrey Hoffstein, Jill Pipher, Joseph H. Silverman, “An Introduction to Mathematical Cryptography”, Springer

Mathematics of Modern Cryptography Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	BT-EAE	BT-EAE-1	CS-306P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Mathematics of Modern Cryptography) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to implement DES and AES Algorithms for Encryption and Decryption.
2. Write a program to implement the RSA Algorithm for Encryption and Decryption.
3. Write a program to implement Caesar Cipher.
4. Write a program to implement Playfair Cipher Substitution Technique.
5. Make a Detailed Report on Network Security Threats covering Structured, Unstructured, Internal and External Threats.
6. Write a program to implement Blowfish Algorithm.
7. Write a program to calculate the messagedigest of a text using the SHA-1 algorithm.
8. Write a program to implement the MD5 hashing technique.
9. Study of various S-Box Properties.
10. Write a program to implement Serpent Algorithm.

Measurement and Control	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	ICE-OAE	ICE-OAE-2	OICE-322T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To make students able to understand the basic concepts of Measurement & Control systems
2.	To make students capable to understand Calibration and Applying Calibration on various applications
3.	To make students capable of Analysing various errors, characteristics & time domain analysis pertaining to measuring systems, Instruments.
4.	To make students understand the concept of Transfer Function and hence to Evaluate them using different Techniques.

Course Outcomes (CO)

CO 1	ility to understand basics of Measurement & Control System
CO 2	ility to apply Calibration Technique for calibrating various instruments.
CO 3	Ability to Analyse various errors in measurement system , static & dynamic characteristics of Instruments , time domain Analysis of various systems.
CO 4	Ability to Evaluate Transfer Function using different Techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	-		-	-	-	-	-	-	-	-	3
CO 2	3	2	-	-	-	-	-	2	2	2	-	3
CO 3	2	2	-	-	-	-	-	2	2	2	-	3
CO 4	2	2	2	-	-	-	-	-	-	-	-	3

Unit I

Introduction to Measurement: Measurement& its significance, different methods of measurement, Classification of measuring instruments, Application of measurement systems.
Standards: Different standards for measurement
Performance Characteristics: Definition of range, span , accuracy, precision, drift, sensitivity, reproducibility, repeatability, dead zone, resolution, hysteresis, threshold, zero error, noise , linearity, Static characteristics & dynamic characteristics (Speed of response, fidelity, measuring lag) of Instruments**.**

Unit II

Testing & Calibration: Significance of testing & Calibration, Standards for calibration, Different calibration procedures – Primary, Secondary, direct, indirect, routine calibration, calibration of voltmeter and ammeter.

Analysis of Errors: Definition, types of errors , Uncertainty in measurement
Instruments: Instrumentation amplifier & its applications , Digital storage Oscilloscope

Unit III

Control System Basics: Introduction to basic terms, classification and types of control system , block diagram and signal flow graphs, Transfer Function , determination of transfer function using block diagram reduction technique and Mason's Gain formula
Control System Components: Electrical, Mechanical, Electronic, Servo Motors, Stepper Motors, Magnetic Amplifier

Unit IV

Time-Domain Analysis: Time domain performance specifications, transient response of first order & second order system steady state errors, response with P, PI, PID controllers, limitation of time domain Analysis.

Textbooks:

1. B. C. Nakara & Chaudhry, "Instrumentation Measurement and Analysis", TATA McGraw-Hill, New Delhi.
2. Nagrath Gopal, "Control System Engineering" Prentice Hall of India.

References:

1. Patrick F Dunn, Michael P. Davis. "Measurement and Data Analysis for Engineering and Science 4th Edition, Kindle Edition, CRC Press
2. K. Ogata, " Modern Control Engineering" Pearson
3. B.C Kuo " Automatic control System" Prentice Hall of India
4. A.K Sawhney "Electrical & Electronic Measurement & Instrumentation" Dhanpat Rai Publications

Measurement and Control Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	ICE-OAE	ICE-OAE-2	OICE-322P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Measurement and Control) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To perform Calibration of Voltmeter using Potentimeter.
2. To perform Calibration of Ammeter using Potentimeter.
3. To perform Calibration of Energy Meter.
4. To study Instrumentation Amplifier
5. To study digital storage Oscilloscope
6. To determination Transfer Function of DC Machine.
7. To observe the effect of P, PI, PID, PD Controller for open loop and closed loop of second order system.
8. To study the speed torque characteristics of SERVO MOTOR.
9. To determination Characteristics of Magnetic Amplifiers
10. Plot unit step response of given transfer function and finds delay time, rise time, peak overshoot.
11. Determination of step & impulse response for a second order unity feedback system

Measurement Data Analysis	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-1	ICE-308

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To expose the students the concepts of measurement, error and uncertainty
2.	To introduce mean, variance and moments of random variables
3.	To introduce the fundamental concepts relevant to the modeling of experimental data
4.	To define and identify some basic probability distributions and random variables

Course Outcomes (CO)

CO 1	Ability to understand study about the concepts of measurement, error and uncertainty
CO 2	Ability to identify an appropriate theoretical distribution to fit the empirical data and find out the properties of data.
CO 3	Apply the concept of linear regression to simple prediction problems, confidence and higher order analysis
CO 4	To Evaluate the mean, variance and moments of random variables

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	-	-	-	-	-	-	2	-	3
CO 2	3	3	-	-	-	2	-	-	2	2	-	3
CO 3	3	3	2	2	-	2	-	-	2	2	2	3
CO 4	3	3	2	2	-	2	2	2	2	2	2	3

UNIT I

Errors: Types of errors, Methods of error analysis, uncertainty analysis- modeling and experimental uncertainty probabilistic basics of uncertainty, identifying sources of error, systematic and random errors, quantifying systematic and random errors, measurement uncertainty analysis

UNIT II

Basic Statistical Concepts: Types of measured quantities, central tendency of data, best estimate of true value data, measurement of dispersion, standard deviation of the sample of means, evaluation of standard deviation and sample of means by method of coding, evaluation of best estimate mean value and least error in a multiple set of data.

UNIT III

Normal Distribution: Gaussian distribution, area under normal distribution curve, confidence level, central limit test, significance test, introduction to probability, probability distributions-binomial distribution, poisson distribution, hypothesis testing and estimation, one sample t test, two sample t test criteria for goodness of fit

UNIT IV

Graphical representation and curve fitting: Equations of approximating curves, graphical representation of functional relationships, determination of parameters in linear relationships, least square regression analysis, linear analysis, higher order analysis, multivariable linear analysis, determining the appropriate fit, regression confidence levels.

Textbooks:
1. B. C. Nakara & Chaudhry, "Instrumentation Measurement and Analysis", Tata McGraw-Hill, New Delhi.

References:
2. Patrick F Dunn, Michael P. Davis. "Measurement and Data Analysis for Engineering and Science 4th Edition, Kindle Edition, CRC Press

Mechanical Vibrations	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-2	MEE-320T
EAE	7	DT-EAE	DT-EAE-4	DT-425T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To gain the knowledge of mathematical modelling of a physical system and applying the principles of Newton's Second Law and conservation of energy to derive the equations of motion.
2.	To familiarize with linear systems with degrees of freedom.
3.	To study the response of a vibrating system with periodic excitation and understand the principle of vibration isolation.
4.	To gain the knowledge of multi degree freedom of systems.

Course Outcomes (CO)

CO 1	Develop a mathematical model for a physical system and derive the governing differential equations.
CO 2	Determine the natural frequencies of single and two degrees of freedom systems
CO 3	Determine and analyse the response of machine members or structures in forced vibration with different excitation frequencies.
CO 4	Understand and develop numerical methods for multi degree of freedom sytems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	3	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	3	-	3	-	-	--	-	-	2

UNIT-I

Introduction: Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats, Fourier theorem and problems.

Undamped (Single Degree of Freedom) Free Vibrations: Derivations for spring mass systems, Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and Problems.

UNIT-II

Damped Free Vibrations (1DOF): Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.

Forced Vibrations (1DOF): Introduction, Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping and Problems.

UNIT-III

Systems with two degrees of Freedom: Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) – Simple spring mass systems, masses on tightly stretched strings, double pendulum, torsional systems, combined rectilinear and angular systems, geared systems and Problems. Undamped dynamic vibration absorber and Problems.

UNIT – IV

Numerical Methods for multi degree freedom of systems: Introduction, Maxwell's reciprocal theorem, Influence coefficients, Rayleigh's method, Dunkerley's method, Stodola method, Holzer's method, Orthogonality of principal modes, method of matrix iteration and Problems.

Textbook(s):

1. S.S. Rao, Mechanical Vibration, Pearson.
2. V.P. Singh, Mechanical vibration, Dhanpath Rai &.Co.

References:

1. Thomson, William T, Theory of Vibration with Application, Pearson Education.
2. Graham Kelley,S., Mechanical Vibration – Schaums Outline Series, TMH
3. F.S. Tse, Morse &Hinkle, Mechanical Vibration, Allyn and Bacon.
4. G.S. Grover & Nigam, Mechanical Vibrations, Nem Chand & Bros.

Mechanical Vibrations Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-2	MEE-320P
EAE	7	DT-EAE	DT-EAE-4	DT-425P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Mechanical Vibrations) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Determine natural frequency of compound pendulum, equivalent simple pendulum system.
2. Determine natural frequency for longitudinal vibrations of helical springs, and springs in series and parallel
3. Determine natural frequency and nodal points for single rotor and two-rotor vibratory system
4. Frequency and acceleration measurements of any one vibrating system using National Instruments Lab VIEW software, DAQ and accelerometer
5. Determination of damping coefficient of any system/media
6. Experimental balancing of single and multi-rotor system
7. Measurement of vibration response of a system
8. Vibration analysis of mechanical system using MATLAB/SCILAB/GNU Octave
9. Experiment using Frahm tachometer to measure frequency of vibration or speed of rotating parts of a machine.
10. Experiment on whirling of shaft.

Mechanics and Design of Solids	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	ME-OAE	ME-OAE-4	OME-441T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about different types of load conditions and determine the stress, strain and change in geometrical parameters of different types of materials.
2.	To understand the resistance mechanism of beams due to bending and shearing.
3.	To understand the principal stresses, behaviour of torsional members, columns and failure mechanisms in materials, the difference between thin & thick pressure vessels and the design of springs.
4.	To learn to design springs, power screws, shafts and pipes.

Course Outcomes (CO)

CO 1	Evaluate the stress induced in structural members subjected to tension, compression, tangential and thermal loads.
CO 2	Analyse the performance of the beam for different types of loads and support conditions using SFD and BMD and determine the bending stress, shear stress and deflection induced.
CO 3	Analyse the stress induced in columns and members under torsion, distinguish between thin and thick pressure vessels and estimate the different stresses induced in pressure vessels and springs.
CO 4	Developing the practical skills to design and develop any industrial mechanical / machine part.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Simple Stresses & strains: Concept of stress and strain. Hooke’s law, Stress-Strain diagram, factor of safety, Elongation of tapering bars of circular and rectangular cross sections, Elongation due to self-weight. Saint Venant’s principle, Compound bars, state of simple shear, complementary shear stress, Volumetric stresses and Strains, Elastic constants and their relationship, Thermal stresses, Compound section subjected to thermal stresses, Sudden, gradual & impact load, Strain energy & Proof Resilience, Strain energy under normal and shear stress.

UNIT-II

Shear Force and Bending Moment in Beams: Types of beams, supports and loadings, Definition of bending moment and shear force, Sign conventions, relationship between load intensity, Bending moment and shear force, Shear force and bending moment diagrams for statically determinate beams subjected to points load, Uniformly distributed loads, Uniformly varying loads, Couple and their combinations.

Bending and Shear Stresses in Beams: Introduction, Pure bending theory, Assumptions, Derivation of bending equation, Modulus of rupture, Section modulus, Flexural rigidity, Beam of uniform strength, Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for circular, rectangular, ‘I’, and ‘T’ sections, Castigliano’s theorem, Shear Centre (only concept).

Slope and deflection of Beams: Definition of slope, Deflection and curvature, Sign conventions, Derivation of moment curvature equation, Double integration method, Macaulay’s method and Principle of superposition method, Slope and deflection for standard loading cases and for determinate prismatic beams subjected to point loads, UDL, UVL and couple.

UNIT-III

Columns: Introduction, Short, Medium and Long columns, Slenderness ratio, Euler’s theory; Assumptions, Derivation for Euler’s Buckling load for different end conditions, Limitations of Euler’s theory, Rankine-Gordon’s formula for columns.

Torsion: Stresses and strains in pure torsion of solid circular shafts and hollow circular shafts, Power transmitted by shafts, Shaft in series and parallel, Combined bending and torsion. Springs: Analysis of Close-coiled helical springs, Springs in series and parallel, Stress in leaf springs.

Compound stresses and strains: State of stress at a point, General two-dimensional stress system, Principal stresses and strains, Principal planes. Mohr’s circle of stresses. Pressure vessels: Thin cylindrical and Spherical vessels subjected to internal pressure, Hoop stresses, Longitudinal stress and change in volume, Thick cylinders subjected to internal and external pressure, Lame’s equation, Radial and hoop stress distribution.

UNIT – IV

Principles of mechanical design, systematic design process, aesthetic and ergonomic considerations in design, use of standards in design. Manufacturing consideration in design: casting, machining, forging.

Design of Elements: Force analysis and design of power screw jack,uses and design of close coiled helical springs, design of shafts, design of pipes.

Textbook(s):

1. Sadhu Singh, “Strength of Materials”, Khanna Pub.
2. S.S. Bhavikatti, “Strength of Materials”, Vikas Publishers (2000).

References:

1. S.P. Timoshenko and J. Gere, “Elements of Strength of Materials”, East-West affiliated, New Delhi.
2. J.E. Shigley& C.R. Mischke, "Mechanical Engineering Design”, Tata McGraw Hill Co. Inc.
3. L.S. Sri Nath et.al., “Strength of Materials”, McMillan, New Delhi;(2001).
4. Eger P. Popov, “Engg. Mechanics of solids”, Prentice Hall, New Delhi;(1998).
5. Roger T. Fenner, “Mechanics of Solids”, U.K. B.C. Publication, New Delhi;(1990).
6. V.B. Bhandari, “Machine Design”, Tata McGraw Hill.

Mechanics and Design of Solids Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	ME-OAE	ME-OAE-4	OME-441P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Mechanics and Design of Solids) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To perform the Hardness Test (Rockwell, Brinell &Vicker's test) and find the Hardness Number of different materials (MS, HSS, Wood, C.I., Al specimens).
2. To perform the Impact Test on a standard notched specimen to evaluate its Impact Number.
3. To perform the Tensile/Compression Test in ductile/brittle materials, draw a stress-strain curve and evaluate various mechanical properties of a given specimen.
4. To perform Shear Test and find maximum (ultimate) shear strength of given test specimen.
5. To perform the Bending /Deflection Test on a beam and evaluate its Young's Modulus.
6. To perform the Torsion Test and find modulus of rigidity, rupture stress (maximum shear stress), shear stress at yield point.
7. To determine Buckling loads of long columns with different end conditions.
8. To design a shaft carrying a pulley and a gear, mounted on two bearings, transmitting power.
9. To design a Screw Jack for lifting a given load.
10. To design a closed coiled helical spring for the valve mechanism of an engine.
11. To design pipes.
12. To find the Shear Modulus of two different materials; Aluminum and Steel using two twist and bent test rigs are used.
13. To determine the endurance limit of the given specimen under fatigue or cyclic loading.

Mechatronics	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	6	PC	PC	MAC-310

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To study the mechanical actuation system, hydraulic and pneumatic actuation system and smart materials.
2.	To gain knowledge about electrical actuation system, and to have the overview of digital electronics and systems.
3.	To have the knowledge of various sensors, transducers and their application. Also to learn the techniques of system interfacing and data acquisition.
4.	Introduction to signal conditioning and to study about programmable logic controller learn ladder programming. Study various case studies for understanding mechatronic approach to design.

Course Outcomes (CO)

CO 1	Distinguish between mechanical, hydraulic and pneumatic actuation systems.
CO 2	Develop pneumatic and electro pneumatic sequencing problems with the help of electrical actuation and digital electronics systems.
CO 3	Describe the characteristics of sensors, transducers, signal conditioning & data acquisition used in mechatronic systems.
CO 4	Examine the structure, principles of operation & ladder programming of PLC and apply the concepts to study the real life industrial problems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	2	2	3	2	2	-	3
CO 2	3	3	3	2	2	2	-	3	2	2	-	3
CO 3	3	2	3	2	2	2	-	3	2	2	-	3
CO 4	3	3	3	3	3	2	1	3	2	2	-	3

UNIT – I

Mechanical Actuating Systems: Types of motion, Degrees of freedom, constraints, Kinematic Chains, Cam, Gear and gear trains, Ratchet and pawl Belt drive, chain drive, Bearing, pre loading. Smart materials: Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.

Hydraulic & Pneumatic Actuation Systems: Fluid power systems, hydraulic systems, Pneumatic systems, system structure and signal flow, hydraulic pumps and Pressure Control Valves and regulation, air compressors and treatment, Cylinders, Direction Control Valves, Process control valves, Rotary Actuators, Accumulators, Amplifiers, and Pneumatic Sequencing Problems.

UNIT – II

Electrical Actuation Systems: Switching Devices, Mechanical Switches **–** SPST, SPDT, DPDT, keypads; Relays, Electronic sensors, Diodes, Thyristors, Transistors, solenoid operating Valve, Solenoid Operated Hydraulic and Pneumatic Valves, Electro-Pneumatic Sequencing Problems. Control of DC Motors, Permanent Magnet DC Motors, Bush less Permanent Magnet DC Motors, AC Motors and speed controls, Stepper Motors and Controls, Servo Motors.

Digital Electronics and Systems: Number Systems, Binary Mathematics, Boolean Algebra, Gates and Integrated Circuits Like 7408, 7402, Karnaugh Maps, Application of Logic Gates as: Parity Generators, Digital Comparators, BCD to Decimal Decoders, Flip Flops and applications, sequential logic, Microprocessor and microcontrollers, programming, instruction set, assembly language, C programming for Intel 8051 / 8082 micro-controller.

UNIT – III

Sensors, Transducers and Application: Performance Terminology, Static and Dynamic Characteristics, Displacement, Position and Proximity Sensors, Potentiometer Sensors, Strain Gauge Element, LVDT, Optical Encoders, Pneumatic Sensors, Hall Effect Sensors, Tachogenerators, Strain Gauge Load Cell, Thermostats, Photo Darlington. Interfacing Sensors in Mechatronic System.

System Interfacing and Data Acquisition: Data acquisition systems, Data loggers, SCADA, Interfacing requirements, Buffers, Darlington Pair, Handshaking, Serial and Parallel Port Interfacing, Peripheral Interface Adapters, Analog to Digital Conversion, Digital To Analog Conversion, Sample and Hold Amplifiers, Multiplexers, Time Division Multiplexing, Digital Signal Processing, Pulse Modulation, Component Interconnection and Impedance Matching, Interfacing Motor drives. Electrical power supply and protection.

Introduction to Signal Conditioning: Signal Conditioning Processes, Inverting Amplifiers, Non Inverting Amplifiers, Summing, Integrating, Differential, Logarithmic Amplifiers, Comparators, Amplifiers Error, Filtering, wheatstone Bridge, Temperature Compensation, Thermocouple Compensation.

UNIT – IV

Programmable Logic Controllers: Programmable logic controllers (PLC) Structure, Input / Output Processing, principles of operation, PLC versus computer, Programming Languages, programming using Ladder Diagrams, Logic Functions, Latching, Sequencing, Timers, Internal Relays And Counters, Shift Registers, Master and Jump Controls, Jumps, Data Movement, Code Conversion, Data handling and manipulation, selecting a PLC.

Case studies: Mechatronic approach to design, Boat Auto pilot, high speed tilting train, automatic car park system, coin counter, engine management system, autonomous mobile system, antilock brake system control, Auto-Focus Camera, Printer, Domestic Washing Machine, Optical Mark Reader, Bar Code Reader and Pick and Place robot Arm, Using PLC for extending and retracting a pneumatic piston and two pneumatic pistons in different combinations, control of vibrating machine, control of process tank, control of conveyor motor, detecting, sorting and packaging unit.

Textbooks:

1. W. Bolton, "Mechatronics, "Electronic control systems in Mechanical & Electrical Engineering", Pearson Education Ltd., 2003.
2. K. P. Ramachandran, G.K. Vijayaraghavan, M.S. Balasundaram, Mechatronics, "Integrated Mechanical Electronic Systems", Wiley.

References:

1. Joji P, "Pneumatic Controls", Wiley.
2. Dan Necsulescu, "Mechatronics", Pearson.
3. David g Alciatore, Michael B Histand, "Introduction to Mechatronics and measurement systems", MGH.
4. A Smaili, F Mrad, "Mechatronics, "Integrated Technologies for Intelligent Machines", Oxford Higher Education.
5. NitaigourPremchandMahalik, "Mechatronics Principles, Concepts & Application", TMH, 2003.

Mechatronics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	6	PC	PC	MAC-356

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Mechatronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the terminology and use of LADSIM software and develop simple basic circuits on software using inputs and outputs and develop AND, OR and NOT circuits.
2. To study the use of Latch, flags, timers, counters, BSR, BSL in LADSIM software and develop a circuit to control an automated inspection conveyor.
3. To study various pneumatic actuation and control valves available in laboratory and develop basic circuits A+A-, A+A-A+A-.....,A+B+A-B-A+B+A-......, with button starts.
4. To study various electro-pneumatic control valves and relays available in laboratory and develop basic circuits A+A-, A+A-A+A-.....,A+B+A-B-, using solenoid-solenoid direction control valves and A+A-, A+A-A+A-....., using solenoid-spring direction control valves.
5. To develop higher level pneumatic and electro-pneumatic circuits using flow control and safety valves of A+B+B-A-, A+A-B+B- on pneumatic sequencer; A+A-B+B-, A+B+A-B- using solenoid-spring direction control valves.
6. To program a Vinytics make PLC through Keypad and develop basic programs to demonstrate use of Inputs, outputs, AND inverse, OR and OR Inverse commands.
7. To automate a bottling plant and a traffic control unit using LADSIM simulator.
8. Wire an industrial PLC and program it for AND/ OR/ NAND / XOR logic
9. Wire an industrial PLC and program for single push button start - stop logic.
10. To develop higher level electro-pneumatic circuits using flow control valves and relays of A+B+C+-A-B-C-.
11. Wire an industrial PLC and program Timer ON Delay and Counter.
12. To develop higher level electro-pneumatic circuits using flow control valves and relays of A+B+C+-A-B-C-.

Medical Image Processing, Analysis and Reconstruction	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-5	ECE-421T
EAE	7	IPCV-EAE	IPCV-EAE-4B	IPCV-455T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To define the principles of image sampling, quantization, enhancement and filtering techniques
2.	Todiscover the different image compression methods and morphological based processes and machine learning techniques for image segmentation
3.	To develop the methods of image registration and visualization for medical applications
4.	To acquire the student with the techniques of shape analysis and image classification using neural networks for brain computer interface and computer aided diagnosis.

Course Outcomes (CO)

CO 1	Comprehend image sampling and DFT and process the given medical images to enhance them
CO 2	Explore supervised & unsupervised learning algorithms and apply them for solving problems.
CO 3	Apply compression techniques and morphological operations for segmentation
CO 4	Design and develop algorithms to process and visualize images from different modalities

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	1	-	2	1	-	2
CO 2	3	3	3	3	2	2	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Image Fundamentals : Image perception-Image model-Image sampling and quantization -2D DFT and DCT
Image Enhancement and Filtering: Image enhancement-Histogram modelling, Spatial operations -Image restoration, Contrast manipulation, histogram equalization, Laplacian derivatives, Sobel and Klisch operators, rank operators –textural analysis, Noise models, Image degradation model, Wiener filtering, Maximum entropy restoration

UNIT II

Medical Image Analysis: Introduction of X-ray, CT, MRI, Ultrasound Imaging, Texture in Medical Images: structural & statistical.
Image Segmentation: Region Growing and Clustering, Active contours, Machine Learning based segmentation

algorithms -Singular Value Decomposition (SVD), Principal Component Analysis and its applications, Support Vector Machine and its applications, Independent Component Analysis and its application

UNIT III

Image Registration and Visualization: Image Registration, Medical image Fusion, SPECT/CT, MR/CT, PET/CT, Image visualization, Volume Rendering, Surface rendering and Maximum Intensity Projection.
Shape Analysis and Image Classification: Topological attributes -Shape orientation descriptors, Fourier descriptors, K means clustering, application of machine learning, deep learning, Neural Network approaches, Statistical Parametric Mapping in Imaging -Regression analysis.

UNIT IV

Image reconstruction from projections, Radon transform, Methods for generating projection data, Transmission tomography, Reflection tomography, Emission tomography, Magnetic resonance imaging
Image Compression and Morphological Processing: Image compression –Lossyand lossless Compression, Predictive techniques -Dilation, Erosion, Open, Close, Skeleton operations, Top-hat algorithm -Morphology based segmentation
Recent advances & Analysis: Retinal, CT, MRI, ultrasound, histology images and Brain Computer Interface, Patient specific modelling -Brain Computer Interface (BCI) and its applicationsin Neuroscience.

Textbook(s):
1. Reiner Salzer, “Biomedical Imaging: Principles and Applications”, 2012, 1stEdition, Wiley, New Jersey

References:
1. Jonathan Wolpaw, Elizabeth Winter, (Eds.) “Brain-Computer Interfaces: Principles and Practice”, 2012, 1stEdition, Oxford University Press, Oxford.
2. Pears, Nick, Liu, Yonghuai, Bunting, Peter (Eds.) “3D Imaging, Analysis and Appliations”, 2012, 2ndEdition, Springer, Berlin.

Medical Image Processing, Analysis and Reconstruction Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-5	ECE-421P
EAE	7	IPCV-EAE	IPCV-EAE-4B	IPCV-455P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Medical Image Processing, Analysis and Reconstruction) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Implementation of mean and median filters using MATLAB or other software. Use them to filter different medical images.
2. To implement theThresholding algorithm to different medical and non-medical images using MATLAB or other software.
3. Implementation ofthe edge detection concepton different medical images using MATLAB or other software.
4. To Perform Convolution operation on Images.
5. Implement different morphological tasks including dilation, and erosionusing MATLAB or other software.
6. Apply Morphological operations on different medicalimages.
7. Computation of Mean, Standard Deviation, the Correlation coefficient of the givenMedical Image
8. Write a Program for the Reconstruction of Images from Projection Data.
9. Write a Program to Deblur Medical Images using Regularized Filter and Weiner Filter.
10. Write a Program to do 3-D Brain Tumour Segmentation using Deep Learning.

Metal Forming and Press Working	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-3	MEE-332T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concept of different metal forming process.
2.	To understand the metal forming processes both analytically and numerically.
3.	To Design various elements of metal forming processes.
4.	To develop approaches and solutions to analyze metal forming processes and the associated problems and flaws.

Course Outcomes (CO)

CO 1	Understand the concept of different metal forming process.
CO 2	Approach metal forming processes both analytically and numerically.
CO 3	Design various elements of metal forming processes.
CO 4	Develop approaches and solutions to analyze metal forming processes and the associated problems and flaws.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Introduction to Metal Forming: Classification of metal forming processes, advantages and limitations, stress-strain relations in elastic and plastic deformation. Concepts of true stress, true strain, triaxial& biaxial stresses. Determination of flow stress, principal stresses, yield criteria and their significance, Tresca & Von-Mises yield criteria, concepts of plane stress & plane strain. Deformation mechanisms, Hot and Cold working processes and its effect on mechanical properties. Simple numerical problems.

Effects of Parameters: Metallurgical aspects of metal forming, slip, twinning mechanics of plastic deformation, Effects of Temperature, strain rate, friction and lubrication, hydrostatic pressure in metalworking, Deformation zone geometry, workability of materials, and Residual stresses in wrought products. Simple numerical problems.

UNIT-II

Forging: Classification of forging processes. Forging machines equipment. Expressions for forging pressures & load in open die forging and closed die forging by slab analysis, concepts of friction hill and factors affecting it. Die-design parameters. Material flow lines in forging, forging defects, residual stresses in forging. Simple numerical problems.
Rolling: Classification of rolling processes. Types of rolling mills, expression for rolling load. Roll separating force. Frictional losses in bearing, power required in rolling, effects of front & back tensions, friction, friction hill. Maximum possible reduction. Defects in rolled products. Rolling variables. Simple numerical problems.
Drawing: Drawing equipment& dies, expression for drawing load by slab analysis, power requirement. Redundant work and its estimation, optimal cone angle & dead zone formation, drawing variables, Tube drawing, classification of tube drawing. Simple numerical problems.

UNIT-III

Extrusion: Types of extrusion processes, extrusion equipment & dies, deformation, lubrication & defects in extrusion. Extrusion dies, extrusion of seamless tubes. Extrusion variables. Simple problems.
Sheet Metal Forming: Forming methods, dies & punches, progressive die, compound die, combination die. Rubber forming. Open back inclinable press (OBI press), piercing, blanking, bending, deep drawing, LDR in drawing, forming limit criterion, defects of drawn products, stretch forming. Roll bending & contouring. Simple problems.

UNIT-IV

High Energy Rate Forming Methods & Powder Metallurgy: High Energy Rate Forming Methods: Principles, advantages and applications, explosive forming, electro hydraulic forming, Electromagnetic forming.
Powder Metallurgy: Basic steps in Powder metallurgy brief description of methods of production of metal powders, conditioning and blending powders, compaction and sintering application of powder metallurgy components, advantages and limitations.

Text books:
1. Amithab Gosh & A.K.Malik, "Manufacturing Science", East-West press 2001.
2. O. P. Khanna & Lal," Production Technology Vol-II ", Dhanpat Rai Publications-2012.

Reference Books:
1. E.Paul, Degramo, J.T.Black, Ranold, A.K ".Materials & Process in Manufacturing", PHI, 2002.
2. S.K.Hajra Choudhury," Elements of Workshop Technology Vol 1", Media Promoters & Publishers, 2008.
3. Lal G K,"Fundamentals of Manufacturing Processes" , Narosa.
4. P. C. Sharma," Textbook of Production Engineering", S Chand & Company Ltd.
5. 2. R.K Jain, Production "Technology (Manufacturing process technology and Automation", Khanna Publishers-2004.
6. G.E.Dieter, "Mechanical metallurgy (SI Units)", McGraw hill Pub-2001.
7. B.S Raghuwanshi, "A Course in Workshop Technology Vol: 1", Manufacturing Process, Dhanpat Rai, 2014.

Metal Forming and Press Working Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-3	MEE-332P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Metal Forming and Press Working) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To Study the general safety rules for metalworking operations
2. To carry out cold rolling of nonferrous metal and study its effect on properties
3. To determine the coefficient of interfacial friction during plastic deformation of metals by means of compression of a ring between two compression platens.
4. To carry out the hot rolling process
5. To make rod/pipe/falt sheet bending using Mechanical/Hydraulic press (or) to perform Bending Operation and calculate bending force.
6. To draw an Aluminum wire of Ø3.35mm from Ø 9.50mm Rod
7. To study the deep drawing process.
8. To learn the forming characteristics of sheet metal specimens with Deep Drawing operation.
9. To carry out the Extrusion process
10. To examine the microstructure of rolled, forged, extruded and drawn parts
11. To carry out the Forging process

Metro Systems Engineering	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IE-EAE	IE-EAE-3	IE-435

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the concepts of different metro systems.
2.	To study different types of construction methods for elevated and underground section.
3.	To analyse problems and determine the construction quality and safety.
4.	To design mechanical and rolling stock according to the latest techniques.

Course Outcomes (CO)

CO 1	Understand the need of the metro and its construction methods.
CO 2	Analyse the quality and safety systems.
CO 3	Determine the factors involved in operation, control, and monitoring.
CO 4	Design the tunnelling ventilation systems, fire control systems of Metro.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	1	-	-	-	2	-	1	-	1
CO 2	3	2	-	1	-	-	-	2	-	1	-	1
CO 3	3	2	-	1	-	-	-	2	-	1	-	1
CO 4	3	2	-	1	-	-	-	2	-	1	-	1

UNIT-I

General: Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials.
Construction Methods: Civil Engineering- Overview and construction methods for elevated and underground stations. Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings for metros. Initial Surveys & Investigations for metro constructions.

UNIT-II

Quality & Safety Systems: Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration to improve metro efficiency, multimodal transfers, and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management required for smooth transfer and working.

UNIT-III

Operation Control Centre: Electronics and Communication Engineering- Signalling systems used in metro; Automatic fare collection; Operation Control Centre (OCC and BCC); Supervisory Control and Data Acquisition system and other control systems; Platform Screen Doors. Biometric Token System, Driverless Train Operations, Green Energy, Head on Generation (HOG) System and LiDAR Technology.

UNIT – IV

Mechanical & Rolling Stock: Mechanical & TVS, AC: Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators. Electrical: OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics.

Textbook(s):

1. Paul Garbutt, World Metro Systems, Capital Transport Pub; 2nd Edition, 1997.
2. Smart Metro Station Systems: Data Science and Engineering, Elsevier - Health Sciences Division, 2022

References:

1. Procedure for Safety Certification and Technical Clearance of Metro Systems Government of India Ministry of Railways December 2015 Urban Transport & High-Speed Directorate Research Designs & Standards Organisation Manak Nagar, Lucknow
2. Quanwei Liu,Key Technologies of Metro Construction in Hard Rock Stratum,Qingdao West Coast Rail Transit Co., Ltd, China,September 2020

Metrology and Instrumentation	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	5	PC	PC	MEC-307

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Design of part, tolerances and fits.
2.	Principles of measuring instruments and gauges and their uses.
3.	Determine error and analysing uncertainty in the measurements.
4.	Evaluation and inspection of surface roughness and textures.

Course Outcomes (CO)

CO 1	Explain the basic knowledge of measurements, metrology, and measuring devices.
CO 2	Understand the fundamentals and the working of comparators.
CO 3	Understand the fundamentals of various methods for the measurements of screw threads and the working of optical measuring instruments.
CO 4	Understand various advanced measuring devices and machine tool metrology and describe application of principle of metrology and measurements in industries.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Principles of Measurement: Definition of Metrology, the difference between precision and accuracy. Sources of errors: Controllable and Random Errors, Effects of Environment and Temperature, Effects of support, alignment errors, application of Least Square principles, and errors in measurement of quality which is the function of other variables.
Length Standards: Line standards, end standards, and wavelength standards, transfer from line standards to end standards. Numerical based on line standards. Slip gauges – its use and care, methods of building different heights using different sets of slip gauges.
Limits, Fits, and Tolerances: Various definitions, IS919-1963, different types of fits, and methods to provide these fits. Numerical to calculate the limits, fits, and tolerances as per IS 919- 1963. ISO system of limits and fits; Gauges and their types, limit gauges – plug and ring gauges. Gauge Design – Taylor's Principle, wear allowance on gauges. Different methods of giving tolerances on gauges, Numerical.

UNIT-II

Comparators: Mechanical Comparators: Johanson Mikrokator and Sigma Mechanical Comparator. Mechanical-optical comparator. Principles of Electrical and electronic comparators. Pneumatic comparators – advantages, systems of Pneumatic Gauging:- Flow type and back pressure type, Principle of working of back pressure gauges, different types of sensitivities and overall magnification, Solex Pneumatic gauges and differential comparators. Numerical based on pneumatic comparators.

UNIT-III

Straightness and Flatness: Definition of Straightness and Flatness error. Numerical based on the determination of straightness error of straight edge with the help of spirit level and auto collimator. Numerical based on the determination of flatness error of a surface plate with the help of spirit level or auto-collimator.
Screw Thread Measurement: Errors in threads, Measurement of elements of screw threads – major dia, minor dia, pitch, flank angle, and effective diameter (Two and three-wire methods). Effect of errors in pitch and flank angles and its mathematical derivation. Numerical.

UNIT – IV

Instrument Calibration Methods: Introduction, Definition of Calibration, Need for Calibration, Characteristics of Calibration, Calibration Overall Requirements and Procedures, Calibration Methods/Procedures, Calibration Laboratory Requirements, Industry Practices and Regulations, Calibration and Limitations of a Digital System, Verification and Calibration of CNC Machine Tool, Inspection of the Positioning Accuracy of CNC Machine Tools, CNC Machine Error Assessment and Calibration, Calibration of 3-axis CNC Machine Tool, Calibration of a Coordinate Measuring Machine (CMM)
Surface Texture: Introduction, different types of irregularities, standard measures for assessment and measurement of surface finish.

Textbook(s):

1. R.K. Jain, “Engineering Metrology”, Khanna Publishers, Delhi.
2. I.C. Gupta, “Engineering Metrology”, Dhanpat Rai Publications, Delhi.

References:

1. F.W. Galyer& C.R. Shotbolt, “Metrology for Engineers”, ELBS edition.
2. Samir Mekid, Metrology and Instrumentation - Practical Applications for Engineering and Manufacturing, John Wiley & Sons, Inc. and ASME Press 2022.

Metrology and Instrumentation Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	5	PC	PC	MEC-355

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Metrology and Instrumentation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of Slip Gauges along with their usage i.e. wringing of Slip Gauges
2. Study and working of simple measuring instruments: Vernier calipers and micrometer.
3. To study bore gauge diameter with bore gauge.
4. Measurement of angle using sine bar and slip gauges, Study of limit gauges.
5. Study and angular measurement of a given piece using bevel protractor. Study of dial indicator & its constructional details.
6. Measurement of effective diameter of a screw thread using 3 wire method.
7. To measure major diameter, minor diameter and pitch of screw thread using Profile Projector.
8. To measure major diameter, minor diameter and pitch of screw thread using Tool Maker’s microscope.
9. To measure the surface roughness using MAHR Pocket Surf instrument.
10. To find the flatness error in surface plate.
11. Study of various equipment(s) viz. Laser Distance measuring device, micro weighing device, sound level meter, etc.

Micro-electromechanical Systems (MEMS) and Sensors	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-4	ECE-409T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	An impression of Microsystems and their applications in a variety of branches of Engineering and basic sciences.
2.	Sketch micro machined passive components
3.	Investigate consistency issues in MEMS structures
4.	Replicate/Model MEMS sensor and packaging techniques

Course Outcomes (CO)

CO 1	Understanding various RF for MEMS devices, their parameters
CO 2	Comprehending the MEMS switches and relays
CO 3	Model micro machined passive components such as Inductors, Capacitors, Switches, Transmission lines and Antennas
CO 4	Understand the concept of micro machined sensor integration and packaging standards of MEMS

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	1	3	2	2	3	3	1	-	2	1	1	2
CO 2	2	3	3	3	3	3	1	-	2	1	1	2
CO 3	3	3	3	3	3	3	1	-	2	1	1	2
CO 4	3	3	3	3	3	3	1	-	2	1	1	2

UNIT- I

Introduction and origin of MEMS, Micro fabrications for MEMS, RF MEMS for microwave applications, Electromechanical transducers, Electrothermal actuators, Microsensing for MEMS, Materials for MEMS, fabrication techniques, Electrical and chemical properties, Growth and deposition, Thin films for MEMS and their deposition techniques, Oxide film formation by thermal oxidation, Deposition of silicon dioxide and silicon nitride, Bulk micromachining for silicon-based MEMS, Isotropic and orientation-dependent wet etching, Dry etching, Silicon surface micromachining, scanning method.

UNIT- II

Introduction to MEMS switches; Capacitive shunt and series switches: Physical description, circuit model and electromagnetic modeling; Techniques of MEMS switch fabrication and packaging; Design of MEMS switches.

UNIT- III

Inductors and Capacitors: Micro machined passive elements; Micro machined inductors: Effect of inductor layout, reduction of stray capacitance of planar inductors, folded inductors, variable inductors and polymer-based inductors; MEMS Capacitors: Gap-tuning and area-tuning capacitors, dielectric tunable capacitors.

UNIT- IV

MEMS Microsensors (Thermal), Micromachined Microsensors (Mechanical), MEMS Pressure and Flow Sensor, Micromachined Flow Sensors, MEMS Inertial Sensors, Micromachined Microaccelerometers for MEMS, MEMS Accelerometers for Avionics, Temperature Drift and Damping Analysis, Piezoresistive Accelerometer Technology, MEMS Capacitive Accelerometer, MEMS Gyro Sensor, MEMS for Space Application,
Integration and Packaging: Role of MEMS packages, types of MEMS packages, module packaging, packaging materials and reliability issues.

Textbook(s):
1. Vijay K. Varadan K.J. Vinoy and K.A. Jose, “RF MEMS and Their Applications”, John Wiley USA
2. Mohamed Gad-el-Hak, “MEMS Design and Fabrication Edited”, Taylor and Francis.

References:
1. Vijay K Varadan , K J Vinoy and K A Jose, “RF MEMS and their Applications”, John Wiley & Sons, 2002
2. Rebeiz G M, “MEMS: Theory Design and Technology”, John Wiley & Sons, 1999
3. De Los Santos H J, “RF MEMS Circuit Design for Wireless Communications”, Artech House, 1999
4. Christian C. Enz & Andreas Kaiser, “MEMS-based Circuits and Systems for Wireless Communication”, Springer

Micro-electromechanical Systems (MEMS) and Sensors Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-4	ECE-409P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Micro-electromechanical Systems (MEMS) and Sensors) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Presentation to the software COMSOL and its relevance in MEMS/Microfluidics.
2. Simulation of MEMS Sensors/Actuators by means of COMSOL
3. Microfluidic models using COMSOL: Laminar Flow; Convection diffusion; Conjugate heat transfer.
4. Design/Development of PCB/µ-devices using dry film resist based photolithography.
5. Design/Development of Micro-device by means of FDM based 3D printing.
6. Design/Development of electrically conductive polymers by means of CO2 Laser.
7. Design/Development of micro-devices by means of Direct Laser Writing (DLW) & Soft Lithography.
8. Essentials of Clean room and demonstration of Electron Beam Vapour Deposition.
9. Characterization I: Study of Scanning Electron Microscopy, Four Probe, Tensiometer, etc.
10. 10 Case Study: IoT in MEMS & Point of Care Devices
11. Simulation of cantilever.
12. Simulation of micro machined structures

Microelectronics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	5	PC	PC	ECC-305

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of MOSFET based circuits and the small signal models of MOS transistors.
2.	To impart the knowledge of CMOS inverter and digital circuitry using MOSFET.
3.	To impart the knowledge of CMOS amplifiers.
4.	To impart the knowledge of various design metrics of CMOS analog circuits.

Course Outcomes (CO)

CO 1	Analyze MOSFET based circuits and the small signal models of MOS transistors
CO 2	Design CMOS inverters and other digital circuits.
CO 3	Design CMOS amplifiers.
CO 4	Understand various design metrics of CMOS analog circuits.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	1	1	-	-	2	1	2
CO 2	2	3	3	2	3	1	2	-	1	2	2	2
CO 3	2	3	3	2	3	1	2	-	1	2	2	2
CO 4	2	3	3	2	3	1	2	-	1	2	2	2

UNIT I

CMOS & NMOS process technology. MOS capacitor, device structure & electrical characteristics. MOS under external bias, derivation of threshold voltage equation, enhancement & depletion transistor, MOS device design equations, MOSFET capacitances. MOSFET scaling and various short channel effects, Moore’s law, multi-gate MOSFETs, non-conventional MOSFET, technology nodes and ITRS.

UNIT II

CMOS inverter and its DC characteristics, Static & dynamic power dissipation. Rise time, fall time delays, noise margin. Combinational CMOS logic circuits, pass transistor and transmission gate designs, Sequential MOS logic circuits: SR latch, CMOS D latch and edge triggered flip flop. Dynamic CMOS logic circuits: Domino CMOS logic, NORA CMOS logic, Zipper, TSPC.

UNIT III

Small signal model of MOSFET, Single stage amplifier: Common source stage with resistive load, diode connected load, triode load, Common source stage with source degeneration, source follower, Common Gate stage, cascode amplifier, folded cascode amplifier. Basic current mirrors, Cascode current mirrors.

UNIT IV

MOS Differential amplifier, Single-Ended and Differential operation, qualitative and quantitative analysis of basic differential pair, common mode response, differential amplifier with MOS loads, Gilbert cell. Miller effect, frequency response of common-source single stage amplifier.

Textbook(s):

1. Adel S. Sedra, Kenneth C. Smith: Microelectronics Circuits, Oxford University Press.
2. Design of Analog CMOS Integrated Circuits, by Behzad Razavi, McGraw-Hill.
3. Analysis and Design of Analog Integrated Circuit, Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer, John Wiley & Sons.

References:

1. R. L. Geiger, Allen and Stradder, VLSI Design Techniques for Analog and Digital Circuits, McGraw-Hill Education, 2010.
2. CMOS: Circuit Design, Layout, and Simulation by R. Jacob Baker, Wiley-IEEE Press (2019).

Microelectronics Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	5	PC	PC	ECC-353

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Microelectronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Determine the transfer and output characteristics of NMOS and PMOS.
2. Determine the device parameters (VT0, k',λ, γ, SS) of NMOS and PMOS.
3. Simulation the resistive load NMOS MOSFET inverter and measure the values of VOH, VOL, VIH and VIL.
4. Simulation of CMOS Inverter and measure its delay, noise margin, power dissipation.
5. Design a voltage reference and simple cascode current mirror circuit.
6. Design & simulation of CMOS common source Amplifier.
7. Design & simulation of resistive load differential Amplifier.
8. Design & simulation of resistive load differential Amplifier with MOS loads.
9. Design & simulation of CMOS common source Amplifier.
10. Simulation of 5 stage CMOS ring oscillator circuit.

Microgrid Stability Assessment and Protection	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	MT-EAE	MT-EAE-3	MT-419T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge of Microgrid stability.
2.	To impart knowledge of techniques of Microgrid stability.
3.	To impart knowledge of the concepts of Microgrid Protection.
4.	To impart knowledge of the analysis of Microgrid Protection.

Course Outcomes (CO)

CO 1	Ability to understand the concepts of Microgrid stability.
CO 2	Ability to understand the techniques of Microgrid stability.
CO 3	Ability to understand the concepts of Microgrid protection.
CO 4	Ability to understand the analysis of Microgrid protection.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	1	2	1	2	2	2	2	1	3
CO 2	3	2	3	3	3	2	1	2	3	2	1	2
CO 3	3	2	2	1	2	2	1	2	2	2	1	3
CO 4	3	3	3	3	3	2	1	2	3	2	1	2

UNIT-I

Microgrid Stability Assessment; Introduction, Microgrid with Inertial and Non Inertial Distribution sources, Power sharing in distributed generation, Supplementary Controller, Grid connected and Island Operation, Power quality and reliability, Concepts of Microgrid stability.

UNIT-II

Microgrid Stability Analysis; System Structure and Autonomous Microgrid, Stability analysis of multiple converter based autonomous microgrid, Droop control, Droop method based control, Stability Improvement, Network and Load Models analysis, grid coupled microgrid, Stability analysis of grid coupled microgrid.

UNIT-III

Microgrid Protection; Issues of High integration of the renewable energy resources and distributed generation

(DG), Microgrid fault and classification, Generalised form of Fault model, Microgrid operation under unbalanced conditions; Concept of grid standards, Low-voltage ride-through, high-voltage ride through, and reactive current injection. .

UNIT-IV

Microgrid Protection and Control; Concept of Generalized fault model, Fault detection, Fault Discrimination, Fault calculations for the microgrids and distributed energy resources, Overcurrent relay coordination in microgrids, Current limiting strategy, Protection based on Artificial neural networks (ANNs) and transient monitoring function. .

Textbook(s):

1. Modelling and Stability Analysis of Microgrid, Shuai, Z. (2020). Transient Characteristics, Springer.
2. Microgrid Protection and Control Zhang, W., Wei, D., Netsanet, S., Yue, J., Wang, P., Zheng, D., Bitew, G. T. (2021). Elsevier.

References:

1. Microgrids and Methods of Analysis, Baghaee, H. R., Garehpetian, G. B., Shabestary, M. M. (2021). Elsevier.
2. Microgrid Architectures, Control and Protection Methods. (2019). Springer.
3. Microgrid: Operation, Control, Monitoring and Protection. (2020). Springer.
4. Microgrid Technologies. (2021). Wiley.

Microgrid Stability Assessment and Protection Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	MT-EAE	MT-EAE-3	MT-419P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Microgrid Stability Assessment and Protection) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study Instantaneous over current protection relay.
2. To study Overcurrent/overload protection scheme.
3. Simulation of islanding protection in microgrids.
4. Study of over current protection of dc microgrid
5. Study of over current protection of ac microgrid
6. To Realise Relay coordination by programmable logic controller
7. Study Mathematical modelling of microgrid and its realization.
8. Realization of Fault model of inverter-interfaced distributed energy resource in Software viz Matlab/ Labview.
9. Implementing Protection of wind and solar power fed microgrid in Software viz Matlab/ Labview
10. Microgrid Stabiity Assessment using MATLAB.

Microprocessors and Interfacing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	6	PCE	PCE-3	CIE-364T
EAE	6	ES-EAE	ES-EAE-1A	ES-302T
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OECE-417T
OAE	7	ECE-OAE	ECE-OAE-3B	OECE-417T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the internal organization of 8-bit Intel microprocessors and apply the knowledge to develop assembly language programs using 8085 microprocessor.
2.	To impart knowledge about interfacing of memory devices and simple I/O devices with 8085 microprocessor.
3.	Understand the internal organization of 16-bit Intel microprocessors and apply the knowledge to develop assembly language programs using 8086 microprocessor.
4.	Understand the architecture and operation of Programmable Peripheral Devices and their interfacing with 8086 microprocessor.

Course Outcomes (CO)

CO 1	Ability to understand and distinguish the use of different 8085 instructions and apply those instructions for implementing assembly language programs.
CO 2	Understand and realize the interfacing of memory devices and simple I/O devices with 8085 microprocessor.
CO 3	Ability to understand and distinguish the use of different 8086 instructions and apply those instructions for implementing assembly language programs.
CO 4	Understand the architecture and operation of Programmable Peripheral Devices and ability to use them for interfacing I/O devices.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	-	1	2	2	1	1	1
CO 2	3	3	3	2	3	-	1	2	2	1	1	1
CO 3	3	3	3	2	3	-	1	2	2	1	1	1
CO 4	3	3	3	2	3	-	1	2	2	1	1	1

UNIT-I

Introduction to microprocessors – Single Chip CPU, Microprocessors Evolution, Trends in Microprocessor Technology.

Introduction to Microprocessor Systems: Architecture and PIN diagram of 8085, Timing Diagram, memory organization, Addressing modes, Interrupts. Assembly Language Programming.

UNIT-II

Methods of Data Transfer and Interrupt Structure of 8085- Data transfer mechanisms, Memory mapped and I/O mapped data transfer, Programmed data transfer, Parallel data transfer, Serial data transfer, RS-232 standard, RS-485 standard, GPIB/IEEE 488 standard, Interrupt driven data transfer, Interrupt Structure of 8085, RST instructions, Multiple interrupts and priorities, 8085 vectored interrupts, Direct Memory access concepts. **Interfacing of Memory devices with 8085**-Generation of control signals for memory, Interfacing EPROM and RAM chips with 8085.

UNIT-III

8086 Microprocessor: Architecture of 8086, Difference between 8086 and 8088, Programming Model, generation of physical address, Memory Segmentation, PIN diagram of 8086, Minimum mode and Maximum mode configurations, Timing Diagrams. Instruction set of 8086, Assembler Directives, Assembly Language Programming, 8086 Interrupts, Memory Interfacing.

UNIT – IV

Interfacing of 8086 with 8255, 8254/ 8253, 8251, 8259, 8257: Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI)-Intel 8255, Sample-and-Hold Circuit and Multiplexer, Keyboard and Display Interface, Keyboard and Display Controller (8279), Programmable Interval timers (Intel 8253/8254), USART (8251), PIC (8259), DMA (8257), DAC, ADC and Stepper Motor.

Textbook(s):

1. Ramesh Gaonkar, Microprocessor Architecture, Programming, and application with 8085, Sixth Edition, Penram International Publication, 2013.
2. Sunil Mathur, Microprocessor 8086 Architecture, Programming and Interfacing, PHI, 2011.
3. Douglas V. Hall, Microprocessors and Interfacing, Tata McGraw Hill.

References:

1. B. Ram, "Microprocessors and Microcontrollers", Dhanpat Rai Publications, 2013.
2. John Uffenbeck, Microcomputers and Microprocessors, Third Edition, PHI, 2000.

Microprocessors and Interfacing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	6	PCE	PCE-3	CIE-364P
EAE	6	ES-EAE	ES-EAE-1A	ES-302P
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OECE-417P
OAE	7	ECE-OAE	ECE-OAE-3B	OECE-417P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Microprocessors and Interfacing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program in 8085 to add two 8 bit numbers using:
   i. Immediate addressing
   ii. Direct addressing
   iii. Indirect addressing
2. Write a program in 8085 to find the largest/smallest number in an array of 8 bit numbers.
3. Write a program in 8085 to multiply and divide two 8-bit numbers stored in consecutive memory locations.
4. Write a program in 8085 to sort a series of ten data bytes in ascending/descending order.
5. Write a program to add and subtract two 16-bit numbers with/ without carry using 8086.
6. Write a program in 8086 to add two binary numbers of 16 byte lengths.
7. Write a program to multiply/divide two 8- bit numbers using 8086.
8. Write a Program to generate Fibonacci series.
9. Write a Program to generate Factorial of a number.
10. Write a Program to read 16-bit Data from a port and display the same in another port.
11. Write a Program to generate a square wave using 8254.
12. Design a Minor project using 8086 Microprocessor (Ex: Traffic light controller/temperature controller etc)

Microprocessors and Microcontrollers

L	P	C
3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	4	PC	PC	ECC-210
EE/EEE/ICE	5	PC	PC	ECC-313

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge about architecture and instruction set of 8085 microprocessor so that students can implement 8085 assembly language programs.
2.	To impart knowledge about architecture and instruction set of 8086 microprocessor so that students can implement 8086 assembly language programs.
3.	To impart knowledge about interfacing of 8255, 8254/8253, 8251, 8259 and I/O devices with 8086 microprocessor.
4.	To impart knowledge about architecture and operation of 8051 microcontroller and their interfacing with memory and I/O.

Course Outcomes (CO)

CO 1	Ability to understand and distinguish the use of different 8085 instructions, timing diagram, addressing modes, interrupts and apply those instructions for implementing assembly language programs.
CO 2	Ability to analyse the timing diagrams, understand its instruction set, assess its memory organisation and will implement the assembly language programs , interfacing of memory with 8086 successfully
CO 3	Understand and realize the interfacing of 8255 (PPI), 8254/8255 (PIT), 8251 (USART), 8259 (PIC), 8279 (Keyboard and display), Sample and hold circuit, DAC/ADC, LCD & Stepper motor with 8086 microprocessor.
CO 4	Understand the architecture and operation of 8051 microcontroller and ability to use them for designing various applications based on 8051 by implementing the elaborate instruction set.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	1	1	-	-	-	-	1
CO 2	3	3	3	2	3	1	1	-		-		1
CO 3	3	3	3	2	3	1	1	-	1	-	-	1
CO 4	3	3	3	2	3	1	1	-	-	-	-	1

UNIT - I

Introduction to Microprocessor Systems: Architecture and PIN diagram of 8085, Timing Diagram, memory organization, addressing modes, interrupts. Assembly Language Programming.

UNIT – II

8086 Microprocessor: 8086 Architecture, difference between 8085 and 8086 architecture, generation of physical address, PIN diagram of 8086, Minimum Mode and Maximum mode, Bus cycle, Memory Organization, Memory Interfacing, Addressing Modes, Assembler Directives, Instruction set of 8086, Assembly Language Programming, Hardware and Software Interrupts.

UNIT – III

Interfacing of 8086 with 8255, 8254/8253, 8251, 8259: Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI)-Intel 8255, Sample-and-Hold Circuit and Multiplexer, Keyboard and Display Interface, Keyboard and Display Controller (8279), Programmable Interval timers (Intel 8253/8254), USART (8251), PIC (8259), DAC, ADC, LCD, Stepper Motor.

UNIT – IV

Overview of Microcontroller 8051: Introduction to 8051 Micro-controller, Architecture, Memory organization, Special function registers, Port Operation, Memory Interfacing, I/O Interfacing, Programming 8051 resources, interrupts, Programmer's model of 8051, Operand types, Operand addressing, Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions, Timer & Counter Programming, Interrupt Programming.

Textbook(s):

4. Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", Pearson, 2006
5. Douglas V Hall, "Microprocessors and Interfacing, Programming and Hardware" Tata McGraw Hill, 2006.
6. Ramesh Gaonkar, "MicroProcessor Architecture, Programming and Applications with the 8085", PHI

References:

5. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. MCKinlay "The 8051 Microcontroller and Embedded Systems",2nd Edition, Pearson Education 2008.
6. Kenneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing The PC", Delmar Publishers, 2007.
7. A K Ray, K M Bhurchandi, "Advanced Microprocessors and Peripherals", Tata McGraw Hill, 2007.
8. Vaneet Singh, Gurmeet Singh, "Microprocessor and Interfacing", Satya Prakashan, 2007.

Microprocessors and Microcontrollers Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	4	PC	PC	ECC-210
EE/EEE/ICE	5	PC	PC	ECC-363

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Microprocessors and Microcontrollers as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to add and subtract two 16-bit numbers with/ without carry using 8086.

2. Write a program to multiply two 8 bit numbers by repetitive addition method using 8086.

3. Write a Program to generate Fibonacci series.

4. Write a Program to generate Factorial of a number.

5. Write a Program to read 16-bit Data from a port and display the same in another port.

6. Write a Program to generate a square wave using 8254.

7. Write a Program to generate a square wave of 10 kHz using Timer 1 in mode 1(using 8051).

8. Write a Program to transfer data from external ROM to internal (using 8051).

9. Design a Minor project using 8086 Microprocessor (Ex: Traffic light controller/temperature controller etc)

10. Design a Minor project using 8051 Micro controller

Middleware Technologies	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	6	PCE	PCE-3	CIE-366T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Learn how to use Middleware to Build Distributed Applications
2.	Implement Business Processes
3.	Learn about Middleware Technologies
4.	Implement Business Processes

Course Outcomes (CO)

CO 1	Understand Distributed systems design and implementation Use Middleware to Build Distributed Applications
CO 2	Understand existing Distributed Technologies
CO 3	Understand Middleware Interoperability
CO 4	Understand Web services architectures

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	3	1	-	-	3	2	3	2
CO 2	3	2	3	2	3	1	-	-	3	2	3	2
CO 3	3	2	3	2	3	1	-	-	3	2	3	2
CO 4	3	2	3	2	3	1	-	-	3	2	3	2

UNIT-I

Introduction to client server computing: Evolution of corporate computing models from centralized to distributed computing, client server models. Benefits of client server computing, pitfalls of client server programming.
CORBA with Java: Distributed programming with Java RMI; Overview of CORBA, CORBA IDL, Client/server programming with CORBA & Java.

UNIT-II

XML Technologya and Soap: XML Technology XML – Name Spaces – Structuring With Schemas and DTD – Presentation Techniques – Transformation – XML Infrastructure. SOAP: Overview of SOAP – HTTP – XML-RPC – SOAP: Protocol – Message Structure – Intermediaries – Actors – Design Patterns And Faults – SOAP With Attachments

UNIT-III

Webservices Overview: XML Technology XML – Name Spaces – Structuring With Schemas and DTD – Presentation Techniques – Transformation – XML Infrastructure.SOAP: Overview of SOAP – HTTP – XML-RPC – SOAP: Protocol – Message Structure – Intermediaries – Actors – Design Patterns And Faults – SOAP With Attachments

UNIT – IV

Agent Communication and Collaboration: Agent Communication and Collaboration: Overview of Agent Oriented Programming - Agent Communication Language – Agent-Based Framework of Interoperability - Agents for Information Gathering - Open Agent Architecture - Communicative Action for Artificial Agent
Agent Architecture: Agents for Information Gathering - Open Agent Architecture – Communicative Action for Artificial Agent

Textbooks:
1. Frank. P. Coyle, "XML, Web Services and The Data Revolution", 1st Edition, Pearson Education, 2002.
2. Jeffrey M. Bradshaw, "Software Agents", 1st Edition, PHI, 2010.

References:
1. M.L.Liu , "Distributed Computing, Principles and applications", 1st Edition, Pearson Education, 2008.
2. Ramesh Nagappan, Robert Skoczylas and Rima Patel Sriganesh, "Developing Java Web Services" , 1st Edition, Willey Publishing , 2004.

Middleware Technologies Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	6	PCE	PCE-3	CIE-366P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Middleware Technologies) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Create a distributed application to download various files from various servers using RMI
2. Create a Java Bean to draw various graphical shapes and display it.
3. Develop an Enterprise Java Bean for financing operations
4. Develop an Enterprise Java Bean for University operations
5. Create an Active-X control for all File operations
6. Develop a component for converting the currency values using distributed model
7. Develop a component for encryption and decryption using using distributed model
8. Develop a component for retrieving information from message box using using distributed model
9. Develop a middleware component for retrieving Stock Market Exchange information using CORBA
10. Develop a middleware component for retrieving Weather Forecast information using CORBA

Mining Software Repositories and Predictive Modelling	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	SE-EAE	SE-EAE-3	SE-483T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Students will understand the concepts of software testing, quality assurance, and data mining in software engineering, including software maintenance, static code analysis, and software metrics.
2.	Students will gain proficiency in Git for version control and learn how to effectively manage and collaborate on software development projects.
3.	Students will explore software analytics techniques to extract insights from software repositories, such as identifying error-prone code, monitoring technical debts, and planning refactoring processes.
4.	Students will develop skills in predictive modeling techniques, including linear regression, decision trees, clustering, and deep neural networks, and apply them to tasks such as defect prediction and failure prediction in software engineering.

Course Outcomes (CO)

CO 1	Students will gain knowledge and skills in software testing, quality assurance, data mining, and predictive modeling techniques.
CO 2	Students will learn to analyze program models, perform static code analysis, and extract valuable information from software repositories using tools like Git.
CO 3	Students will be proficient in software analytics, identifying error-prone code, and monitoring technical debts.
CO 4	Students will develop expertise in predictive modeling, including regression, decision trees, clustering, and deep neural networks, and understand their applications in defect prediction, refactoring planning, and redesign processes.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2	2	1	1	2	1	2	1	2	2
CO 2	3	2	2	2	3	1	2	1	2	1	2	2
CO 3	3	3	2	3	3	2	3	1	2	1	2	2
CO 4	3	3	3	3	3	2	3	3	3	1	2	3

UNIT-I

Introduction: Software Testing and Quality Assurance, Program Modelling Software Testing, Fundamentals of Data mining, Data mining for Software Engineering, Software Maintenance, Static Code Analysis, Software Metrics, Lines of Code, Nesting Level, Cyclomatic complexity, Module Dependencies, Object Oritented Metrics.

UNIT-II

Version Control: Introduction to Version Control, Types of Version Control.
Git: Fundamentals of Git, Git Workflow, Git Setup Basics, Remote Git Repository, Operations on Git Repositories, Adding Collaborators to Git, Git Local Repository to Remote Repository.
Mining Software Repositories: Coupled Change Analysis, Commit Analysis, Documentation Analysis
Software Analytics-I: Software Maps, Exploring System Implementations, Discovering Error-Prone Code, Monitor Technical Debts

UNIT-III

Software Analytics-II: Involvement and Knowledge Distribution, Refactoring Planning, Monitoring Redesign Processes.
Techniques: Tracing, TraceViews, Code Usage & Test Coverage, Software Effectiveness, Prescriptive Software Analytics.
Visual tools for Software Analytics: Treemaps, 2.5D Treemaps Hierarchical Circular Bundle Views

UNIT - IV

Fundamentals of Predictive Modelling, Applications of Predictive Modelling
Predictive Modelling Techniques: Linear regression, Decision trees, K-means clustering, Deep neural networks. Limitations of Predictive Modelling. Predictive Modelling workflow, Evaluation metrics for Predictive Models, Deep Learning based Defect Prediction, Cross Project defect Prediction, Just-in-Time defect prediction, Failure Prediction.

Textbook(s):
1. Software Testing, Yogesh Singh, Cambridge University Press,3rd Edition ISBN: 978-1107652781
2. Hands-On Predictive Analytics with Python: Master the complete predictive analytics process, from problem definition to model deployment, Alvaro Fuentes, Packt Publishing, 1st edition, ISBN: 178913871X

References:
1. Software Engineering, Ian Sommerville, Pearson Publication, 10th Edition ISBN: 9332582696
2. Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Dean Abbott, Wiley, 1st Edition, ISBN: 978-1-118-72796-6

Mining Software Repositories and Predictive Modelling Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	SE-EAE	SE-EAE-3	SE-483P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Mining Software Repositories and Predictive Modelling) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Experiment 1: Static Code Analysis for Quality Assurance

Objective: To understand the importance of static code analysis in software quality assurance and identify potential issues in a given codebase.

Select a sample codebase (e.g., a small software project) with multiple modules and classes. Introduce intentional defects in the codebase, such as logical errors, coding standards violations, and potential security vulnerabilities. Use a static code analysis tool (e.g., SonarQube, FindBugs) to analyze the codebase and generate a detailed report. Review the generated report to identify and understand the detected issues. Prioritize the identified issues based on their severity and potential impact on the software's functionality and quality. Collaboratively discuss and propose appropriate solutions or code improvements to address the identified issues. Implement the necessary changes and re-run the static code analysis tool to verify the effectiveness of the improvements. Reflect on the process and discuss the importance of static code analysis in maintaining code quality and reducing potential risks.

Experiment 2: Data Mining for Software Engineering

Objective: To apply data mining techniques to extract meaningful insights from a software repository and make informed decisions for software engineering purposes

Select a software repository (e.g., a Git repository) containing a significant amount of historical data. Define a specific research question or hypothesis related to software development or maintenance. Extract relevant data from the repository, such as commit history, bug reports, code changes, and metrics (e.g., lines of code, cyclomatic complexity). Clean and preprocess the extracted data to ensure its quality and consistency. Apply appropriate data mining techniques, such as association rule mining, clustering, or classification, to uncover patterns, trends, or relationships in the dataset. Analyze the results of the data mining process and interpret the discovered patterns or relationships in the context of the research question or hypothesis. Discuss the implications of the findings and their potential impact on software development practices or decision-making. Reflect on the limitations and challenges of data mining in the software engineering domain and propose possible improvements or future research directions.

Experiment 3: Coupled Change Analysis in Mining Software Repositories

Objective: To analyze coupled changes in a software repository and understand the interdependencies between code changes.

Set up a Git repository locally and create a basic project structure. Explore the Git workflow by initializing the repository, adding files, committing changes, and branching. Simulate a collaborative scenario by adding collaborators to the Git repository. Perform operations on the Git repository, such as pushing and pulling changes, resolving conflicts, and merging branches. Document the workflow and collaboration process, highlighting the benefits and challenges of using version control systems like Git.

Experiment 4: Coupled Change Analysis in Mining Software Repositories

Objective: To analyze coupled changes in a software repository and understand the interdependencies between code changes.

Select a software repository or a specific project from a repository. Identify a set of related files or modules within the project. Analyze the commit history to identify instances where changes in one file/module were followed by changes in another related file/module. Use data mining techniques to quan`tify and visualize the coupled changes, such as calculating change coupling metrics or creating a dependency graph. Interpret the results to understand the impact of coupled changes on the software system and identify potential areas for improvement or refactoring.

Experiment 5: Error-Prone Code Analysis using Software Analytics

Objective: To detect and analyze error-prone code segments in a software system using software analytics techniques.

Select a software project or a specific codebase for analysis. Create software maps or visual representations of the codebase, highlighting different modules, classes, or components. Use software analytics techniques to explore the system implementation, such as identifying complex code segments, high cyclomatic complexity, or excessive nesting levels. Perform error-prone code analysis by analyzing historical data, including bug reports, and correlating it with the identified code segments. Monitor technical debts by identifying code smells, redundant code, or deprecated methods and evaluate their impact on software quality. Present the findings and propose recommendations for code refactoring or improvements to mitigate potential errors and technical debts.

Experiment 6: Comparative Evaluation of Predictive Models

Objective: Compare the performance of linear regression, decision trees, k-means clustering, and deep neural networks for a specific software engineering task, such as defect prediction.

Collect relevant data from software repositories, preprocess the data, train and evaluate predictive models using different techniques, and compare their performance using evaluation metrics such as accuracy, precision, recall, and F1-score.

Experiment 7: Deep Learning-Based Defect Prediction

Objective: Develop a deep learning model for defect prediction based on software repository data.

Gather historical data from software repositories, preprocess the data, design and train a deep neural network model, evaluate its performance using appropriate evaluation metrics, and compare it with traditional predictive models (e.g., decision trees) in terms of accuracy and effectiveness.

Experiment 8: Cross-Project Defect Prediction

Objective: Investigate the feasibility of using predictive models trained on one project to predict defects in another project.

Select multiple software projects with similar characteristics, collect and preprocess data from their repositories, train predictive models on one project, and evaluate their performance on the other projects. Compare the results to assess the effectiveness of cross-project defect prediction.

Experiment 9: Just-in-Time Defect Prediction

Objective: Develop a predictive model that can identify potential defects in software code during the development process.

Utilize real-time or near real-time data from software repositories, continuously update the model as new data becomes available, and predict the likelihood of defects in code changes. Evaluate the model's accuracy and effectiveness in detecting defects in a timely manner.

Experiment10: Failure Prediction Analysis

Objective: Investigate the factors contributing to software system failures and develop a predictive model to identify potential failures.

Gather historical data on software failures from repositories, extract relevant features and metrics, apply predictive modeling techniques (e.g., decision trees) to develop a failure prediction model. Evaluate the model's ability to predict future failures based on its training and testing performance, and analyze the factors contributing to system failures.

Mobile App Development	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	FSD-EAE	FSD-EAE-4	FSD-437T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce students the fundamentals of mobile app development and its significance in the digital era.
2.	To familiarize students with the Android and iOS platforms as key mobile app development platforms.
3.	To provide students with hands-on experience in designing, developing, testing, and deploying mobile applications.
4.	To expose students to advanced subjects in mobile app development, such as cross-platform development and upcoming trends.

Course Outcomes (CO)

CO 1	Understand the importance, principles of mobile app development, Identify and explain the characteristics and features of the Android and iOS platforms.
CO 2	Develop mobile applications using programming languages relevant to the platforms and design user-friendly and visually appealing mobile app interfaces.
CO 3	Implement data storage, synchronization, and location-based services in mobile apps. Test and debug mobile applications for optimal performance and functionality.
CO 4	Demonstrate knowledge and understanding of cross-platform app development frameworks and Stay updated with emerging trends and future directions in mobile app development.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1	1	2	-	3	-	1	2	3
CO 2	3	2	1	1	1	2	-	3	-	1	2	3
CO 3	3	2	1	1	1	2	-	3	-	1	2	3
CO 4	3	2	1	1	1	2	-	3	-	1	2	3

UNIT I

Introduction to Mobile App Development: Overview, history, and importance, Mobile platforms and operating systems: Android and iOS, Mobile app development tools and environments, Introduction to programming languages for mobile app development

User Interface Design and Development: User interface (UI) design principles for mobile apps, UI components and layouts, designing for multiple screen sizes and resolutions, Implementing navigation and user interaction

UNIT II

Mobile App Development Technologies: Mobile app architecture and components, Backend integration and API consumption, Data storage and synchronization, Location-based services and mapping.

UNIT III

Mobile App Testing and Deployment: Testing methodologies for mobile apps, Debugging and error handling, App store submission and deployment process, App performance optimization and analytics

UNIT IV

Advances Topics in Mobile App Development: Mobile app security and privacy considerations, InCross-platform app development frameworks (e.g., React Native, Flutter), Emerging trends and future directions in mobile app development.

Textbooks:

1." Android Programming: The Big Nerd Ranch Guide" by Bill Phillips and Chris Stewart
2. "iOS Programming: The Big Nerd Ranch Guide" by Christian Keur and Aaron Hillegass
3. "Head First Android Development: A Brain-Friendly Guide" by Dawn Griffiths and David Griffiths
4. "Beginning iOS Cloud and Database Development: Build Data-Driven Cloud Apps for iOS" by Thomas P. Fitzpatrick

Reference Books:

1. "Learning Swift: Building Apps for macOS, iOS, and Beyond" by Jonathon Manning, Paris Buttfield-Addison, and Tim Nugent
2. "Beginning Android Programming with Kotlin" by Jerome DiMarzio
3. "Designing Interfaces: Patterns for Effective Interaction Design" by Jenifer Tidwell
4. "iOS Human Interface Guidelines: Creating a Great User Experience" by Apple Inc.
5. "Android Studio Development Essentials: Android 10 Edition" by Neil Smyth
6. "Test-Driven Development with Python" by Harry Percival
7. "Mobile App Development with React Native: Build iOS and Android Apps with JavaScript" by Johnathan Horton and Muhammed Murtaza
8. "Mobile Design and Development: Practical concepts and techniques for creating mobile sites and web apps" by Brian Fling

Mobile App Development Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	FSD-EAE	FSD-EAE-4	FSD-437P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Mobile App Development) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Experiment 1: Setting up the Development Environment

- Install Android Studio and set up the Android development environment.
- Install Xcode and set up the iOS development environment.
- Create a basic "Hello World" app for Android and iOS platforms.

Experiment 2: User Interface Design and Development

- Design a simple user interface using XML for an Android app.
- Design a user interface using Interface Builder for an iOS app.
- Implement navigation between multiple screens in both Android and iOS apps.

Experiment 3: Database Integration in Mobile Apps

- Create a SQLite database and perform basic CRUD operations in an Android app.
- Implement Core Data framework for data storage in an iOS app.

Experiment 4: Web Services and API Consumption

- Retrieve data from a RESTful API and display it in an Android app.
- Consume a web service and display data in an iOS app using URLSession.

Experiment 5: Location-Based Services and Mapping

- Implement location tracking and display user location on a map in an Android app using Google Maps API.
- Integrate MapKit framework in an iOS app to show user location and add annotations on the map.

Experiment 6: Cross-Platform App Development with React Native or Flutter

- Develop a simple mobile app using React Native, utilizing components and navigation.
- Create a mobile app using Flutter, implementing UI elements and handling user input.

Experiment 7: Testing and Debugging

- Perform unit testing on key functionalities of an Android app using JUnit and Android Testing frameworks.
- Debug and test an iOS app using Xcode debugger and XCTest framework.

Experiment 8: App Deployment and Performance Optimization

- Package and deploy an Android app to Google Play Store.
- Package and deploy an iOS app to the App Store.
- Optimize app performance by analyzing and improving resource usage, network efficiency, and responsiveness.

Experiment 9: Augmented Reality (AR) Integration

- Integrate AR features into an Android app using ARCore or ARKit for iOS.

Experiment 10: IoT Integration in Mobile Apps

- Connect a mobile app with IoT devices, such as smart home devices, sensors, or wearables.

Mobile Communication	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-1	ECE-310

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic concepts of Cellular Mobile Systems and Cellular Radio Systems Design.
2.	To impart the conceptual knowledge of cell coverage for signal & antenna structures and frequency management & channel assignment.
3.	To impart the understanding of the modulation methods and coding for error detection and correction and Multiple access techniques.
4.	To impart the knowledge related to the basics of Second generation digital wireless systems.

Course Outcomes (CO)

CO 1	Understand the concepts of Cellular Mobile Systems and Cellular Radio Systems Design.
CO 2	Develop conceptual knowledge of cell coverage for signal & antenna structures and frequency management & channel assignment.
CO 3	Understand the modulation methods and coding for error detection and correction and Multiple access techniques.
CO 4	Integrate the basics of Second generation digital wireless systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	1	1	-	1	1	-	3
CO 2	3	2	2	2	2	1	1	-	1	1	-	3
CO 3	3	2	2	2	2	1	1	-	1	1	-	3
CO 4	3	2	2	2	2	1	1	-	1	1	-	3

UNIT I

Introduction to Cellular Mobile Systems: A basic cellular system, performance criteria, uniqueness of mobile radio environment, operation of cellular systems, planning a cellular system, overview of generations of cellular systems.

Elements of Cellular Radio Systems Design and Interference: General description of the problem, concept of frequency reuse channels, co-channel interference reduction factor, desired C/I from a normal case in an omni directional antenna system, cell splitting, consideration of the components of cellular systems, Introduction to co-channel interference, co-channel measurement design of antenna system, antenna parameter and their effects.

UNIT II

Cell Coverage for Signal & Antenna Structures: General introduction, obtaining the mobile point to point mode, propagation over water or flat open area, foliage loss, propagation near in distance, long distance propagation, point to point prediction model – characteristics, cell site, antenna heights and signal coverage cells, mobile to mobile propagation, Characteristics of basic antenna structures, antenna at cell site, mobile antennas.
Frequency Management & Channel Assignment, Hand Off & Dropped Calls: Frequency Management, fixed channel assignment, non-fixed channel assignment, traffic & channel assignment, Why hand off, types of handoff and their characteristics, dropped call rates & their evaluation.

UNIT III

Modulation methods and coding for error detection and correction: Introduction to Digital modulation techniques, modulation methods in cellular wireless systems, OFDM, Block Coding, convolution coding and Turbo coding.
Multiple access techniques: FDMA, TDMA, CDMA: Time-division multiple access (TDMA), code division multiple access (CDMA), CDMA capacity, probability of bit error considerations, CDMA compared with TDMA.

UNIT IV

Second generation digital wireless systems: GSM, IS_136 (D-AMPS), IS-95, mobile management, voice signal processing and coding.

Textbook(s):
1. William, C. Y. Lee, “Mobile Cellular Telecommunications”, 2nd Edition, McGraw Hill, 1990
2. Mischa Schwartz, “Mobile Wireless Communications”, Cambridge University Press, UK, 2005.

References:
1. “Mobile Communication Hand Books”, 2nd Edition, IEEE Press.
2. Theodore S Rappaport, “Wireless Communication Principles and Practice”, 2nd Edition, Pearson, 2002.
3. Lawrence Harte, “3G Wireless Demystified”, McGraw Hill Publications, 2001.
4. Kaveh Pahlavan and Prashant Krishnamurthy”, Principles of Wireless Networks”, PHI, 2001.

Mobile Computing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	6	PCE	PCE-3	CIE-368T
ECE	6	PCE	PCE-1	ECE-316T
EAE	7	WMC-EAE	WMC-EAE-3B	WMC-455T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of mobile physical layer and mobile computing architecture.
2.	To impart the fundamentals of mobile data link layer and Bluetooth.
3.	To impart the knowledge of mobile IP network layer and mobile transport layer.
4.	To impart the knowledge related to the usage of wireless devices and operating systems and the concepts of mobile application languages.

Course Outcomes (CO)

CO 1	Understand and illustrate the concepts of mobile physical layer and mobile computing architecture.
CO 2	Integrate the knowledge of mobile data link layer and Bluetooth.
CO 3	Analyse the features of mobile IP network layer and mobile transport layer.
CO 4	Outline the usage of wireless devices and operating systems and summarizing the concepts of mobile application languages.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	1	1	-	1	1	-	3
CO 2	3	2	2	2	2	1	1	-	1	1	-	3
CO 3	3	2	2	2	2	1	1	-	1	1	-	3
CO 4	3	3	2	2	3	1	1	-	1	1	-	3

UNIT-I

Mobile Physical layer: Review of generation of mobile services, overview of wireless telephony, cellular concept, GSM: air-interface, channel structure, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, CDMA, GPRS.

Mobile computing Architecture: issues in mobile computing, three tier architecture for mobile computing, design considerations, Mobile file systems, Mobile databases. WAP: Architecture, protocol stack, Data gram protocol, Wireless transport layer security, Wireless transaction protocol, wireless session protocol, application environment, and applications.

UNIT-II

Mobile Data link layer: Wireless LAN over view, IEEE 802.11, Motivation for a specialized MAC, Near & far terminals, Multiple access techniques for wireless LANs such as collision avoidance, polling, Inhibit sense, spread spectrum, CDMA, LAN system architecture, protocol architecture, physical layer MAC layer and management, Hiper LAN.
Blue Tooth: IEEE 802.15 Blue tooth User scenarios, physical, MAC layer and link management.
Local Area Wireless systems: WPABX, IrDA, ZigBee, RFID, WiMax

UNIT-III

MOBILE IP Network Layer: IP and Mobile IP Network Layer- Packet delivery and Handover Management- Location Management- Registration- Tunnelling and Encapsulation-Route Optimization- Dynamic Host Configuration Protocol, Ad Hoc networks, localization, MAC issues, Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), VoIP –IPSec,
Mobile Transport Layer: Traditional TCP/IP, Transport Layer Protocols-Indirect, Snooping, Mobile TCP

UNIT – IV

Support for Mobility: Data bases, data hoarding, Data dissemination, UA Prof and Caching, Service discovery, Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, Mobile devices and File systems, Data Synchronization, Sync ML.
Introduction to Wireless Devices and Operating systems: Palm OS, Windows CE, Symbion OS, Android, Mobile Agents. Introduction to Mobile application languages and tool kits.

Textbook(s):

1. J. Schiller, “Mobile Communications”, 2nd edition, Pearson, 2011.
2. Raj Kamal “Mobile Computing” Oxford Higher Education, Second Edition, 2012.
3. Dharam Prakash Agrawal and Qing-An Zeng, “Introduction to Wireless and Mobile Systems” 3rd Edition, Cengage learning 2013.

References:

1. Asoke K Talukder, Hasan Ahmed,Roopa R Yavagal “Mobile Computing”, Tata McGraw Hill.
2. Pei Zheng, Larry L. Peterson, Bruce S. Davie, Adrian Farrell “Wireless Networking Complete” Morgan Kaufmann Series in Networking , 2009
3. Vijay K Garg “Wireless Communications & Networking” Morgan Kaufmann Series, 2010
4. M. V. D. Heijden, M. Taylor, Understanding WAP, Artech House.
5. Charles Perkins, Mobile IP, Addison Wesley.
6. Charles Perkins, Ad hoc Networks, Addison Wesley.
7. Uwe Hansmann, Lothar Merk, Martin S. Nicklous, Thomas Stober, “Principles of Mobile Computing”, Springer.
8. Evaggelia Pitoura and George Samarus, “Data Management for Mobile Computing”, Kluwer Academic Press, 1998
9. V. Jeyasri Arokiamary, “Mobile Computing”, Technical Publications

Mobile Computing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	6	PCE	PCE-3	CIE-368P
ECE	6	PCE	PCE-1	ECE-316P
EAE	7	WMC-EAE	WMC-EAE-3B	WMC-455P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Mobile Computing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to create a card and print "Hello! WML" in <p> tag.
2. Write a program to create and execute external links in WML.
3. Write a program to create multiple cards in WML and perform navigation between them using do tags.
4. Write a program to show images (.wbmp file) in WML page.
5. Write a program to create a table in WML.
6. Write a program to create a form in one card and show entered/selected data in second card in WML. Use input, select, option and do tags.
7. Write a program to show the usage of onpick and ontimer events in WML page.
8. Write a simple WML script to set and show the value of a variable.
9. Write a WML script to input a number and show the square of that number.
10. Write a WML script to input two numbers and show the sum.
11. Write a WML script and program to create a calculator.
12. Develop an android app which displays “Hello, welcome to Android Lab” message.
13. Using Android, create a login Activity which asks “username” and “password” from user. Display the welcome message if the username and password are valid.

Modeling and Analysis of Microgrids	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	MT-EAE	MT-EAE-2	MT-314T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of Micro-grid modelling.
2.	To impart the knowledge of Micro-grid converters modelling.
3.	To understand the concepts of Micro-grid analysis.
4.	To understand the analysis of Micro-grid with power electronics interface.

Course Outcomes (CO)

CO 1	Ability to understand the concepts of Micro-grid modelling.
CO 2	Ability to understand the techniques of Micro-grid modelling.
CO 3	Ability to understand the concepts of Micro-grid analysis.
CO 4	Ability to understand the analysis of Micro-grid with power electronics interface.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	1	2	1	2	2	2	2	1	3
CO 2	3	2	3	3	3	2	1	2	3	2	1	3
CO 3	3	2	1	1	2	1	2	2	2	2	1	3
CO 4	3	3	3	3	3	2	1	2	3	2	1	3

UNIT-I

Concepts of Micro-grid Modelling: Micro-grids concept, Review of micro-grid sources, Structure and configuration of a micro-grid, Modes of operation and control, grid connected and islanded mode, anti-islanding schemes; Techniques for voltage, frequency, active and reactive power control, Concept of Modelling, Computer aided modelling.

UNIT-II

Schemes of Micro-grid modelling: Modelling of Power Electronics interfaces in DC and AC micro-grid in isolated and grid coupled mode; Formulation of load control and frequency control models; Direct load control, Interruptible load control, Active and reactive power control models; Micro-grid modelling schemes, anti-islanding, and communication based techniques.

UNIT-III

Concepts of Micro-grid Analysis: Analysis of micro-grid; Power-flow analysis, Droop-controlled and electronically-coupled distributed energy resources, neural networks based non-linear equation sets for micro-grid analysis. Power Electronics interfaces in DC and AC micro-grid, analysis of the power supplied to the AC grid.

UNIT-IV

Analysis of Micro-grid with Power Electronics Interface; Analysis of voltage-controlled inverter-interfaced micro-grid, Fundamental-frequency deterministic power flow, Probabilistic power flow problem, Extension of harmonic power flow, Hierarchical droop-based control scheme, complementary stabilizing control loop. Directly voltage-controlled schemes, current limiting strategy in different reference frames, Utilizing neural networks function.

Textbook(s):

1. Microgrids and Methods of Analysis, Gevork B. Gharehpetian, Hamid Reza Baghaee and Masoud M. Shabestary Amirnaser
2. “Voltage Source Converters in Power Systems: Modeling, Control and Applications”, Yezdani and Reza Iravani, IEEE John Wiley Publications, 2009.

References:

1. Microgrids: Architectures and Control, Nikos Hatziargyriou (Editor), ISBN: 978-1-118- 72068-4, 340 pages, December 2013, Wiley-IEEE Press
2. Microgrids and Active Distribution Networks, S. Chowdhury, S.P. Chowdhury and P. Crossley, The Institution of Engineering and Technology, London, U.K, 2009.
3. Dorin Neacsu, “Power Switching Converters: Medium and High Power”, CRC Press, Taylor & Francis, 2006.

Modeling and Analysis of Microgrids Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	MT-EAE	MT-EAE-2	MT-314P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Modeling and Analysis of Microgrids) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study time-domain analysis of AC Microgrid (use platform like MATLAB/SIMULINK environment)
2. To study time -domain simulations of DC Microgrid (in platform like MATLAB/SIMULINK environment)
3. To simulate a dc microgrid with two renewable sources and supported by battery storage.
4. Simulation of grid connected Microgrid by using 3-phase inverter.
5. To study voltage regulation of voltage source.
6. To study the effect of Temperature on Solar Panel Output.
7. Simulation of effect of load on Wind Turbine Output.
8. To study the effect of Variables Affecting Solar Panel Output
9. To study the real/ reactive power control of AC microgrid.
10. To study Power electronic interface of micro-grid.
11. Simulation of Voltage and frequency regulation of microgrid under load disturbances

Multimedia Communication	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-2	ECE-324

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of multimedia information representation and various multimedia applications.
2.	To impart the knowledge of text and image compression principles and methodologies.
3.	To impart the knowledge of audio and video compression techniques and different multimedia communication standards.
4.	To impart the knowledge of distributed multimedia systems and distributed multimedia applications and various file formats.

Course Outcomes (CO)

CO 1	To illustrate real-time multimedia network applicationsand to summarize different techniques of representing multimedia information.
CO 2	To illustrate text and image compression principles and to understand different text and image compression techniques.
CO 3	To understand different audio and image compression techniques and summarize different video compression standards.
CO 4	To understand the concept of distributed multimedia systems, networks and applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	1	2	-	2	2	-	2
CO 2	3	3	3	3	2	2	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	2	-	2

UNIT I

Multimedia Communication: Introduction, Multimedia networks, Multimedia applications, Application and networking terminology, Multimedia information representation: digitization principles, text representation, audio representation, video representation.

UNIT II

Text and Image Compression: Compression Principles: Lossless and Lossy compression, Run length encoding, Statistical encoding, Differential encoding, Transform encoding, Text compression using Static Huffman coding, Dynamic Huffman coding, Arithmetic coding, Lempel-Ziv coding etc. Image Compression: Graphics interchange format, Tagged image file format, digitized documents, JPEG Encoding and Decoding.

UNIT III

Audio and Video Compression: Audio compression using DPCM, Adaptive differential PCM, Adaptive Predictive coding, Linear predictive coding, Perceptual coding, MPEG audio coders, Dolby audio coders etc. Video compression principles, Video compression standards: H.261, H.263, MPEG-1, MPEG-2, MPEG-4.

UNIT IV

Distributed Multimedia Systems: Features of DMS, Resource Management of DMS, IP Networking, Multimedia Operating Systems, Distributed Multimedia servers, Distributed Multimedia Applications, Multimedia File Formats

Textbooks:

1. Fred Halsall, “Multimedia Communications: Applications, Networks, Protocols and Standards”, Pearson
2. Rao, Bojkovic, Milovanovic “Multimedia Communication Systems”, PHI, 2006

Reference Books:

1. Sharda, “Multimedia Information Networking”, PHI
2. Vaughan, “Multimedia making it work”, Tata Mc Graw Hill

Multimedia Technologies	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	6	PCE	PCE-2	CIE-342T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To identify a range of concepts and introduce the fundamental elements of multimedia.
2.	To cover the different compression standards used in multimedia, some current technology and related issues.
3.	To learn about the cost involved in multimedia planning, designing, and producing.
4.	To acquire knowledge on the major aspects of creative multimedia such as modelling, animation and rendering.

Course Outcomes (CO)

CO 1	This Course introduces the multimedia systems and their applications to students.
CO 2	Uses different compression techniques of text, audio, video and apply basics of animation.
CO 3	Use multimedia applications and user interface for effective animations.
CO 4	Develop introductory level competencies in the areas of character design, life drawing and animation.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	2	1	1	1	2	-	-	-	-	2
CO 2	3	2	3	2	2	-	-	2	-	-	-	2
CO 3	2	1	2	-	2	-	-	-	-	-	-	2
CO 4	3	2	3	2	3	1	2	3	2	1	1	3

UNIT-I

Introductory Concepts: Concept of Multimedia, Media & data stream, Basic properties of multimedia system, medium types (Temporal and non-temporal), Multimedia applications, uses of multimedia. Data stream characteristics, CD-ROM and the Multimedia Highway, Uses of Multimedia.

Introduction to making multimedia: The Stages of project, the requirements to make good multimedia, Multimedia skills and training, Training opportunities in Multimedia. Motivation for multimedia usage, Frequency domain analysis, Application Domain & ODA etc.

Multimedia-Hardware and Software: Multimedia Hardware – Macintosh and Windows production Platforms, Hardware peripherals – Connections, Memory and storage devices, Media software – Basic tools, making instant multimedia, Multimedia software and Authoring tools, Production Standards.

UNIT-II

Multimedia – making it work: multimedia building blocks – Text, Sound, Images, Animation and Video, Digitization of Audio and Video objects, Data Compression: Different Compression: Introduction, its need, lossless/lossy compression techniques concern to text, audio, video and images etc.,

UNIT-III

Multimedia and the Internet: History, Internet working, Connections, Internet Services, The World Wide Web, Tools for the WWW – Web Servers, Web Browsers, Web page makers and editors, Plug-Ins and Delivery Vehicles, HTML, VRML, designing for the WWW – Working on the Web, Multimedia Applications – Media Communication, Media Consumption, Media Entertainment, Media games.

UNIT - IV

Introduction Animation Tool: Fundamentals, **Modeling:** NURBS, Polygon, Organic.
Animation: Key frame animation, reactive animation, path animation, Skelton animation, etc., deformers.
Dynamics: soft bodies, Rigid bodies and its usages in the scene etc.
Rendering: soft, Hard rendering. IPR rendering, Line and box rendering etc.
Special Effects: Shading & Texturing Surfaces, Lighting, Special effects.
Working with MEL: Basics & Programming

Textbook(s):
1. Steve Heath, “Multimedia & Communication Systems”, Focal Press, UK, 1999.
2. Tay Vaughan, “Multimedia: Making it work”, TMH, 1999.
3. K. Andleigh and K. Thakkar, “Multimedia System Design”, PHI, PTR, 2000.
4. Autodesk, “Getting Started with Maya”, CA, USA, 2008

References:
1. Keyes, “Multimedia Handbook”, TMH, 2000.
2. Ralf Steinmetz and Klara Naharstedt, “Multimedia: Computing, Communications & Applications”, Pearson, 2001.
3. Steve Rimmer, “Advanced Multimedia Programming”, MHI, 2000.

Multimedia Technologies Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	6	PCE	PCE-2	CIE-342P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Multimedia Technologies) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Overview of Multimedia Tools.
2. Perform different operations (rotation, scaling move etc.) on objects.
3. Curves and surfaces representation using NURBS.
4. Implentation of Key frame animation.
5. Implentation of Path animation.
6. Make a Goblet using spin tool and perform basic rendering on it.
7. Create an animation having five images having fade-in fade-out effect
8. Devise a routine to produce the animation effect of a square transforming to a triangle then to a circle.
9. Create an scene to show the sunrise (using multiple layers and motion tweening).
10. Simulate the Pool Table or Mine Sweeper Game.

Nano Electronics	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EEE	6	PCE	PCE-2	EEE-330

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Knowledge of working and applications of basics of Nano-Technology
2.	To understand fabrication of Nano-Layers.
3.	To understand characterization of Nano-Structures
4.	To understand working of MOSFET Structures.

Course Outcomes (CO)

CO 1	To understand working and applications of basics of Nano-Technology
CO 2	Ability to understand fabrication of Nano-Layers.
CO 3	Ability to understand characterization of Nano-Structures
CO 4	Ability to understand working of MOSFET Structures.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Introduction to nanotechnology, Impacts, Limitations of conventionalmicroelectronics, Trends in microelectronics and optoelectronics, Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanicalcoherence, Schrodinger's Equation, wave function, Low dimensional structures Quantum wells, wires and dots, Density ofstates and dimensionality, Basic properties of two dimensional semiconductor nanostructures,square quantum wells of finite depth, parabolic and triangular quantumwells, Quantum wires and quantum dots, carbon nano tube, graphene.

UNIT II

Introduction to methods of fabrication of nano-layers, different approaches, physical vapour deposition, chemical vapour deposition, Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods, Fabrication of nano particle- grinding with iron balls, laser ablation, 15 reduction methods, sol gel, self assembly, precipitation of quantum dots.

UNIT III

Introduction to characterization of nanostructures, tools used for of nano materials characterization, microscope-optical, electron, and electron microscope, Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope, X-Ray Diffraction analysis, PL & UV Spectroscopy, Particle size analyser.

UNIT IV

MOSFET structures, Heterojunctions, Quantum wells, modulation doped quantum wells, multiple quantum wells, The concept of super lattices Kronig - Penney model of super lattice.

Textbook(s):
1. J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda Nanotechnology for Microelectronics and optoelectronics, Elsevier, 2006.
2. W.R. Fahrner, Nanotechnology and Nanoelctronics, Springer, 2005

Reference Books:
1. Chattopadhyay, Banerjee, Introduction to Nanoscience & Technology, PHI 2012
2. Poole, Introduction to Nanotechnology, John Wiley 2006.

Natural Language Processing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI	7	PC	PC	AI-409T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Analysing the concept and techniques of Natural Language Processing based on Morphology and CORPUS.
2.	Mathematical foundations, Probability theory with Linguistic essentials such as syntactic and semantic analysis of text.
3.	The application of statistical learning methods and cutting-edge research models from deep learning.
4.	Applying the natural language and suitable modelling technique based on the structure.

Course Outcomes (CO)

CO 1	Understand the knowledge of complex language behaviour in terms of phonetics, morphology etc.
CO 2	Understand the semantic and pragmatics for text processing to compile and analyse the texts based on digestive approach.
CO 3	Apply Part-of-speech (POS) tagging for a given natural language and suitable modelling technique.
CO 4	Apply state of the art algorithms and techniques for text based processing of natural language with respect to morphology.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	-	-	-	-	-	-	-	-	-	-	1
CO 2	1	-	-	-	-	-	-	-	-	-	-	1
CO 3	1	-	1	-	2	-	1	-	-	-	-	2
CO 4	1	-	2	-	2	-	2	-	-	-	-	2

UNIT-I

Introduction to NLP, The classical tool kit, Knowledge in speech and Language processing, ambiguity and models and algorithm, Language and understanding, brief history, Regular Expressions, patterns, words, Text normalization, Minimum edit distance, Regular Language and FSAs, Raw Text Extraction and Tokenization, Extracting Terms from Tokens, Normalization.

UNIT-II

N-grams, Evaluating language model, Generalization and zeros, smoothing, kneser-Ney smoothing, huge language models and stupid back off. Perplexity’s relation to entropy, Inflection, Derivational Morphology, Finite-State Morphological Parsing, Lexical and Morphotactics, Morphological Parsing with Finite State

Transducers, Combining FST Lexicon and rules.

UNIT-III

Methodological Preliminaries, Supervised Disambiguation: Bayesian Classification, an information theoretic approach, Dictionary-Based Disambiguation: Disambiguation based on sense, Thesaurus based disambiguation, Disambiguation based on translations in a second-language corpus.

UNIT - IV

Markov Model: Hidden Markov model Fundamentals, Probabilities of properties, Parameter estimation, Variants, Multiple input observation. The Information sources in Tagging: Markov model and taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging.

Textbook(s):

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing”, Prentice Hall.
2. Christopher D. Manning and Hinrich Schutze, “Foundation of Natural Language Processing”, The MIT Press Cambridge.

References:

1. James Allen, “Natural Language Understanding:, Pearson Publication.
2. Nitin Indurkhya, Fred J. Damerau, “Handbook of Natural Language Processing”, CRC Press, 2010.

Natural Language Processing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI	7	PC	PC	AI-409P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Natural Language Processing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Implement word similarity.
2. Implementing simple problems related to word disambiguation.
3. Simple demonstration of part of speech tagging.
4. Lexical Analyzer.
5. Part of speech tagging.
6. Semantic Analyzer.
7. Sentiment Analysis.
8. Natural Language Generation/Summarization.
9. NLP Applications: Text Summarization, Information retrieval and question answering.
10. Grammar formalisms.

Nature Inspired Biological Optimization Techniques	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-5	ECE-431T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the characteristics of natural agents and building blocks involved in biological processes.
2.	To provide an understanding on the application of Genetic algorithms
3.	To provide an understanding on the application of bio inspired algorithms to solve complex problems.
4.	To provide insights into the implementation of bio inspired algorithms.

Course Outcomes (CO)

CO 1	To understand phenomena guiding biological processes through self-organization and adaptability
CO 2	To visualize the effect of low-level interactions on high-level phenomena
CO 3	To analyze complex engineering problems and solve them by adapting biological processes suitably
CO 4	To design and implement simple bio-inspired algorithms

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	1	1	1	-	1	1	-	1
CO 2	3	3	2	2	3	1	1	-	1	1	-	1
CO 3	3	3	3	3	3	1	1	-	1	1	-	1
CO 4	3	3	3	3	3	1	1	-	1	1	-	1

UNIT I

Artificial Neural Networks – Pattern classification – Single and Multilayer perceptrons – Backpropagation – Pattern Association – Hebbian learning – Hopfield networks – Bidirectional Associative Memory Networks.

UNIT II

Competitive learning – Kohenen's Self Organizing Maps- Genetic algorithms – Representation – Reproduction – Crossover and Mutation Operators – Crossover and Mutation rates.

UNIT III

Selection mechanisms – Fitness proportionate – ranking and tournament selection – Building Block – Hypothesis and Schema Theorem- Swarm Intelligence – Stigmergy – Competition and Cooperation.

UNIT IV

Particle Swarm Optimization – Anatomy of a particle – Velocity and Position updation– PSO topologies – Control parameters –Ant Colony Optimization – Pheromone updation and evaporation.

Textbook(s):

1. Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications, L. N. de Castro (2006), CRC Press.
2. Leandro Nunes De Castro, Fernando Jose Von Zuben, "Recent Developments in Biologically Inspired Computing", Idea Group Publishing, 2005.
3. Laurene Fausett, "Fundamentals of neural networks: architectures, algorithms, and applications", Prentice-Hall, 1994

Reference Books:

1. Goldberg, "Genetic algorithms in search optimization and machine learning", Addison Wesley, 1999
2. Xin-She Yang, "Recent Advances in Swarm Intelligence and Evolutionary Computation", Springer International Publishing, Switzerland, 2015.
3. Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies, D. Floreano and C. Mattiussi (2008), MIT Press.
4. Evolutionary Optimization Algorithms, D. Simon (2013), Wiley.

Nature Inspired Biological Optimization Techniques Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-5	ECE-431P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Nature Inspired Biological Optimization Techniques) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Implement linear regression and multi-regression for a set of data points
2. Plot the correlation plot on some suitable dataset and visualize giving an overview of relationships among data.
3. Create a perceptron with appropriate number of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights
4. Write a program to implement artificial neural network without back propagation.
5. Write a program to implement artificial neural network with back propagation.
6. Implement travelling sales person problem using genetic algorithms.
7. Write a program to implement Hebb’s rule
8. Implement crisp partitions for real-life iris dataset.
9. Write a program to implement logic gates.

Network Programming	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-NET	7	PC	PC	NET-471T
EAE	7	NET-EAE	NET-EAE-3	NET-471T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand inter process and inter-system communication.
2.	To understand socket programming in its entirety.
3.	To understand usage of TCP/UDP / Raw sockets.
4.	To understand how to build network applications.

Course Outcomes (CO)

CO 1	To write socket API based programs.
CO 2	To design and implement client-server applications using TCP and UDP sockets.
CO 3	To analyze network programs and to use the IP addressing in networks.
CO 4	To design socket with the help of socket programming.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	-	2	-	3	-	1	-	3	3
CO 2	3	2	3	-	2	-	3	-	1	-	3	3
CO 3	3	2	3	-	2	-	3	-	1	-	3	3
CO 4	3	2	3	-	2	-	3	-	1	-	3	3

UNIT-I

Introduction to Network Programming: OSI model, Unix standards, TCP and UDP & TCP connection establishment and Format, Buffer sizes and limitation, standard internet services, Protocol usage by common internet application.

Sockets: Address structures, value – result arguments, Byte ordering and manipulation function and related functions Elementary TCP sockets – Socket, connect, bind, listen, accept, fork and exec function, concurrent servers. Close function and related function.

UNIT-II

TCP client server: Introduction, TCP Echo server functions, Normal startup, terminate and signal handling server process termination, Crashing and Rebooting of server host shutdown of server host. Elementary UDP sockets: Introduction UDP Echo server function, lost datagram, summary of UDP example, Lack of flow control with UDP, determining outgoing interface with UDP. I/O Multiplexing: I/O Models, select function, Batch input, shutdown function, poll function, TCP Echo server. Socket options: getsockopt and setsockopt functions. Socket states, Generic socket option, IPV4 socket option, ICMPV6 socket option, IPV6 socket options and TCP socket options. Advanced I/O Functions-Introduction, Socket Timeouts, recv and send Functions, readv and writev Functions, recvmsg and sendmsg Functions, Ancillary Data, How Much Data Is Queued? Sockets and Standard I/O.

UNIT-III

Elementary name and Address conversions: DNS, gethost by Name function, Resolver option, Function and IPV6 support, uname function, other networking information. Daemon Processes and inetd Superserver: Introduction, syslogd Daemon, syslog Function, daemon_init Function, inetd Daemon, daemon_inetd Function Broadcasting- Introduction, Broadcast Addresses, Unicast versus Broadcast, dg_cli Function Using Broadcasting, Race Conditions Multicasting: Introduction, Multicast Addresses, Multicasting versus Broadcasting on A LAN, Multicasting on a WAN, Multicast Socket Options, mcast_join and Related Functions, dg_cli Function Using Multicasting, Receiving MBone Session Announcements, Sending and Receiving, SNTP: Simple Network Time Protocol, SNTP.

UNIT - IV

Raw Sockets-Introduction, Raw Socket Creation, Raw Socket Output, Raw Socket Input, Ping Program, Traceroute Program, An ICMP Message Daemon, Datalink Access- Introduction, BPF: BSD Packet Filter, DLPI: Data Link Provider Interface, Linux: SOCK_PACKET, libpcap: Packet Capture Library, Examining the UDP Checksum Field. Remote Login: Terminal line disciplines, Pseudo-Terminals, Terminal modes, Control Terminals, rlogin Overview, RPC Transparency Issues.

Textbook(s):
1. W. Richard Stevens, Bill Fenner and Andrew M. Rudoff, “UNIX Network Programming”, Pearson Education.
2. W. Richard Stevens, “UNIX Network Programming”, PHI.

References:
1. T Chan, “UNIX Systems Programming using C++”, PHI.
2. Graham GLASS and King abls, “UNIX for Programmers and Users”, Pearson Education.
3. M. J. Rochkind, “Advanced UNIX Programming”, Pearson Education.

Network Programming Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-NET	7	PC	PC	NET-471P
EAE	7	NET-EAE	NET-EAE-3	NET-471P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Network Programming) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to Create Sockets for Sending and Receiving data.
2. Write a program to obtain the Local & Remote Socket Address.
3. Write a program to obtain the Local & Remote Socket Address.
4. Write a program to obtain the Information about The (A) Host (B) Network (C) Protocols (D) Domains.
5. Write a program to manipulate the IP Address.
6. Write a program to write a Telnet Client.
7. Write a program to make an FTP Client.
8. Write a program to implement Web Server using sockets
9. Write a program for file access using sockets
10. Write the programs to demonstrate the usage of Advanced socket system calls like getsockopt(), setsockopt(), getpeername (), getsockname(), readv() and writev()

Network Security and Cryptography	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	6	PCE	PCE-1	CIE-318T
CSE-NET/CSE-CS	6	PC	PC	CS-312T
EAE	6	CS-EAE	CS-EAE-2A	CS-312T
ECE	7	PCE	PCE-5	ECE-423T
CSE-ICB	7	PC	PC	CS-427T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand basics of Network Security and Cryptographic techniques.
2.	Identify the essential and up-to-date concepts, algorithms, protocols, tools, and methodology of Security
3.	To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
4.	To understand various protocols for network security to protect against the threats in the networks.

Course Outcomes (CO)

CO 1	Classify the symmetric encryption techniques and Illustrate various Public key cryptographic techniques.
CO 2	Understand security protocols for protecting data on networks and be able to digitally sign emails and files.
CO 3	Understand vulnerability assessments and the weakness of using passwords for authentication
CO 4	Be able to perform simple vulnerability assessments and password audits, Summarize the intrusion detection and its solutions to overcome the attacks.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	1	1	-	-	-	-	1	-	1
CO 2	3	3	2	2	1	-	-	-	-	1	-	2
CO 3	3	2	2	1	2	-	-	-	-	1	-	2
CO 4	2	2	1	2	2	-	-	-	-	1	-	1

UNIT-I

Introduction to security attacks, services and mechanism, Introduction to Cryptography and basic Cryptographic Techniques, Computational Complexity, Finite Fields, Number Theory, DES and AES, Public Key Cryptosystems, IDEA encryption and decryption, strength of IDEA, Traffic Confidentiality , Cryptanalysis, Intractable (Hard) Problems, Hash Functions, OSI Security Architecture Privacy of Data.

UNIT-II

Cryptanalysis: Linear and Differential Cryptanalysis, DES, Triple DES, Message Authentication and Digital Signatures, Attacks on Protocols, Elliptic Curve Architecture and Cryptography, Public Key Cryptography and RSA, Evaluation criteria for AES, Key Management, , Introductory idea of Elliptic curve cryptography, Elganel encryption.

UNIT-III

Buffer Flow attack, Distributed Denial of service attack, Weak authentication, Design of Substitution Boxes (SBoxes), Hash Functions , Security of Hash Functions, Secure Hash Algorithm, Authentication applications, Kerberos, IP security, Pretty Good Privacy (PGP), S/MIME , Web Security Light weight cryptography for mobile devices, Side channel attacks.

UNIT–IV

System security, Security Standards, Intruders, and Viruses, Firewalls, Malicious software, Intrusion Detection System, Intrusion Prevention System, Trusted Systems, Virus Counter measures, Authentication Strategies. Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management.

Textbook(s):
1. William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy.
2. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", Pearson.

References:
1. Menezes, P. van Oorschot, S. Vanstone. "Handbook of Applied Cryptography", CRC press, 1997
2. Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag.

Network Security and Cryptography Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	6	PCE	PCE-1	CIE-318P
CSE-NET/CSE-CS	6	PC	PC	CS-312P
EAE	6	CS-EAE	CS-EAE-2A	CS-312P
ECE	7	PCE	PCE-5	ECE-423P
CSE-ICB	7	PC	PC	CS-427P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Network Security and Cryptography) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To write a program to implement the Playfair Substitution technique.
2. Write a program to implement DES and AES algorithm for Encryption and Decryption.
3. Write a program to implement RSA algorithm for Encryption and Decryption.
4. Study of Account and password management. PAM, password cracking.
5. To configure common services like IIS, Apache, Open SSH, WU-FTP.
6. Study of Security analysis tools: Nessus, Microsoft baseline security analyzer.
7. Study of Security configuration tools: Bastille, Microsoft IIS lockdown tool.
8. To write a program to implement the signature scheme named digital signature standard (Euclidean Algorithm).
9. To Calculate the message digest of a text using the SHA-1 algorithm.
10. To identify organization’s Firewall IP address.

Network Security Issues and Challenges	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	CS-EAE	CS-EAE-2B	CS-314T
CSE-CS	7	PC	PC	CS-429T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To explain how various attacks work.
2.	To explain how various security mechanisms work, and correlate these security mechanisms with security principles.
3.	To compare various security mechanisms, and articulate their advantages.
4.	To apply security principles to solve problems.

Course Outcomes (CO)

CO 1	To understand Security goals, attacks,threat and software vulnerabilities.
CO 2	Analyze and design traditional encryption techniques and block ciphers.
CO 3	Understand and analyze public-key cryptography, RSA and other public-key cryptosystems
CO 4	Understand network management architecture, its standards and to differentiate the management protocols.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	1	2	1	-	-	-	-	1	-	1
CO 2	2	2	2	2	1	-	-	-	-	1	-	1
CO 3	3	3	2	1	1	-	-	-	-	1	-	2
CO 4	3	2	1	1	1	-	-	-	-	1	-	1

UNIT-I

Security Taxonomy, Domain of information security, Security goals, security attacks, threats Vulnerabilities, Malicious Software, Virus, Trojan, Worms, spywares, Security services and Mechanism Security Techniques: Steganography, Digital watermarking, Security Models, Introduction to DB Security. Software vulnerabilities, Buffer and Stack over flow, Phishing.

UNIT-II

Mathematics of Cryptography, Integer Arithmetic, modular arithmetic, Linear congruences, Algebraic structures, GF(2n) Traditional Symmetric Key ciphers, Substitution, Transposition, Stream and Block Ciphers, Some Classical systems – Statistical theory of cipher systems-Complexity theory of crypto systems – Stream ciphers, Block ciphers.

UNIT-III

Modern Block Ciphers – DES and variant, modes of use of DES. Advanced Encryption Standard Transformations, Key expansion, Public Key Cryptography RSA, ECC, Web security, IP sec, Email Security.

UNIT – IV

Network management Architecture & Applications, Management standards and Models, Network Management Functions- Configurations Configuration Management, Fault management, Identification and Isolation, Management Protocols SNMP v1, SNMP v3, Network management Accounting & Performance Functions: accounting Management, Performance Management, Network Usage, Metrics.

Textbook(s):

1. Behrouz A. Forouzan , "Cryptography and Network Security", 1st Edition, 2007, The McGraw-Hill
2. William Stallings, "Cryptography and Network security Principles and Practices", 4th edition, 2005, PHI

References:

1. J. Richard Burkle, "Network Management Concepts and Practice: A hands on approach", Pearson, 3rd Ed.
2. Gollmann, Dieter, "Computer Security", 2nd edition, 2005, John Wiley & Sons Ltd.

Network Security Issues and Challenges Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	CS-EAE	CS-EAE-2B	CS-314P
CSE-CS	7	PC	PC	CS-429P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Network Security Issues and Challenges) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To write a program to implement the Playfair Substitution technique.
2. Write a program to implement DES and AES algorithm for Encryption and Decryption.
3. Write a program to implement RSA algorithm for Encryption and Decryption.
4. Study of Account and password management. PAM, password cracking.
5. To configure common services like IIS, Apache, Open SSH, WU-FTP.
6. Study of Security analysis tools: Nessus, Microsoft baseline security analyzer.
7. Study of Security configuration tools: Bastille, Microsoft IIS lockdown tool.
8. To write a program to implement the signature scheme named digital signature standard (Euclidean Algorithm).
9. To calculate the message digest of a text using the SHA-1 algorithm.
10. To identify organization’s Firewall IP address.

Network Simulation and Optimization	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-NET	7	PC	PC	NET-477T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the concepts on Networks and work on how to simulate the same
2.	Design Networks and learn how they work
3.	Understand the need for Optimization and Optimize a given network
4.	Understand the need for different tools for various network scenarios.

Course Outcomes (CO)

CO 1	Understand the quantitative methods of performance evaluation of networks.
CO 2	Use and evaluate different simulation tools for analyzing networks.
CO 3	Study and analyze different algorithm to solve network optimization problems.
CO 4	Design, Implement and validate various network simulation models.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2	2	1	1	2	1	2	1	2	2
CO 2	3	2	2	2	3	1	2	1	2	1	2	2
CO 3	3	3	2	3	3	2	3	1	2	1	2	2
CO 4	3	3	3	3	3	2	3	3	3	1	2	3

UNIT-I

Basics of Computer Network, Modeling and performance analysis of networks., Classification of the simulators, design and challenges of discrete event simulators.

UNIT-II

Tools and software for network simulation (NS2/NS3/GNS3/omnet++/PacketTracer etc.).

UNIT-III

Design, implementation, verification, and validation of simulation models for analyzing wired and wireless networks, Evaluation and presentation of simulation results.

UNIT – IV

Theory, algorithms, and the applications of network optimization problems including the shortest path problem, the maximum flow problem, the minimum cost flow problem, the minimum spanning tree problem, and matching problems, case studies.

Textbook(s):

1. High performance TCP/IP Networking : concepts, issues, and solutions, Hassan, Mahbub, Jain, Raj, Pearson
2. Introduction to Network Simulator NS2, Springer
3. Network Flows. Theory, Algorithms and Applications, Ahuja R.K., Magnanti T.L., Orlin J.B., Prentice Hall

References:

1. An Introduction to Network Modeling and Simulation for the Practicing Engineer (The ComSoc Guides to Communications Technologies), Jack Burbank, William Kasch, Jon Ward, (Wiley-IEEE Press)
2. Network Modeling and Simulation: A Practical Perspective, Mohsen Guizani, Ammar Rayes, Bilal Khan, Ala Al-Fuqaha, (Wiley-Interscience)
3. GNS3 Network Simulation Guide, Chris Welsh
4. The Book of GNS3, Jason C. Neumann
5. Wireless Network Simulation: A Guide using Ad Hoc Networks and the ns-3 Simulator, Henry Zárate Ceballos; Jorge Parra Amaris; Hernan Jiménez Jiménez; Diego Romero Rincón; Oscar Agudelo Rojas; Jorge Eduardo Ortiz Triviño
6. Computer Network Simulation in Ns2: Basic Concepts and Protocols Implementation, Neeraj Bhargava, Pramod Singh Rathore, Dr. Ritu Bhargava, Dr. Abhishek Kumar (BPB Publication)
7. Network Simulation, Richard M. Fujimoto, George Riley, Kalyan Perumalla (Morgan and Claypool Publishers)

Network Simulation and Optimization Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-NET	7	PC	PC	NET-477P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Network Simulation and Optimization) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To create Scenario and study the performance of CSMA/CD protocol through simulation.
2. To create scenario and study the performance of token bus and token ring protocols through simulation.
3. To create scenario and study the performance of wireless network with CSMA/CA protocol and compare with CSMA/CD protocols.
4. Implementation and study of Stop and Wait protocol.
5. Implementation and study of Go back N and Selective Repeat protocols.
6. Implementation of Distance Vector Routing algorithm.
7. Implementation of Link state routing algorithm.
8. Implementation of data encryption and decryption.
9. Implement and configure basic EIGRP and Route Summarization.
10. Implement Load Balancing across Equal Cost Path & Unequal Cost Path.
11. Configure EIGRP Authentication (MD5) and EIGRP Stub.
12. Configure EIGRP redistribution with RIPv2 and OSPF.

Neural Networks and Fuzzy Logic	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-2	ICE-322T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide in-depth knowledge on various learning rules of neural networks.
2.	To explain some applications of neural network in different fields.
3.	To introduce fuzzy logic, fuzzy relation, and fuzzy mathematics
4.	To understand the principle of fuzzy set theory,fuzzy logic to design real world problem.

Course Outcomes (CO)

CO 1	Apply artificial neural network concept for real-world problem with scientific tools.
CO 2	Analyse the supervised and unsupervised learning algorithms and its applications.
CO 3	Application of Fuzzy logic concepts to real world problem.
CO 4	Develop fuzzy logic controller using fuzzy logic concepts.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	3	3	-	2	-	-	1	3	2
CO 2	3	3	1	1	1	-	1	1	-	2	2	1
CO 3	3	2	3	3	2	-	2	-	-	2	3	1
CO 4	1	2	3	2	2	-	1	-	-	1	2	2

Unit I

Introduction to Networks: Basic concepts of Neural networks, Human Brain, Model of an Artificial Neuron, Neural network architectures, Characteristics of Neural Networks.

Unit II

Learning Methods:supervised and unsupervised learning, Reinforcementlearning methods Hebb, delta and back propagation methods, Architecture of a Back propagation network, thePerceptron Model, The solution, Single layer Artificial Neural Network, Model forMultilayer Perceptron, Back propagation Learning, Illustration, Applications, Selection of Various Parameters in BPN

Unit III

Fuzzy Set Theory: Fuzzy versus Crisp, Crisp sets, Fuzzy Sets, Crisp Relations, Membership functionsFuzzy Relations. Fuzzy Logic and Inference, Fuzzy Logic, Fuzzy Rulebased System, Defuzzification Methods.

Unit IV

Applications of Fuzzy logic and Fuzzy System: Fuzzy controller design for washing machine, DC motor, Power Converter, and air conditioning system.

Textbooks:
1. N.P. Padhy, S.P. Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2. S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd, 2nd Edition, 2011.

References:
1. Simon Haykin, Neural Network- A Comprehensive Foundation, Pearson Education.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, John Wiley and sons, 2010
3. S. Rajasekaran, G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd, 2017.
4. N.P. Padhy, S.P. Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.

Neural Networks and Fuzzy Logic Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-2	ICE-322P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Neural Networks and Fuzzy Logic) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Create a fuzzy based decision-making system to select 11 players out of 50 using MATLAB.
2. Design a fuzzy controller to calculate the washing time of washing machine.
3. Simulate a Fuzzy logic-based boost converter.
4. Write a program in MATLAB to plot triangular, trapezoidal, and bell-shaped membership functions.
5. Write a program in MATLAB to implement OR gate using artificial neural network using delta method.
6. Write a program in MATLAB to implement AND gate using artificial neural network with Back Propagation algorithm.
7. Write MATLAB program for Back Propagation Neural Network Algorithm.
8. To write a MATLAB program to generate AND function using McCulloch-Pitts neural net.
9. To write a Program in MATLAB to perform addition, subtraction, and multiplication operations of fuzzy set.
10. Design and simulate an air conditioning system using fuzzy logic control.

Neuro Fuzzy Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CI-EAE	CI-EAE-4	CI-409T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understanding the concept of neural network and related algorithms.
2.	Introduce fuzzy logic and set theory operations and ruled for demonstration of fuzzy logic
3.	Learn the different for fuzzy models to design neuro fuzzy control
4.	Understanding the basic concept of optimization technique

Course Outcomes (CO)

CO 1	Comprehend fuzzy logic, neural network and optimization algorithm
CO 2	Identify and describe for fuzzy logic and ANN technique in building intelligent machine for effective problem-solving methodologies
CO 3	Integrate neural network and Fuzzy logic to extend the capabilities.
CO 4	Apply knowledge of fuzzy logic, Ann and GA to design controller.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	1	2	3	1	1	1	1	1	1	3
CO 2	3	3	3	3	3	3	2	1	2	3	1	3
CO 3	3	3	3	3	3	3	2	1	2	3	1	3
CO 4	3	3	3	3	3	3	3	1	3	3	1	3

UNIT –I

Neural Networks: Fundamental of neural network, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning Methods, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms-perceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perception Model, Radial Basis functions, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.

UNIT-II

Fuzzy sets: Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Extension principle and fuzzy relationsFuzzy Logic: Fuzzification and defuzzification, Membership Function, Linguistic Variables, Linguistic hedges, Fuzzy rules and reasoning, lamda cut-sets. Arithmetic operations on Fuzzy numbers.

UNIT-III

Fuzzy Inference System: Fuzzy Modeling, Mamdani Fuzzy model, TSK Fuzzy model, Fuzzy Controller, Industrial Applications.
Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Hybrid learning algorithms, Neuro-fuzzy Control.

UNIT-IV

Introduction to Evolutionary Techniques: Genetic Algorithm, Basic Concepts, Flow Chart of GA, Genetic representations (Encoding), Initialization and Selection, Genetic Operators, Mutation, Generational Cycle, Convergence of GA and Applications.

Text Books:
1. Neural Network,Fuzzy Logic and Genetic Algorithms by S.Rajasekaran PHI Learning India 2011
2. Principles of Soft Computing by S. N. Sivanandam, S.N. Deepa, Wiley India.

References Books:
1. Artificial Intelligence, Patricks Henry,Winston,Pearson Education,2001
2. Artificial Intelligence, Nilsson, Morgon, Kufmann 1998.
3. Neuro-Fuzzy and Soft Computing by J.-S.R.Jung, c.T.Sun PHI Learning India 2011
4. Hagan Demuth, Beale” Neural Network Design “ Cengage Learning 2013
5. S N Sivanandam, “Neural Network using Matlab” TMH 2013

Neuro Fuzzy Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CI-EAE	CI-EAE-4	CI-409P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Neuro Fuzzy Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Create a fuzzy based decision-making system to select 11 players out of 50 using MATLAB.
2. Design a fuzzy controller to calculate the washing time of washing machine.
3. Simulate a Fuzzy logic-based boost converter.
4. Write a program in MATLAB to plot triangular, trapezoidal, and bell-shaped membership functions.
5. Write a program in MATLAB to implement OR gate using artificial neural network using delta method.
6. Write a program in MATLAB to implement AND gate using artificial neural network with Back Propagation algorithm.
7. Write MATLAB program for Back Propagation Neural Network Algorithm.
8. To write a MATLAB program to generate AND function using McCulloch-Pitts neural net.
9. To write a Program in MATLAB to perform addition, subtraction, and multiplication operations of fuzzy set.
10. Design and simulate an air conditioning system using fuzzy logic control.

Next Generation Networks	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-4	ECE-407

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the basics of the next generation networks.
2.	To impart the knowledge about the various new technologies and topologies on which NGN are based upon.
3.	To provide exposure to the various new services that telecommunication operators have as they create new 3G networks and beyond.
4.	To impart the knowledge of the numerous applications it offers.

Course Outcomes (CO)

CO 1	Develop the basic knowledge of NGN, its building blocks and various services.
CO 2	Understand IP networks, LAN and WAN technologies and topologies.
CO 3	Study concept of ATM, MPLS and multiservice networks.
CO 4	Understand various NGN applications

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	2	2	3	2	3	-	-	1	1	3
CO 2	2	3	2	1	3	2	3	-	-	1	2	3
CO 3	2	2	2	1	2	2	3	-	-	1	1	2
CO 4	2	2	2	2	3	3	3	1	-	2	2	2

UNIT I

Introduction to next generation networks. Communicating in the new Era, New Era of Networking, Technologies influencing change, IP Everywhere, Optical fiber anywhere, wireless access, building blocks for NGN, IP Networks, VOIP, Multi service Flexible Networks architecture. VPNs, Optical Networks, Wire line & Wireless Networks, NGN Services, Network Infrastructure convergence, services convergence, from technology push to service pull.

UNIT II

IP Networks, IP past, present and future, IP influence and confluence, IP version 4, I. P. Version 6, IP Network convergence, LAN Technologies, IP Routing, LAN Switching, WAN's, WAN Technologies and Topologies. Wireless IP LANS, Mobility Networks, Global IP Networks, Global capacity, Globally Resilient IP, Internet – A Network of Networks. Beyond IP, Technology Brief – IP Networks, Business Drivers, Success factors, Applications and Service Value.

UNIT III

Muti service Networks Origin of multi service ATM, Next Generation Multi service Networks, Next Generation Multi service ATM switching, Multi protocol Label switching, Networks, Frame Based MPLS, Cell based MPLS, MPLS services and their benefits, multi service provisioning platforms (MSPP) & Multi service switching platform (MSSP).

UNIT IV

NGN Applications Internet connectivity, e-commerce, call center, third party application service provision, UMTS, WAP, WiMAX, integrated billing, security and directory enabled networks.

Textbook(s):

1. Neill Wilkinson, “Next Generation Networks Services, Technologies and Strategies”, Wiley.
2. Robet Wood, “Next Generation Network Services”, Pearson.

Reference Books:

1. Next Generation Telecommunications Network, Parliament office of Science and Technology (Postnote). Dec 2007, No. 296, Ref. http://www.parliament.uk/briefing-papers/POST-PN-296.pdf
2. Huber, J.F.’ “Mobile Next Generation Networks”, IEEE Multimedia Vol. 11, Issue I Jan- March 2004.
3. J.C. Crimi, “Next Generation Network (NGN) Service”, A Telecoolia Technologies white paper; refer www.telecodia.com
4. International Conference on Next Generation Networks & Basestations Tackles LTE, WiMAX, Femtocells, Backhaul, Spectum Re-farming and Also Goes. http://www.thefreelibrary.com/International+Conference+on+Next+Generation+Networks+%26+Basestations...-a0176872977
5. Carugi, M.; Hirschman, B.; Narita, A., "Introduction to the ITU-T NGN focus group release 1: target environment, services, and capabilities, “Communications Magazine, IEEE , vol.43, no.10, pp. 42-48, Oct. 2005 doi: 10.1109/MCOM.2005.1522123 URL:http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1522123&isnumber=32552http://encyclopedia2.thefreedictionary.com/LTE

Next Generation Web	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	7	PCE	PCE-4	CIE-413T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the basic concept associated with Internet and internet protocols
2.	To understand the Database Connectivity.
3.	To understand the Web Page, Website and Web Application
4.	To describe the various Web attacks and their preventions

Course Outcomes (CO)

CO 1	To understand the basic concepts of Internet and World Wide Web
CO 2	To develop the concept of Web Technologies
CO 3	Understand the functionalities of Web Engineering Technologies in distributed systems.
CO 4	Identifying the issues in Security Threats and Security risks of a site.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	3	3	-	-	-	3	2	2	3
CO 2	3	3	2	3	2	-	-	-	3	3	2	3
CO 3	3	3	2	3	3	-	-	-	3	3	2	3
CO 4	3	3	2	3	3	-	-	-	3	3	3	3

UNIT-I

Growth of Internet, Basic internet protocols, History of the Internet, World Wide Web, HTTP: Hypertext Transfer Protocol, Markup languages-XHTML, Introduction to HTML, Basics of XTHML, DHTML, and XML Anatomy of Internet, APRANET and Internet history of the World Web, Basic Internet Terminology, Internet Protocols: TCP/IP, Router, Internet Addressing Scheme, Machine Addressing (IP address), E-mail Address, XML versions & declarations, Introduction to WML.

UNIT-II

Database Connectivity: JDBC, ODBC, Database-to web connectivity, Web Page, Website and Web Application, Technology Framework for development, Client-side scripting: JavaScript, Client Side Programming: JAVA Scripts, basic syntax, variables & data-types, literals, functions, objects, arrays and built-in objects, Server side programming , Java Servlets, Life cycle, parameter data, sessions, cookies, servlets capabilities, servlets & concurrency.

UNIT-III

Web attacks and their prevention, Security Threats, Security risks of a site, Session management, authentication, HTTPS and certificates, Firewalls (WAFs), Web security model, Client-side security, Cookies security policy, HTTP security extensions, Web user tracking, Server-side security tools, Web Application and Fuzzers.

UNIT - IV

Concept and issues of Web 2.0 and Web 3.0, Latest Trends in Web Technologies, Search Engines, Web Crawling, Search Engine Optimization, Web Security concerns, Applications of Web Engineering Technologies in distributed systems etc, Case studies using different tools, Web IR System, Web Analytics, Web Mining Framework, Social Web Mining and Text Mining.

Textbook(s):

1. Internet and Web Technologies by Raj Kamal, Tata McGraw Hill edition. (ISBN: 9780070472969), 2002
2. Web Technologies: A Computer Science Perspective, Jackson, Pearson Education India, 2007.
3. Modeling the Internet and the Web, Pierre Baldi, Paolo Frasconi, Padhraic Smyth, John Wiley and Sons Ltd.

References:

1. Achyut Godbole, Atul Kahate, “Web Technologies”, McGraw-Hill Education, Third Edition.
2. PHP and MySQL for Dynamic Web Sites, Ullman, Larry, Peachpit Press.1 (ISBN: 978-0-321-784070), 2012.
3. Chris Bates, "Web Programming", Wiley

Next Generation Web Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	7	PCE	PCE-4	CIE-413P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Next Generation Web) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Create a webpage with HTML using paragraph and list tags.
2. Experiments based on PHP and MySQL to be implemented.
3. Experiment based on developing websites and portals using HTML, CSS, Java Script.
4. Exercise based on implementation of XML technologies.
5. Design the static web pages required for any online web site.
6. Create a simple JSP page. Separate the JSP and HTML coding in different files and link them together.
7. Demonstrate the concept of Database Connectivity using JDBC and ODBC.
8. Demonstrate the concept of Database to web connectivity.
9. Demonstrate the concept of Servlets.
10. Experiment based on Client Side Programming.

Non Destructive Evaluation of Structures	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	6	PCE	PCE-3	CEE-318T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the basic principles, techniques, equipment, applications and limitations of NDT methods such as Visual, Penetrant Testing, Magnetic Particle Testing, Ultrasonic Testing, Radiography, Eddy Current.
2.	To enable selection of appropriate NDT methods.
3.	To identify advantages and limitations of non-destructive testing methods
4.	To make aware the developments and future trends in NDT.

Course Outcomes (CO)

CO 1	Apply the various NDT techniques to identify the defects
CO 2	Select the suitable NDT techniques for various defects
CO 3	Understand the various factors affecting the concrete and Advanced Non-Destructive Testing Methods.
CO 4	Illustrate knowledge on Non-destructive testing (NDT) equipment's – Rebound hammer, Ultrasonic pulse velocity meter

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	2	-	-	-	-	-	-	-	-	-	-	1
CO 2	2	1	-	-	-	-	-	-	-	-	-	1
CO 3	1	2	2	-	-	-	-	-	-	-	-	2
CO 4	3	2	2	2	3	2	2	2	1	-	2	1

UNIT-I

Introduction to DT, NDT and NDE, necessity of NDE and SHM; Fundamental differences between NDE and SHM philosophies; Causes of degradation in concrete and steel structures; General methods of NDT of civil engineering structures according to Indian Standards, future progress in NDT, economics aspects of NDT. Visual Inspection - tools, applications and limitations -Fundamentals of visual testing: vision, lighting, material attributes, environmental factors. Visual perception, direct and indirect methods mirrors, magnifiers, boroscopes, fibroscopes, closed circuit television, light sources.

UNIT-II

Permeability test: Fundamental principle, General procedure for permeability test, Equipment for permeability test, Initial surface absorption test, Modified Figg permeability test, In situ rapid chloride ion permeability test, Applications of permeability test, Range and limitations of permeability test, Half-cell electrical potential method.

UNIT-III

Penetration resistance or windsor probe test, resistivity measurement Sensor based SHM of civil structures – optical, piezoelectric and non-contact approaches; Imaging as a tool for NDT – A scan, Bscan, C-scan, time of flight based reconstruction, synthetic aperture focusing technique.

UNIT – IV

Electromagnetic imaging – fundamentals, ground penetrating radar; Thermography – fundamentals, Infrared thermography; Elastic wave based methods – impact echo; Ultrasonics – fundamentals, instrumentation, imaging methodologies; Future directions.

Textbook(s):
1. Grandt Jr A F, Fundamentals of Structural Integrity: Damage Tolerant Design and Nondestructive Evaluation, Wiley Publications (2014).
2. Maierhofer C and Dobmann G, Non-Destructive Evaluation of Reinforced Concrete Structures:Non-Destructive Testing Methods, Woodhead Publishing (2010)

References:
1. Hellier C, Handbook of Nondestructive Evaluation, Mc-Graw Hill Education (2012).

Non Destructive Evaluation of Structures Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
CE	6	PCE	PCE-3	CEE-318P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Non Destructive Evaluation of Structures) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study about need and scope of Non-destructive testing (NDT).
2. To perform visual test for given sample using visual aid.
3. To study and perform Rebound Hammer Test.
4. To study and perform Electrochemical Half-Cell Potentiometer Test.
5. To study and perform Tests for Carbonation of Concrete.
6. To study and perform Ultrasonic Pulse velocity Test.
7. To perform Dye/Liquid Penetration Test for given sample with visible and fluorescent dye.
8. To study and perform Magnetic Particle test using different methods of magnetization.
9. To study Radiographic Testing.
10. To study and perform penetration resistant test
11. To study and perform pull out test
12. To study and perform Leak Testing.
13. To study of Eddy Current Test.
14. To study acoustic emission testing and thermography

Non Traditional Manufacturing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-5	MEE-423T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Understand the classifications of non-traditional machining processes based on industrial applications.
2.	To describe the working of modern machining methods based on mechanical, chemical, thermal and thermo-electric energy.
3.	To explain, how to investigate the of process parameters of advanced machining methods on its characteristics.
4.	To describe the effects of process parameters numerically, on the performance of Non-traditional methods.

Course Outcomes (CO)

CO 1	Explain Categories of non- traditional machining processes based on industrial applications.
CO 2	Analyse the working principle of modern machining methods based on mechanical, chemical, thermal and thermo-electric energy.
CO 3	Carryout the investigation of process parameters of advanced machining methods on its characteristics.
CO 4	Evaluating the effects of process parameters (numerically) on the output parameters of Non-traditional methods.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT I

Introduction: An overview of Modern Manufacturing Methods (MMM) - Classification, their comparative study, Need of MMM.

Process Selection: Physical Parameters, Shape applications, Material applications, Process capability, Effects on equipment and Tooling, Process economy.

UNIT II

Electric Discharge Machining: Working Principle, Mechanism of metal removal, Basic EDM circuits, selection of tool material and dielectrics, Flushing, Advantages, Disadvantages and Applications, Wire-cut EDM.
Ultrasonic Machining: Construction and working Principle, Elements of Process, Effect of process parameters, Applications and limitations.
Abrasive Jet Machining: Working Principle, equipment used, Variables in AJM, Advantages, Disadvantages, Application.
Water Jet Machining: Working Principle, equipment used, process parameter, Advantages, Disadvantages, Application.

UNIT III

Electro Chemical Machining (ECM): Principle, Elements of ECM process, Electrochemistry of ECM, selection of electrolytes and analysis of ECM, Advantages, Limitations, Applications.
Electro Chemical Grinding (ECG): Process: Working principle, equipment used, Process parameters, Advantages, Disadvantages and Applications.
Electro Chemical Honing (ECH): Process: Working principle, equipment used, Process parameters, Advantages, Disadvantages and Application.

UNIT IV

Laser Beam Machining: Working principle, equipment, Process parameters, Advantages, Disadvantages and Application.
Plasma Arc Machining: Working Principle, Parameters, Safety precautions, Applications.
Electron Beam Machining: Principle, beam control techniques, Process capabilities, Comparison of thermal and non-thermal processes, Advantages and limitations.

Textbooks:
1. P.C. Pandey & H.S. Shan, “Modern Machining Process”, Tata McGraw Hills, 2006.
2. Amitabh Gosh and A.K. Mallik, “Manufacturing Science”, Affiliated East-West Press Pvt. Ltd., 1985.

References:
1. Vijay K Jain, “Advance Machining Processes”, Allied Publishers Pvt. Ltd., New Delhi, 2002.
2. P K Mishra, “Nonconventional Machining”, Narosa Publication, 1997.
3. McGeough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998.

Non Traditional Manufacturing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-5	MEE-423P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Non Traditional Manufacturing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of electric discharge machining process.
2. Determination of material removal rate on electric discharge machine (EDM).
3. Determination of surface roughness on EDM.
4. Study of electrochemical machining process.
5. Determination of material removal rate on electro chemical machine (ECM).
6. Determination of surface roughness on ECM.
7. Study of Flexible manufacturing system.
8. Case study of Rapid Prototyping
9. Study the effect of current on material removal rate in EDM.
10. Determine the effect of different tool material on material removal rate in EDM.
11. Determine the effect of current on surface finish rate in EDM.
12. Determine the effect of different tool surface finish on surface finish in EDM.

Non Traditional Manufacturing	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
MAE	7	OAE-MAE	OAE-1	MAO-427

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Understand the classifications of non-traditional machining processes based on industrial applications.
2.	To describe the working of modern machining methods based on mechanical, chemical, thermal and thermo-electric energy.
3.	To explain, how to investigate the of process parameters of advanced machining methods on its characteristics.
4.	To describe the effects of process parameters numerically, on the performance of Non-traditional methods.

Course Outcomes (CO)

CO 1	Explain Categories of non- traditional machining processes based on industrial applications.
CO 2	Analyse the working principle of modern machining methods based on mechanical, chemical, thermal and thermo-electric energy.
CO 3	Carryout the investigation of process parameters of advanced machining methods on its characteristics.
CO 4	Evaluating the effects of process parameters (numerically) on the output parameters of Non-traditional methods.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	3
CO 3	3	3	2	3	-	2	-	-	-	-	-	2
CO 4	3	2	3	2	-	3	-	-	--	-	-	1

UNIT I

Introduction: An overview of Modern Manufacturing Methods (MMM) - Classification, their comparative study, Need of MMM.
Process Selection: Physical Parameters, Shape applications, Material applications, Process capability, Effects on equipment and Tooling, Process economy.
Electric Discharge Machining: Working Principle, Mechanism of metal removal, Basic EDM circuits, selection of tool material and dielectrics, Flushing, Advantages, Disadvantages and Applications

UNIT II

Ultrasonic Machining: Construction and working Principle, Elements of Process, Effect of process parameters, Applications and limitations.
Abrasive Jet Machining: Working Principle, equipment used, Variables in AJM, Advantages, Disadvantages, Application.
Water Jet Machining: Working Principle, equipment used, process parameter, Advantages, Disadvantages, Application.
Abrasive Flow Machining: Working Principle, equipment used, process parameter, Advantages, Disadvantages, Application.

UNIT III

Chemical Machining: Working Principle, equipment used, process parameter, Advantages, Disadvantages, Application.
Electro Chemical Machining (ECM): Principle, Elements of ECM process, Electrochemistry of ECM, selection of electrolytes and analysis of ECM, Advantages, Limitations, Applications.
Rapid Prototyping Introduction Stereo Lithography Systems Introduction: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems. Stereo Lithography Systems: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application

UNIT IV

Laser Beam Machining: Working principle, equipment, Process parameters, Advantages, Disadvantages and Application.
Plasma Arc Machining: Working Principle, Parameters, Safety precautions, Applications.
Electron Beam Machining: Principle, beam control techniques, Process capabilities, Comparison of thermal and non-thermal processes, Advantages and limitations.
Wire Cut EDM: Working principle, process parameter, equipment, characteristics of machining process, applications

Text Books:

1. P.C. Pandey & H.S. Shan, “Modern Machining Process”, Tata McGraw Hills, 2006.
2. Amitabh Gosh and A.K. Mallik, “Manufacturing Science”, Affiliated East-West Press Pvt. Ltd.

Reference books:

1. Vijay K Jain, “Advance Machining Processes”, Allied Publishers Pvt. Ltd., New Delhi, 2002.
2. P K Mishra, “Nonconventional Machining”, Narosa Publication, 1997.
3. Mc Geough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998.

Non-linear System Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CI-EAE	CI-EAE-5	CI-411T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Ability to solve non-linear equations
2.	Ability to analyse stability of non-linear systems
3.	Ability to design non-linear systems using jacobian linearisation
4.	Ability to design non-linear systems using feedback linearisation

Course Outcomes (CO)

CO 1	Ability to solve non-linear equations
CO 2	Ability to analyse stability of non linear systems
CO 3	Ability to design non-linear systems using Jacobian linearisation
CO 4	Ability to design nonlinear systems using feedback linearisation

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	2	1	1	1	2	2	3	1
CO 2	3	2	3	3	2	1	1	1	2	2	3	1
CO 3	3	2	3	3	2	1	1	1	2	2	3	1
CO 4	3	2	3	3	2	1	1	1	2	2	3	1

UNIT- I

Introduction and Background: Introduction to nonlinear and time-varying systems. Mathematical background, including vector spaces and norms. Lp norms for signals, induced norms for systems, and the Lebesgue Lp spaces. Existence and uniqueness of solutions to nonlinear differential equations.

UNIT- II

Stability Analysis: Techniques for the stability analysis of nonlinear and time-varying systems. Internal stability of feedback systems. Phase plane portraits. Lyapunov stability theorems. Popov and circle criteria for nonlinear feedback systems. Passivity and small gain for nonlinear operators.

UNIT- III

Design Techniques: Overview of design for nonlinear systems. Jacobian linearization and gain scheduling. Introduction to feedback linearization and extensions of optimal control techniques. Direct design methods.

UNIT-IV

Feedback linearization- Design via linearization- stabilization - regulation via integral control- gain scheduling. Exact Feedback Linearization - Input state linearization – input output linearization - state feedback control - stabilization - tracking - integral control.

Textbooks:

1. H. K. Khalil Nonlinear Systems, Third Edition, Prentice-Hall., 2002

References:

1. H. J. Marquez, Nonlinear Control Systems: Analysis and Design, John Wiley Intersciencce, 2003.
2. J. J. Slotine and W. Li Applied Nonlinear Control, Prentice-Hall, 1991.
3. M. Vidyasagar, Nonlinear Systems Analysis, SIAM, 2002
4. J. E. Gibson Nonlinear Automatic Control, McGraw-Hill, 1963.
5. J. C. Hsu and A. V. Meyer Modern Control Principles and Applications, McGraw-Hill, 1968.
6. D. Graham and D. McRuer Analysis Of Nonlinear Control Systems, John Wiley 1961
7. G. J. Thaler and M. P. Pastel Analysis and Design of Nonlinear Feedback Control Systems, McGraw-Hill, 1962

Non-linear System Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CI-EAE	CI-EAE-5	CI-411P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Non-linear System Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Create a simulation of a specific nonlinear system using differential equations and simulate its behavior over time.
2. Design a nonlinear controller for a given nonlinear system.
3. Solve optimization problems with nonlinear constraints using MATLAB's optimization toolbox.
4. Fit experimental data to a nonlinear mathematical model.
5. Identify the parameters of a nonlinear system using input-output data. Utilize system identification techniques, such as the extended Kalman filter (EKF), recursive least squares (RLS), or the subspace-based methods, to estimate the model parameters.
6. Apply nonlinear signal processing techniques to analyze and process signals. Implement nonlinear filters, such as the median filter or the adaptive filter, to remove noise or distortions from signals.
7. Analyze and simulate nonlinear electronic circuits using MATLAB's circuit simulation toolbox.
8. Apply nonlinear image processing techniques to enhance or analyze images.

Object Oriented Analysis and Design using UML	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	6	PCE	PCE-2	CIE-344T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the fundamentals of object modelling.
2.	To understand and differentiate Unified Process from other approaches.
3.	To design with the UML dynamic and implementation diagrams.
4.	To improve the software design with design patterns & test the software against its requirements specification

Course Outcomes (CO)

CO 1	Express software design with UML diagrams
CO 2	Identify various scenarios based on software requirements
CO 3	Transform UML based software design into pattern based design using design patterns
CO 4	Design software applications using OO concepts & Understand the various testing methodologies for OO software

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	2	1	1	1	2	2
CO 2	3	2	2	3	3	2	1	1	1	1	2	2
CO 3	3	2	2	3	2	2	2	1	1	1	2	2
CO 4	2	2	2	2	2	2	1	1	2	2	2	3

UNIT I

Unified Process and Use Case Diagrams: Introduction to OOAD with OO Basics - Unified Process – UML diagrams – Use Case –Case study – the Next Gen POS system, Inception -Use Case Modelling – Relating Use cases – include, extend and generalization – When to use Use-cases

UNIT II

Static UML Diagrams: Class Diagram–– Elaboration – Domain Model – Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Finding conceptual class Hierarchies – Aggregation and Composition - Relationship between sequence diagrams and use cases – When to use Class Diagrams

UNIT III

Dynamic and Implementation UML Diagrams: Dynamic Diagrams – UML interaction diagrams - System sequence diagram – Collaboration diagram – When to use Communication Diagrams - State machine diagram and Modelling –When to use State Diagrams - Activity diagram – When to use activity diagrams Implementation Diagrams - UML package diagram - When to use package diagrams - Component and Deployment Diagrams – When to use Component and Deployment diagrams

UNIT IV

Design Patterns: GRASP: Designing objects with responsibilities – Creator – Information expert – Low Coupling – High Cohesion – Controller Design Patterns – creational – factory method – structural – Bridge – Adapter – behavioural – Strategy – observer –Applying GoF design patterns – Mapping design to code TESTING: Impact of object orientation on Testing – Develop Test Cases and Test Plan

Textbooks:

1. Craig Larman, Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development, Third Edition, Pearson Education, 2005.
2. Ali Bahrami - Object Oriented Systems Development - McGraw Hill International Edition - 1999

References:

1. Erich Gamma and Richard Helm, Ralph Johnson, John Vlissides, Design patterns: Elements of Reusable Object-Oriented Software, Addison-Wesley, 1995.
2. Martin Fowler, UML Distilled: A Brief Guide to the Standard Object Modelling Language, Third edition, Addison Wesley, 2003.

Object Oriented Analysis and Design using UML Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	6	PCE	PCE-2	CIE-344P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Object Oriented Analysis and Design using UML) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Draw standard UML diagrams using an UML modelling tool for a given case study and map design to code and implement a 3 layered architecture. Test the developed code and validate whether the SRS is satisfied.

1. Identify a software system that needs to be developed.
2. Document the Software Requirements Specification (SRS) for the identified system.
3. Identify use cases and develop the Use Case model.
4. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.
5. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams
6. Draw relevant State Chart and Activity Diagrams for the same system.
7. Implement the system as per the detailed design
8. Test the software system for all the scenarios identified as per the use case diagram
9. Improve the reusability and maintainability of the software system by applying appropriate design patterns.
10. Implement the modified system and test it for various scenarios.

SUGGESTED DOMAINS FOR MINI-PROJECT:

Passport automation system / Book bank / Exam registration / Stock maintenance system / Online course reservation system / Airline/Railway reservation system / Software personnel management system / Credit card processing / e-book management system / Recruitment system / Foreign trading system / Conference management system / BPO management system / Library management system / Student information system

Open Chanel Flow and Sediment Transportation	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	6	PCE	PCE-3	CEE-320

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the concepts of channel hydraulics.
2.	To study different types of flow and flow characteristics.
3.	To analyze flow problems and determine effect of channel geometric parameter of flow characteristics.
4.	To design of inland waterways needed for irrigation, navigation and to study sediment transport.

Course Outcomes (CO)

CO 1	Define fundamental concepts of various types open channel flow and concepts of specific energy.
CO 2	Analyze the flow through transition, varied flow, forces on sediment load
CO 3	Determine flow profiles, and characteristics of varied flow
CO 4	Design a stable and regime channel.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	2	2	-	1	-	-	-	-	-	1	-	-
CO 2	3	2	2	2	-	1	-	-	-	-	-	-
CO 3	1	1	1	2	-	-	-	-	-	-	-	-
CO 4	3	3	3	2	1	-	-	1	-	-	-	-

UNIT-I

Major and medium irrigation schemes of India, Command area development, Types of Soils and their suitability for irrigation, Root Zone soil water, Irrigation requirements, Irrigation water quality, Irrigation canal system, Duty of water, Canal losses, Estimation of design discharge of a canal, canal outlets, Canal regulation, Water logging, causes, effects and remedial measures.

Alluvial channels carrying clear water and Sediment-Laden water, Evaporation and seepage losses in channels, Cross section of irrigation channels, Berms, Freeboard and service road, Silting of channels.

UNIT-II

Sheet pile cut-off walls, Khosla’s theory and its applications, Correction for Floor Thickness, Correction for Mutual Interference of sheet piles, Correction for the slope of the floor, Method for determination of exit gradient, Uplift force on the floor of canal structure.

Canal regulation structures, Canal Fall, Types of canal fall, Cistern element, Vertical/ Horizontal/Inclined-impact

Cisterns, No-Impact Cisterns, Roughening measures for energy dissipation such as Friction Block, Ribbed pitching and Provisions such as baffle wall/ deflector/dentated cill etc at the Downstream end of cistern system Distributary Head Regulator and Cross Regulator and their Design criteria, Control of Sediment Entry into an offtaking channel.

UNIT-III

Cross Drainage Structure, their need and types, Design of Transitions for canal waterway using Hind's Method, Upiri Method and Vittal and Chiranjeevi's method,
Canal Headworks, Selection of the site, Weir or Barrage, Undersluices, Divide Wall, Fish Ladder, Canal Head Regulator, Sediment Excluders and Sediment Ejector.

UNIT - IV

Types of dams, Factors and General Design Criteria for Embankment Dams, Freeboard, Suitability of Foundation, Slope protection, Factors and General Design Criteria for Gravity Dams, Forces on gravity Dam, Causes of failure of a gravity Dam, Stability Analysis of Gravity Dams, Galleries and outlets.
Introduction to Spillway, Types of spillways, energy dissipaters, Cavitation erosion on spillway surface
Classification/ behaviour of rivers, Cutoffs, Aggradation and Degradation, River Training and its objectives, River training Methods such as Levees, Spurs, Guide Banks.

Textbook(s):
1. S.K.Garg- Irrigation Engineering and Hydraulic Structures, Khanna Publishers, Delhi
2. B.C. Punmia and Pande B.B. Lal- Irrigation and Water Power Engineering, Laxmi Publications (P) Ltd., Delhi.

References:
1. Ralph A.Wurbs, Wisley P.James- Water Resources Engineering, PHI, New Delhi.
2. R.K.Sharma and T.K.Sharma- Irrigation Engineering. S.Chand and Company Ltd., New Delhi.
3. Satya Narayana Murty Challa-Water Resources Engineering [Principles and Practice] NewAge Intl.
4. Applied Hydrology - Ven T Chow, David R Maidment, Larry W Mays, McGraw-Hill, New Delhi.
5. Bharat Singh, Fundamentals of Irrigation Engineering, Nem Chand and Brothers, Roorkee.

Operating Systems	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-305
OAE	7	CSE-OAE	CSE-OAE-4	OCSE-409

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the basics of OS and their functions. To learn the scheduling policies of various operating systems.
2.	Learn memory management methods.
3.	To understand the characterisation of deadlock, system deadlock, preventing deadlock, avoiding deadlock and related concepts.
4.	To understand the meaning of a file, structure of the directories, file structure system and implementation, free-space management

Course Outcomes (CO)

CO 1	Understand the role of operating system in a computing device, and Ability to understand paging and segmentation methods of memory binding and their pros & cons.
CO 2	Understand scheduling of process over a processor. Ability to use concepts of semaphore and its usage in process synchronization.
CO 3	Ability to synchronize programs and make the system deadlock free.
CO 4	Ability to understand file system like file access methods, directory structures, file space allocation in disk and free space management in disk. Ability to understand disk scheduling and disk recovery procedures.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	-	3	-	-	-	-	-	-	-
CO 2	3	3	-	-	2	-	-	-	-	-	-	-
CO 3	3	2	3	-	2	-	-	-	-	-	-	-
CO 4	3	3	-	-	2	-	-	-	-	-	-	-

UNIT-I

Introduction: What is an Operating System, Simple Batch Systems, Multiprogrammed Batches systems, Time Sharing Systems, Personal-computer systems, Parallel systems, Distributed Systems, Real-Time Systems, OS – A Resource Manager.

Processes: Introduction, Process states, process management, Interrupts, Interprocess Communication

Threads: Introduction, Thread states, Thread Operation, Threading Models. Processor Scheduling: Scheduling levels, preemptive vs no preemptive scheduling, priorities, scheduling objective, scheduling criteria, scheduling algorithms, demand scheduling, real time scheduling.

UNIT-II

Process Synchronization: Mutual exclusion, software solution to Mutual exclusion problem, hardware solution to Mutual exclusion problem, semaphores, Critical section problems. Case study on Dining philosopher problem, Barber shop problem etc.
Memory Organization & Management: Memory Organization, Memory Hierarchy, Memory Management Strategies, Contiguous versus non- Contiguous memory allocation, Partition Management Techniques, Logical versus Physical Address space, swapping, Paging, Segmentation, Segmentation with Paging Virtual Memory: Demand Paging, Page Replacement, Page-replacement Algorithms, Performance of Demand Paging, Thrashing, Demand Segmentation, and Overlay Concepts.

UNIT-III

Deadlocks: examples of deadlock, resource concepts, necessary conditions for deadlock, deadlock solution, deadlock prevention, deadlock avoidance with Bankers algorithms, deadlock detection, deadlock recovery.
Device Management: Disk Scheduling Strategies, Rotational Optimization, System Consideration, Caching and Buffering.

UNIT - IV

File System: Introduction, File Organization, Logical File System, Physical File System, File Allocation strategy, Free Space Management, File Access Control, Data Access Techniques, Data Integrity Protection, Case study on file system viz FAT32, NTFS, Ext2/Ext3 etc.

Textbook(s):
1. Deitel & Dietel, “Operating System”, Pearson, 3 rd Ed., 2011
2. Silbersachatz and Galvin, “Operating System Concepts”, Pearson, 5th Ed., 2001
3. Madnick & Donovan, “Operating System”, TMH,1st Ed., 2001

References:
1. Tannenbaum, “Operating Systems”, PHI, 4th Edition, 2000
2. Godbole, “Operating Systems”, Tata McGraw Hill, 3rd edition, 2014
3. Chauhan, “Principles of Operating Systems”, Oxford Uni. Press, 2014
4. Dhamdhere, “Operating Systems”, Tata McGraw Hill, 3rd edition, 2012
5. Loomis, “Data Management & File Structure”, PHI, 2nd Ed.

Operating Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-353

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Operating Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to implement CPU scheduling for first come first serve.
2. Write a program to implement CPU scheduling for shortest job first.
3. Write a program to perform priority scheduling.
4. Write a program to implement CPU scheduling for Round Robin.
5. Wite a program for page replacement policy using a) LRU b) FIFO c) Optimal.
6. Write a program to implement first fit, best fit and worst fit algorithm for memory management.
7. Write a program to implement reader/writer problem using semaphore.
8. Write a program to implement Producer-Consumer problem using semaphores.
9. Write a program to implement Banker’s algorithm for deadlock avoidance.
10. Write C programs to implement the various File Organization Techniques

Optical Communication Systems and Networks	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-2	ECE-326T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the Knoledge of optical communication and propagation of light through physical medium.
2.	To impart the knowledge about optical fibers, propagation of light through them and signal degradation during signal propagation through optical fibers.
3.	Let the students understand about the types, construction, working and characteristics of various optical sources.
4.	Let the students know about the types, construction, working of various optical detectors and also know about basic optical receiver. Students should also know about basic optical networks.

Course Outcomes (CO)

CO 1	To understand the optical communication and propagation of light through physical medium.
CO 2	To understand various types of optical fibers, propagation of light through them and able to analyse signal degradation in optical fibers.
CO 3	To understand various optical sources and use them in optical transmitting systems.
CO 4	To understand various optical detectors and apply them in optical receivers and Analyze various optical networks.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	2	1	-	1	2	1	2
CO 2	3	3	2	2	2	2	1	-	1	2	1	2
CO 3	3	3	2	2	2	2	1	-	1	2	1	2
CO 4	3	3	2	2	2	2	1	-	1	2	1	2

UNIT I

Introduction: Optical spectral bands and windows, Basic optical communication system, Advantages of optical communication systems.

Optical Fiber Waveguides & Fabrication: Nature of light, Ray theory transmission of light, Electromagnetic mode theory for optical propogation, Mode theory for circular waveguides, Optical fiber modes, Fiber materials, Fabrication and mechanical properties, Fiber optic cables.

UNIT II

Optical fiber Structures and Propagation: Classifications of optical fibers, Step-index fibers, Graded-index fibers, Single-mode fibers, Multimode fibers, Wave propagation in all these fibers, Types of single-mode fibers.

Signal Degradation in Optical Fibers:

Attenuation – Absorption, Scattering, Bending loss.

Signal Distortion – Intermodal dispersion, Chromatic dispersion, Dispersion in all types of fibers. Dispersion modified single-mode fibers.

UNIT III

Optical Sources:

LEDs – Basic concepts of radiation, LED Structures, LED Configurations, Types of LEDs, LED Power & Efficiency, Modulation of an LED, LED Characteristics.

Lasers – Basic Concepts(Types of emission, Population inversion, Laser oscillations, Lasing etc.), Laser modes and threshold conditions, Laser diode rate equations, Laser structures and radiation patterns, External quantum efficiency, Types of Lasers, Modulation of Laser, Laser characteristics.

Basic optical transmitter.

UNIT IV

Optical Detectors: Basic concepts(Optical detection principle, Absorption, Quantum efficiency & Responsivity, etc.), p-n Photodiode, p-i-n Photodiode, Avalanche Photodiode, Detector Response time, Photodetector noise, Multiplication factor, Phototransistors, Basic Optical receiver.

Optical Networks: Network concepts, Network topologies, SONET/SDH, High speed lightwave links, WDM Networks, Optical TDM, Subcarrier multiplexing.

Textbook(s):

1. John M. Senior, “Optical Fiber Communications”, Pearson, 3rd Edition, 2010.
2. Gerd Keiser, “Optical Fiber Communications”, Tata McGraw Hill, 4th edition, 2008.

Reference Books:

1. D.K.Mynbeav & L.L. Scheiner, “Fiber optic Communication Technology”, Pearson Education, 2001.
2. J. Gowar, “Optical Communication System”, PHI, 2nd edition, 1993.
3. G. P. Agrawal, “Fiber optic Communication Systems”, John Wiley & sons, New York, 1992.
4. R.P.Khare, "Fiber Optics and Opto Electronics", Oxford University Press, 2004.

Optical Communication Systems and Networks Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-2	ECE-326P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Optical Communication Systems and Networks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To setup a Fiber Optic Analog Link and study Intensity modulation Technique using analog input signal.
2. To setup a Fiber Optic Analog Link, study the frequency response, and determine the analog bandwidth of the link.
3. To setup a simple Fiber Optic Voice Link.
4. To setup a Fiber Optic Digital Link and study Intensity modulation Technique using digital input signal.
5. To setup a Fiber Optic Digital Link using a LED source and determine the maximum bit rate that can be transmitted on the digital link.
6. To study the Time Division multiplexing technique over a Fiber Optic Link.
7. To measure the Propagation Loss in Optical Fiber and determine the attenuation coefficient.
8. To measure the Bending Loss in Optical Fiber.
9. To measure the Numerical Aperture of the Optical Fiber.
10. To study the I-V characteristic of Light Emmiting Diode (LED).
11. To study the P-I characteristic of a LASER Diode.
12. To study and plot the characteristics of a Photo Detector.

Optical Networks	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	WMC-EAE	WMC-EAE-1A	WMC-332T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of multiplexing techniques and different types of losses in optical networks.
2.	To impart the knowledge of different optical components, optical transmitters and optical detectors.
3.	To impart the knowledge of different types of optical networks, control and management and protection of optical networks.
4.	To impart the knowledge of optical packet switching and optical access network architecture.

Course Outcomes (CO)

CO 1	To understand the advanced multiplexing techniques and different types of losses in optical fiber.
CO 2	To study different types of optical components, optical transmitters and detectors.
CO 3	To provide overview of different optical network elements and to study various survivable techniques in optical networks.
CO 4	To understand optical packet switching and optical access network architecture.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Introduction: Telecommunications network architecture, circuit switching and packet switching, First generation optical networks, multiplexing techniques, second generation optical networks, optical layer, optical packet switching, Network evolution: single-mode fiber, multimode fiber, optical amplifiers and WDM, loss and Bandwidth windows, Intermodal dispersion, optical fiber as waveguide, chromatic dispersion, Stimulated Brillouin scattering, Stimulated Raman scattering.

UNIT II

Optical Components: Couplers, Isolators and Circulators, Multiplexers and filters: gratings, Fabry perot filters. Optical Amplifiers: stimulated emission, spontaneous emission, Erbium-doped fiber amplifiers, Raman amplifiers, semiconductor optical amplifiers, Transmitters: LASER, LED, Detectors: photodetector, front end amplifier, optical switches, wavelength convertors, optical subcarrier modulation and multiplexing.

UNIT III

Optical Networks: SONET/SDH, optical transport network, Ethernet, IP, WDM network elements: optical line terminals, optical line amplifiers, optical Add/Drop Multiplexers. Control and Management : Network management functions, optical layer services and interfacing, layers within the optical layer, Network survivability: Basic concepts, Protection in SONET/SDH : point to point links, self-healing rings, ring interconnection and Dual Homing.

UNIT IV

Photonic Packet Switching and Access Networks: Optical time division multiplexing, synchronization, header processing , burst switching, Optical Access networks Architecture, Fiber to the curb FTTC, Deployment considerations: SONET/SDH core network, designing the transmission layer using SDM, TDM, WDM, unidirectional versus bidirectional WDM systems, long haul networks, long haul under sea networks, metro networks .

Textbook(s):

1. R. Ramaswami and K. Sivarajan, "Optical Networks: A Practical Perspective", Morgan Kaufmann Publishers-3rd ed
2. Mayer & Martin, "Optical Switching Networks", Cambridge University Press, 2007.

References:

1. Biswanath Mukherjee, "Optical WDM Networks", Springer series, 2006.
2. P.E .Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.

Optical Networks Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	WMC-EAE	WMC-EAE-1A	WMC-332P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Optical Networks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To design a basic fiber optic communication system using Optsim software.
2. To study the effective loss due to Stimulated Brillouin Scattering.
3. To design DWDM link using Optical Add-Drop Multiplexer Nodes.
4. To measure Optical signal to noise ratio OSNR using reconfigurable OADM link.
5. To design TDM link and to study channel demultiplexing in Optical time division multiplexed network.
6. To design Optical Code division multiple access link.
7. To study the noise performance of Erbium doped fiber amplifiers..
8. To design 40 channel OC-768 DWDM link.
9. To demonstrate the functioning of Bitrate Discrimination circuit (BDC) based dual rate burstmode receiver in PON systems.
10. To design FTTH system with GEPON Access Architecture.
11. To study the effects of optical receiver characteristics on system performance.

Optimization Techniques	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AIML	6	PC	PC	AI-320T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the basics of Optimization Techniques
2.	To analyze problems in which the objective function and the constraints appear as linear functions of the decision variables
3.	To analyze the optimality criteria for various optimization techniques.
4.	To appreciate variety of Modern optimization techniques.

Course Outcomes (CO)

CO 1	Comprehend the techniques and applications of Engineering optimization.
CO 2	Analyze characteristics of a general linear programming problem
CO 3	Analyse various methods of solving the constrained and unconstrained problems.
CO 4	Analyze variety of Modern optimization techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	1	2	-	-	-	-	-	-	-	2
CO 2	2	2	-	2	-	-	-	-	-	-	-	2
CO 3	2	1	-	2	2	-	-	-	-	-	-	2
CO 4	2	1	-	2	2	-	-	-	-	-	-	2

UNIT-I

Introduction to Optimization: Engineering application of Optimization – Statement of an Optimization problem – Optimal Problem formulation – Classification of Optimization problem. Definition of Global and Local optima – Optimality criteria - Global optimality

UNIT-II

Linear programming methods for optimum design: Review of Linear programming methods for optimum design – Post optimality analysis – Application of LPP models

UNIT-III

Optimization algorithms for solving unconstrained optimization problems – Gradient based method: Cauchy's steepest descent method, Newton's method, Conjugate gradient method.

Optimization algorithms for solving constrained optimization problems – direct methods – penalty function methods – Engineering applications of constrained and unconstrained algorithms.

UNIT – IV

Modern methods of Optimization: Genetic Algorithms – Simulated Annealing – Ant colony optimization – Tabu search – Neural-Network based Optimization – Fuzzy optimization techniques – Applications.

Textbook(s):

1. Rao S. S., 'Engineering Optimization, Theory and Practice', New Age International Publishers, 2012, 4th Ed
2. Deb K., 'Optimization for Engineering Design Algorithms and Examples', PHI, 2000

References:

1. Arora J., 'Introduction to Optimization Design', Elsevier Academic Press, New Delhi, 2004
2. Saravanan R., 'Manufacturing Optimization through Intelligent Techniques', Taylor & Francis (CRC Press), 2006
3. Hardley G., 'Linear Programming', Narosa Book Distributors Private Ltd., 2002
4. C.J. Ray, Optimum Design of Mechanical Elements, Wiley, 2007.
5. D. E. Goldberg, Genetic algorithms in Search, Optimization, and Machine Learning, Addison-Wesley, 1989.

Optimization Techniques Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AIML	6	PC	PC	AI-320P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Optimization Techniques) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to optimization techniques.
2. Study of classical optimization techniques.
3. Study and computer implementation of one-dimensional elimination methods to compute optimal solution.
4. Study and computer implementation of one-dimensional interpolation methods to compute optimal solution.
5. Study of one-dimensional interpolation methods to compute optimal solution
6. Derive the expression for quasi-Newton formula using central difference and two point forward difference schemes.
7. Solution approaches for the optimization problems having equality constraints.
8. Solution approaches for the optimization problems having inequality constraints.
9. Create and analyse the working model of simulated annealing
10. Application of Fuzzy optimization technique using a simulation tool.

Optimization using Controllers	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-3	EEE-356T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand static and dynamic optimisation
2.	To apply optimisation in minimum time, energy and control effort problems,
3.	To apply optimisation in linear regulator problem
4.	To understand LQG control and multi objective control

Course Outcomes (CO)

CO 1	Ability to understand static and dynamic optimisation
CO 2	Ability to apply optimisation in minimum time, energy and control effort problems,
CO 3	Ability to apply optimisation in linear regulator problem
CO 4	Ability to understand LQG control and multi objective control

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	2	1	1	1	2	2	3	1
CO 2	3	2	3	3	2	1	1	1	2	2	3	1
CO 3	3	2	3	3	2	1	1	1	2	2	3	1
CO 4	3	2	3	3	2	1	1	1	2	2	3	1

Unit – I

Introduction. Static and Dynamic optimization. Parameter optimization. Calculus of Variations: problems of Lagrange, Mayer and Bolza. Euler-Language equation and transversality conditions, Lagrange multipliers

Unit – II

Pontryagin’s maximum principle; theory; application to minimum time, energy and control effort problems, and terminal control problem; Dynamic programming: Belaman’s principle of optimality, multistage decision processes. Application to optimal control.

Unit – III

Linear regulator problem: Matrix Riccati equation and its solution, tracking problem;return difference inequality and robustness margins, cross product terms, output feedback, Linear quadratic trackers

Unit – IV

LQG control and separation principle, simple applications. Multi-Objective Control and applications.

Textbooks:

1. F.L. Lewis and V.L. Syrmos, "Optimal Control", John Wiley & Sons, NY 1995.
2. D. S. Naidu, "Optimal Control Systems", CRC Press, 2002

References:

1. Donald Kirk, "Optimal Control Theory: An Introduction", Dover Books, 2004.
2. M. Gopal, "Modern Control System Theory", New Age International Publishers, New Delhi, 2014.

Optimization using Controllers lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-3	EEE-356P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Optimization using Controllers) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Design and simulate a feedback control system for a SISO plant. Use MATLAB's control system toolbox to model the plant.
2. Extend the previous experiment to a MIMO control system. Model a MIMO plant using MATLAB's control system toolbox.
3. Implement an LQR controller for a given linear time-invariant (LTI) plant.
4. Design an LQG controller that combines state feedback control with Kalman filtering for optimal control of a linear system with stochastic disturbances.
5. Use MATLAB's control system toolbox or the Model Predictive Control Toolbox to design the controller and simulate its performance.
6. Design an H-infinity controller for a given plant to achieve robust performance and disturbance rejection.
7. Place the closed-loop poles of a system to achieve desired performance characteristics.
8. Optimize the trajectory tracking of a control system. Define a desired trajectory and formulate an optimization problem to minimize the tracking error. Use MATLAB's optimization toolbox.
9. Use MATLAB's control system toolbox and nonlinear control techniques to design optimal controllers for nonlinear plants.

Opto Electronics	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EEE	6	PCE	PCE-2	EEE-332

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand working and characteristics of Opto Electronics Semi Conductors.
2.	To understand working and characteristics of Opto Electronics Materials.
3.	To understand working and characteristics of Opto Electronics Detectors.
4.	To understand working and characteristics of Solar Cell.

Course Outcomes (CO)

CO 1	Ability to understand working and characteristics of Opto Electronics Semi Conductors.
CO 2	Ability to understand working and characteristics of Opto Electronics Materials.
CO 3	Ability to understand working and characteristics of Opto Electronics Detectors.
CO 4	Ability to understand working and characteristics of Solar Cell.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Optoelectronic materials, Semiconductors, compound semiconductors, III-V and II-VI compounds, ZnO, ITO, GaN, direct and indirect band gap, electronic properties of semiconductors, Fermi level, density of states, life time and mobility of carriers, invariance of Fermi level at equilibrium, diffusion, continuity equation, excess carriers, Quasi-Fermi levels, optical properties, theory of recombination, radiative and non- radiative, absorption edge, photoconductivity, light emitting diodes, LED, device configuration and efficiency, LED structures, light current characteristics and device performance, frequency response and modulation band width. Laser diodes – basic concepts, heterojunction and injection lasers, output characteristics.DER, DBR and quantum well lasers, multiple quantum well structures, surface emitting lasers.

UNIT II

Birefringence, uniaxial and biaxial crystals, index ellipsoid, electro-optic effect, electro optic retardation. Phase and amplitude modulators, transverse electro optic modulators and design considerations- high frequency modulation considerations, transit time limitations in lumped modulators, travelling wave modulators.

Acousto-optic effect, Raman-Nath and Bragg regime, acousto-optic modulators, magneto optic effects, spatial light modulators.

UNIT III

Photodetectors, -performance criteria of a photodectetor, expressions for quantum efficiency, responsivity, photoconductors and photodiodes, PIN diodes, heterojunction diodes and APDs, characteristics and device performance, high speed measurement photoresistors, CCDs, photomultiplier tube, noises in photodetectors, SNR, noise equivalent power.

UNIT IV

Solar cell materials and their properties. solar cell research: technology-Silicon,Organic and Perovskite Characterization and analysis: ideal cell under illuminationsolar cell parameters, optical losses; electrical losses, surface recombination velocity, quantum efficiency - measurements of solar cell parameters; I-V curve & L-I-V characteristics, internal quantum yield measurements – effects of series and parallel resistance and temperature - loss analysis.

Textbook(s):

1. Amnon Yariv, Optical Electronics, Holt Rine hart & Winston, Philadelphia, 1991
2. Bhattacharya P., Semiconductor Optoelectronic Devices,, PHI, New Delhi.1995

Reference Books:

1. Ben G. Streetmann & Sanjay Banerjee, Solid State Electronic Devices, 5thEdn, 2000.
2. Solar Cells: Operating principles, Technology and System Applications, by Martin A. Green, PHI, 1981
3. Thin Film Solar Cell: Fabrication, Characterizations and Applications, Poortmans J and Arkhipov V, John Wiley & Sons, England 2006

Optoelectronics Devices	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-4	ECE-417T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the Knowledge about optical processes in semiconductors and Light Emmitting Diodes.
2.	To impart the knowledge about operating principles, modes, structures, construction, and characteristics of Laser Diodes and their applications.
3.	Let the students understand about the types, construction, working and characteristics of various optical detectors and special detection schemes.
4.	Let the students know about various optical devices and apply them in optical networks and analyze various optical parameters.

Course Outcomes (CO)

CO 1	To understand the optical processes in semiconductors and Light Emmitting Diodes.
CO 2	To understand about operating principles, modes, structures, construction, and characteristics of Laser Diodes and their applications.
CO 3	To understand types, construction, working and characteristics of various optical detectors and special detection schemes.
CO 4	To understand various optical devices and apply them in optical networks and analyze various optical parameters.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	2	1	-	1	2	1	2
CO 2	3	3	2	2	2	2	1	-	1	2	1	2
CO 3	3	3	2	2	2	2	1	-	1	2	1	2
CO 4	3	3	2	2	2	2	1	-	1	2	1	2

UNIT-I

Optical Processes in Semiconductors: Electron-hole pair formation & recombination, Absorption in semiconductors, Radiation in semiconductors, Types of Optical sources.

Light Emitting Diodes (LEDs): The Electroluminescent process, Choice of LED materials, Device configuration and efficiency, Light output from LEDs, LED structures, Types of LEDs, Device performance characteristics, Frequency response and modulation bandwidth, Modulation of an LED, Manufacturing process & applications.

UNIT-II

Lasers Operating Principles:- Design of a Laser hetrostucture, Emission and absorption of radiation in a two-level systems, The Einstein relations and population inversion, Gain in a two-level lasing medium, Lasing condition and gain in a semiconductor, Selective amplification & coherence, Lasing threshold condition in a two-level system, Axial and transverse laser modes, Application of semiconductor lasers.
Lasers Structures & Properties:- Junction laser operating principles, Hetrojunction Lasers, Distributed feedback lasers, The cleaved-coupled-cavity lasers, Quantum well lasers, Surface emitting lasers, Alternate pumping techniques, Device fabrication, Radiation pattern, External quantum efficiency, Laser characteristics, Modulation of lasers, Line width of laser modes.

UNIT-III

Optical Detector: Basic optical detection concepts(Optical detection principle, Absorption, Quantum efficiency & Responsivity.), Photoconductors, **Junction Photodiodes -** p-n Photodiode, p-i-n Photodiode, Hetrojunction diodes. **Avalanche Photodiode -** Avalanche multiplication, Multiplication and Ionization coefficients in p-i-n and p-n junction diodes, Measurments of Multiplication factors and Impact-ionisation coefficients, Practical Avalanche photodiodes, Detector Response time, Noise performance of photodiodes.
Special Detection Schemes:- Phototransistors, Modulated barrier photodiodes, Metal-Semiconductor (Schottky Barrier) photodiode, Metal-Semiconductor-Metal (MSM) photodiode, Detectors for long wavelength operations, Wavelenth selective detection, Coherent detection.

UNIT-IV

Solar Cells: Basic principles, Spectral response, Hetrojunction and Cascaded solar cells, Schottky barrier cells.
Optoelectronic Modulation and Switching Devices: Franz-Keldysh and Stark effect modulators, Quantum well Electro-absorption modulators, Electro-optic modulators, Optical switching and logic devices.
Light Wave Networks: Fiber types and modes, Network topologies and configurations, Digital and analog transmission systems, Techniques in Advanced light wave systems – Wavelength division multiplexing, Active and passive couplers, Regenerative and Non-regenerative amplifiers, Cross point switches.

Textbook(s):
1. Pallab Bhattacharya,”Semiconductor Optoelectronic Devices”, Pearson Education inc, 2nd edition, 1997.
2. Niloy K Dutta & Xiang Zhang, “Optoelectronic Devices”, World Scientific, Singapore, 2018.

References:
1. Jasprit Singh, “Optoelectronics-An Introduction to Materials and Devices”, McGrawhill Int.edition, 1998.
2. S. C. Gupta, “Optoelectronic Devices and systems,” 2nd edition, PHI, 2015.

Optoelectronics Devices Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-4	ECE-417P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Optoelectronics Devices) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study the characteristics of LED, the relationship between LED voltage and current and the Wavelength of Light Emitted.
2. Study of Characteristics of LASER diode. Power vs. Current (P-I) characteristics and measure slope efficiency of Laser Diode.
3. Study the Characteristics of Photodiode and measure the responsivity
4. Characteristics of Avalanche Photo Diode (APD) and measure the responsivity.
5. Study of Phototransistor: The relation between photogenerated current and light intensity
6. Study and plot the different characteristics of an optocoupler device.
7. Study of Solar Cell: I-V characteristics
8. Design and simulate the DWDM and WDM techniques used in optical communication.
9. Measurement the Numerical Aperture of a Multimode Fiber.
10. To measure propagation loss in optical fiber using optical power meter
11. Splice the Single Mode Fiber (SMF) by using fusion splicer.

Organizational Behaviour	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	QM-EAE	QM-EAE-5	QM-445

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To develop managerial skills for an organisation and apply it in resolving the conflicts.
2.	To analyse the differences in behaviour individually and in a group.
3.	To understand various processes and working environment /conditions of an organisation.
4.	To determine appropriate leadership styles to accomplish the work in the given time frame.

Course Outcomes (CO)

CO 1	Understand the challenges and opportunities of an organisation.
CO 2	Able to understand individual behaviour and apply the concept of values, attitude, perception in workplace.
CO 3	To understand the organisation design, climate and culture for taking the decisions.
CO 4	To understand types of transactions and leadership styles of an organisation.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	-	-	-	1	-	1	3	2	3	3
CO 2	3	-	-	-	-	1	-	3	3	2	3	3
CO 3	3	-	-	-	-	1	-	3	3	2	3	3
CO 4	3	-	-	-	-	1	-	3	3	2	3	3

UNIT-I

Introduction: Concept and nature of Organizational Behaviour; Contributing disciplines to the field of O.B.; O.B. Models; Need to understand human behaviour; Challenges and Opportunities**,** Management functions**,** Tasks and responsibilities of a professional manager; Managerial skills

UNIT-II

Individual & Interpersonal Behaviour: Biographical Characteristics; Ability; Values; Attitudes-Formation, Theories, Organization related attitude, Relationship between attitude and behaviour; Personality – determinants and traits; Emotions; Learning-Theories and reinforcement schedules, Perception –Process and errors.

UNIT-III

Organization Structure and Process: Organizational climate and culture, Organizational Structure and Design, Managerial Communication, Motivation, Stress and its management, Decision Making: Organizational Context of Decisions, Decision Making Models; Problem Solving.

UNIT – IV

Interactive Aspects of Organizational Behaviour: Interpersonal Behaviour: Johari Window; Transactional Analysis – ego states, types of transactions, life positions, applications of T.A, Group Dynamics; Management of Organizational Conflicts; Leadership Styles.

Textbook(s):

1. Luthans Fred., “Organizational Behaviour”, McGraw Hill, 2010, 12th ed.
2. Robbins & Judge (15th ed.), “Essentials of Organizational Behaviour”, Pearson 2012.

References:

1. Stoner, R. James A.F., “Edward Freeman Daniel R Gilbert Jr., Management” 6TH Ed, PHI.
2. George, J. M. & Jones, G.R. “Understanding and Managing Organizational Behaviour”, 2009, 5th Ed, Pearson.
3. Green Berg, J. and Baron, R.A., “Behaviour in Organization”, 2008, Prentice Hall of India.
4. Mcshane, S.L., Von Glinow, M.A., Sharma, R.R. “Organizational Behaviour”, 2006 Tata McGrawHill.

Parallel Computing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	6	PCE	PCE-3	CIE-370T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand and analyze different parallel computer models.
2.	To assess and analyze the requirement of memory hierarchy.
3.	To compare different architecure of parallel computers.
4.	To understand various platforms for parallel computing.

Course Outcomes (CO)

CO 1	Able to understand and analyze different parallel computer models.
CO 2	Able to assess and analyze the requirement of memory hierarchy.
CO 3	Able to compare different architecure of parallel computers.
CO 4	Able to understand various platforms for parallel computing.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	3	2	1	2	1	-	-	1	1	1
CO 2	2	2	3	2	1	2	1	-	-	1	1	1
CO 3	2	2	3	2	1	2	1	-	-	1	1	1
CO 4	2	2	3	2	1	2	1	-	-	1	1	1

UNIT I

Theory of Parallelism: Parallelism, Reason of parallel processing, Concepts and challenges, applications of parallel processing.
Parallel computer models: The state of computing, Classification of parallel computers, Flynn and Feng's classification, SIMD and MIMD operations, Shared Memory vs. message passing multiprocessors, Distributed shared memory, Hybrid multiprocessors, multiprocessors and multicomputers, Multivector and SIMD computers, PRAM and VLSI Models.
Program and Network Properties: Conditions of parallelism, program partitioning and scheduling, program flow mechanism, system interconnection architecture.

UNIT II

Memory Hierarchy Design: Memory technologies and optimization, inclusion, coherence and locality, cache memory organization and cache performance optimization, shared memory organization, memory protection, virtual memory technology and introduction to buses, crossbar and multi-stage switches.

Pipelining and ILP: Instruction level parallelism and its exploitation- concepts and challenges, overcoming data hazards with dynamic scheduling. Pipelining, instruction and arithmetic pipelining designs, branch handling techniques, linear and non-linear pipeline processors, superscalar and super pipeline design.

UNIT III

Parallel architectures: multi-processor system interconnects, cache coherence and synchronization mechanism, message passing mechanism, vector processing principles, multivector multiprocessors, compound vector processing, principles of multithreading, latency hiding techniques- shared virtual memory, prefetching techniques, distributed coherent cache, scalable and multithread architectures, dataflow and hybrid architecture.

UNIT IV

Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor Architectures, limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks. Parallel Programming Models: Shared variable models, message passing models, parallel languages and complier, code optimization and scheduling, Introduction of shared-memory MIMD machines and message-passing MIMD machines.

Textbooks:

1. Introduction to Parallel Computing by Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Pearson.
2. Advance computer Architecture by Kai Hwang under Tata McGraw Hill publications.
3. Introduction to Parallel Processing: Algorithms & Architectures, Behrooz Parhami in Springer Shop.

References:

1. Introduction to Parallel Processing by P. Ravi Prakash, M. Sasikumar, Dinesh Shikhare by PHI Publications.
2. Fundamentals of Parallel Processing by Jordan Harry, Alaghband Gita, PHI Publication
3. Introduction to Parallel Programming by Steven Brawer.
4. Parallel Computers – Architecture and Programming by V. Rajaraman and C. Siva Ram Murthy.

Parallel Computing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	6	PCE	PCE-3	CIE-370P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Parallel Computing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. OpenMP – Basic programs such as Vector addition, Dot Product
2. OpenMP – Loop work-sharing and sections work-sharing
3. OpenMP – Combined parallel loop reduction and Orphaned parallel loop reduction
4. OpenMP – Matrix multiply (specify run of a GPU card, large scale data Complexity of the problem need to be specified)
5. MPI – Basics of MPI
6. MPI – Communication between MPI process
7. MPI – Advanced communication between MPI process
8. MPI – Collective operation with 'synchronization'
9. MPI – Collective operation with 'data movement'
10. MPI – Collective operation with 'collective computation'
11. MPI – Non-blocking operation

Pattern Recognition	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	IPCV-EAE	IPCV-EAE-2	IPCV-336T
ECE	7	PCE	PCE-4	ECE-405T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms.
2.	To apply the knowledge of feature extraction methods, feature evaluation, and data mining on real life
3.	To apply both supervised and unsupervised classification methods to detect and characterize patterns in real-world data.
4.	To impart the knowledge of the soft computing techniques used in pattern recognition.

Course Outcomes (CO)

CO 1	Understand the need and significance of mathematical fundamentals in pattern recognition to solve real- time problems.
CO 2	Explore on supervised & unsupervised learning algorithms and to apply them for solving problems.
CO 3	Design pattern recognition models to extract interesting patterns & Apply various machine learning techniques like artificial neural networks, Support Vector machines, Fuzzy inference engines etc.to solve real-world problems
CO 4	Develop prototype pattern recognition algorithms that can be used to study algorithm behaviour and performance against real-world multivariate data

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	1	1	2	1	1	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Classification: Overview of pattern recognition, Discriminant functions, Supervised learning-Parametric estimation, Maximum likelihood estimation.

Pattern Classifier: Bayesian parameter estimation, perceptron algorithm, LMSE algorithm, problems with Bayes approach, Pattern classification by distance functions, Minimum distance pattern classifier.

UNIT II

Unsupervised Classification: Criterion functions for clustering; Algorithms for clustering: K-Means, Hierarchical and other methods; Cluster validation; Gaussian mixture models; Expectation-Maximization method for parameter estimation; Maximum entropy estimation.

UNIT III

Sequential Pattern Recognition: Hidden Markov Models (HMMs); Discrete HMMs; Continuous HMMs Structural
Dimensionality reduction: Fisher discriminant analysis; Principal component analysis; Factor Analysis
Feature Extraction and Selection: Feature selection through Functions approximation, Binary feature selection.

UNIT IV

Linear discriminant functions, Neural Networks and Kernel Machines: Neural network structures for pattern recognition, Self-organizing networks, Support vector machines (SVM), Kernel machines, Maximum margin classification, and generalize ability.
Neuro Fuzzy and Genetic Algorithm for pattern classification: Fuzzy logic-Fuzzy pattern classifiers-Neuro-Fuzzy Systems-pattern classification and optimization Using Genetic Algorithms

Textbook(s):
1. Duda R.O.,and Hart.P.E., Pattern Classification and Scene Analysis, second edition, Wiley, 2001
2. RobertJ. Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 2007.

References:
1. Ou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.
2. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993

Pattern Recognition Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	IPCV-EAE	IPCV-EAE-2	IPCV-336P
ECE	7	PCE	PCE-4	ECE-405P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Pattern Recognition) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Installation and working on various AI tools such as Python / MATLAB.
2. Gaussian function evaluation. Write a MATLAB/Python function that computes the value of the Gaussian distribution N (m, S), at a given vector x. Hence, plot the effect of varying mean and variance to the normal distributions.
3. Implementation of pattern recognition problems such as handwritten character/ digit recognition, speech recognition, etc
4. Implementation of anyone classification technique.
5. Model the experiment by means of a Hidden Markov Models (i.e., define the vector of the initial state probabilities, the transition matrix and the matrix of the emission probabilities).
6. Implementation of different feature extraction methods.
7. Compute the Classification Accuracy of Support Vector Machine & Convolutional Neural Network for a given dataset
8. Compute the Classification Accuracy of Extreme Learning Machines & Convolutional Neural Network for a given dataset
9. Implementation of various clustering techniques.
10. Implementation of the Genetic Algorithms for pattern classification

Pattern Recognition and Computer Vision	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AIML	7	PC	PC	ML-411T
EAE	7	AIML-EAE	AIML-EAE-5	ML-411T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the in-depth concept of Pattern Recognition
2.	Implement Bayes Decision Theory
3.	Understand the in-depth concept of Perception and related Concepts
4.	Understand the concept of ML Pattern Classification

Course Outcomes (CO)

CO 1	Discuss various concepts of pattern recognition
CO 2	Understanding various algorithms
CO 3	Explain and apply various computer vision techniques
CO 4	Describe the concept of shape analysis and filtering

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	3	3	-	2	-	-	1	3	2
CO 2	3	3	1	1	1	-	1	1	-	2	2	1
CO 3	3	2	3	3	2	-	2	-	-	2	3	1
CO 4	1	2	3	2	2	-	1	-	-	1	2	2

UNIT-I

Induction Algorithms. Rule Induction. Decision Trees. Bayesian Methods. Overview. Naïve Bayes. The Basic Naıve Bayes Classifier. Naive Bayes Induction for Numeric Attributes. Correction to the Probability Estimation. Laplace Correction. No Match. Other Bayesian Methods. Other Induction Methods. Neural Networks. Genetic Algorithms. Instance-based Learning. Support Vector Machines.

UNIT-II

About Statistical Pattern Recognition. Classification and regression. Features, Feature Vectors, and Classifiers. Pre-processing and feature extraction. The curse of dimensionality. Polynomial curve fitting. Model complexity. Multivariate non-linear functions. Bayes' theorem. Decision boundaries. Parametric methods. Sequential parameter estimation. Linear discriminant functions. Fisher's linear discriminant. Feed-forward network mappings.

UNIT-III

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.

UNIT – IV

Binary shape analysis – connectedness – object labelling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

Textbook(s):
1. Pattern Classification, Richard O. Duda, Peter E. Hart, and David G. Stork. Wiley, 2000, 2nd Edition
2. D. L. Baggio et al., Mastering OpenCV with Practical Computer Vision Projects, Packt Publishing, 2012.

References:
1. Pattern Recognition, Jürgen Beyerer, Matthias Richter, and Matthias Nagel. 2018
2. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012

Pattern Recognition and Computer Vision Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AIML	7	PC	PC	ML-411P
EAE	7	AIML-EAE	AIML-EAE-5	ML-411P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Pattern Recognition and Computer Vision) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a MATLAB/Python function that computes the value of the Gaussian distribution N(m,s) at given vector X and plot the effect of varying mean and variance to the normal distribution.
2. Implementation of Gradient descent.
3. Implementation of Linear Regression using Gradient descent.
4. Comparison of classification accuracy of SVM and CNN for the dataset.
5. Implementation basic Image Handling and processing operations on the image.
6. Implementation of Geometric Transformation.
7. Implementation of Perspective Transformation.
8. Implementation of Camera Calibration
9. Compute Fundamental Matrix.

PHP Programming and MySQL	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	FSD-435T
EAE	7	FSD-EAE	FSD-EAE-3	FSD-435T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Learn how to take a static website and turn it into a dynamic website run from a database using PHP and MySQL.
2.	Analyze the basic structure of a PHP web application and be able to install and maintain the web server, compile, and run a simple web application.
3.	Learn how databases work and how to design one, as well as how to use php MyAdmin to work with MySQL.
4.	Learn different ways of connecting to MySQL through PHP, and how to create tables, enter data, select data, change data, and delete data. Connect to SQL Server and other data sources.

Course Outcomes (CO)

CO 1	Interpret the server side scripting PHP and create dynamic web pages.
CO 2	Outline the advanced concepts of PHP and design web pages to authenticate users.
CO 3	Develop server side programs using PHP and accessing database through PHP.
CO 4	Design web pages to authenticate users using Cookies.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	3	1	-	-	3	2	3	2
CO 2	3	2	3	2	3	1	-	-	3	2	3	2
CO 3	3	2	3	2	3	1	-	-	3	2	3	2
CO 4	3	2	3	2	3	1	-	-	3	2	3	2

UNIT-I

Introduction to PHP: Evaluation of PHP, Basic Syntax, Defining variable and constant, PHP Data type, Operator and Expression, Decisions and loop: Making Decisions, Doing Repetitive task with looping, Mixing Decisions and looping with Html, Function: What is a function, Define a function, Call by value and Call by reference, Recursive function, String Creating and accessing, String Searching & Replacing String, Formatting String, String Related Library function

UNIT-II

Array Anatomy of an Array, Creating index based and Associative array Accessing array, Element Looping with

Index based array, Looping with associative array using each () and foreach(), Some useful Library function, Handling Html Form with PHP Capturing Form, Data Dealing with Multi-value filed, and Generating File uploaded form, redirecting a form after submission

UNIT-III

Working with file and Directories: Understanding file& directory, Opening and closing, a file, Coping, renaming and deleting a file, working with directories, Creating and deleting folder, File Uploading & Downloading, Session and Cookie: Introduction to Session Control, Session Functionality What is a Cookie, Setting Cookies with PHP. Using Cookies with Sessions, Deleting Cookies, Registering Session variables, Destroying the variables and Session.

UNIT - IV

Introduction to RDBMS: Connection with MySql Database, Performing basic database operation (DML) (Insert, Delete, Update, Select), Setting query parameter, Executing queryJoin (Cross joins, Inner joins, Outer Joins, Self joins.)

Textbook(s):
1. Dave W Mercer, Allan Kent, Steven D Nowicki, David Mercer, Dan Squier, Wankyu Choi, “Beginning PHP”.
2. RasmusLerdorf and Kevin Tatore , “Programming PHP”

References:
1. Learning PHP, MySQL, books by ‘ O’ riley Press
2. PHP, MySQL and Apache by Julie C Meloni. Pearson Education

PHP Programming and MySQL Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	FSD-435P
EAE	7	FSD-EAE	FSD-EAE-3	FSD-435P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (PHP Programming and MySQL) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. a. Install and configure PHP, web server, MYSQL
   b. Write a program to print "Welcome to PHP".
   c. Write a simple PHP program using expressions and operators.
2. Write a PHP program to demonstrate the use of Decision making control structures using:
   a. If statement
   b. If-else statement
   c. Switch statement
3. Write a PHP program to demonstrate the use of Looping structures using:
   a. while statement
   b. do-while statement
   c. for statement
   d. foreach statement
4. Write a PHP program for creating and manipulating-
   a. Indexed array
   b. Associative array
   c. Multidimensional array
5. a. Write a PHP program to-
      i. Calculate length of string.
      ii. Count the number of words in string without using string functions.
   b. Write a simple PHP program to demonstrate use of various built-in string functions.
6. Write a simple PHP program to demonstrate use of Simple function and Parametrized function.
7. Develop web page with data validation.
8. Write simple PHP program to-
   a. Set cookies and read it.
   b. Demonstrate session management
9. Develop a simple application to-
   a. Enter data into database.
   b. Retrieve and present data from database.
10. Develop a simple application to Update, Delete table data from database.

Pipe and Open Channel Hydraulics	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	CE-OAE	CE-OAE-2	OCE-304

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the concepts of channel hydraulics.
2.	To study different types of flow and flow characteristics.
3.	To analyze flow problems and determine effect of channel geometric parameter of flow characteristics.
4.	To understand the concept of pipe flow and pipe network analysis.

Course Outcomes (CO)

CO 1	Define fundamental concepts of various types open channel flow and concepts of specific energy.
CO 2	Analyze the flow through transition, varied flow, forces on sediment load
CO 3	Determine flow profiles, and characteristics of varied flow
CO 4	Understand the concept of pipe flow and forces exerted and energy loss during transmission.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	-	1	-	-	-	-	-	1	-	-
CO 2	3	2	2	2	-	1	-	-	-	-	-	-
CO 3	1	1	1	2	-	-	-	-	-	-	-	-
CO 4	3	3	3	2	1	-	-	1	-	-	-	-

UNIT-I

Flow in open channels: Type of channels, classification of flows, geometrical properties of channel section, velocity distribution in channel section, most economical/efficient section of channel(rectangular, triangular, trapezoidal), continuity equation, energy equation and momentum equation, concept of critical depth and specific energy, critical depth for rectangular, triangular, and trapezoidal channels, flow through transition with a hump and with change in width (contraction and expansion).

UNIT-II

Uniform flow: Chezy's equation, Manning's formula, Factors affecting Manning's roughness coefficient, velocity distribution, shear stress distribution, Uniform flow computations for rectangular, trapezoidal and circular channels, standard line canal channels, Hydraulically efficient channel sections, compound sections, Critical slope and limit slope.

UNIT-III

Gradually Varied Flow: Introduction, differential equation of GVF, Classification of flow profiles, M, S, C, H and A profiles, features of flow profiles, control sections, serial combination of channel sections, Transitional depth, numerical solution Method of gradually varied flow problems(direct step method).
Hydraulic jump: Hydraulic jump in rectangular channel: sequent depth ratio, Energy loss; Classification of jumps, use of jump as an energy dissipater.

UNIT - IV

Flow through pipes: Loss of head / energy in pipes - Major losses-friction loss by Darcy Weisbach formula, Chezy's formula; Types of minor losses; Hydraulic gradient and total energy line, Flow through siphon, Pipes in series, concept of equivalent pipe, flow through parallel and branched pipes; Water hammer in pipes, sudden and gradual closure of valve; Analysis of Pipe network using Hardy Cross method.

Textbook(s):
1. K. Subramanya, "Flow in Open Channels", Tata McGraw Hill
2. S.Ramamrutham, "Hydraulics Fluid Mechanics and Fluid Machines", Dhanpat Rai Publishing Company, 2018

References:
1. Modi, P.N. Seth S.M., Hydraulics and Fluid Mechanics (incl. Hydraulic Machines), Standard Book House, New Delhi.
2. Garde, R J, and Ranga Raju, K G, Mechanics of Sediment Transportation and Alluvial Stream Problems, Wiley Eastern Ltd., New Delhi.
3. Applied Hydrology - Ven T Chow, David R Maidment, Larry W Mays, McGraw-Hill, New Delhi
4. R.K.Sharma and T.K.Sharma, Irrigation Engineering. S.Chand and Company Ltd., New Delhi.

Planning and Design of Green Buildings	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	GTSE-EAE	GTSE-EAE-1	GTSE-318

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge of the principles and practices of the green buildings
2.	To understand the principles of effective energy and resources management in buildings
3.	To bring awareness of the basic criteria in the green building rating systems.
4.	To understand the methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes (CO)

CO 1	Assimilate environmental impact of buildings.
CO 2	Quantify the environmental impact of buildings in terms of energy consumption.
CO 3	Integrate design strategies in the construction of green buildings as well as existing buildings.
CO 4	Comprehend the procedure involved in green building certification.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	2	-	-	1	3	-	-	-	-	2
CO 2	-	-	3	2	-	3	3	-	-	-	-	2
CO 3	-	2	3	3	-	2	3	-	-	-	-	2
CO 4	-	-	3	-	-	3	3	-	-	-	-	2

UNIT-I

Green building concept- History of Green Building Movement, increased public focus on Sustainability and Energy Efficiency, Supportive Framework and general condition, Green Home Certifications, CO2 Emission Trade, Impacts of built environment on natural environment, High Performance Building Characteristic, the LEED rating system, Rating system for Sustainable Building, Barriers to green building growth.

UNIT-II

Green Building Requirements: Principles of Energy, Heat Flow, Fuel Types, Air Flow, Moisture Flow, Condensation and Dew Point, Relative Humidity, Concept of Earth air Tunnel System for moderating air Temperature, sky-therm system, Solar chimney-based hybrid system

Indoor Built Environment: Problem of Existing Buildings and Built Environment; Energy use in buildings; Greenhouse Gas Emissions and Indoor Air pollution; Building Water Use; Land use and consumption; Construction Materials; Construction, Operation and Demolition Waste. Building shape and orientation, building envelope, building materials and furnishing, natural resources. An integrated view of green building-

Lifecycle engineering

UNIT-III

Planning of Green from Start- Traditional Design, Integrated Design, Site Selection, Site Development, Construction Waste, Materials required, Paints, Adhesive and sealants for use in building, Volatile organic content (VOC), Tree Protection, Pest Control, Floors and Exterior walls, Roofs, Landscaping

Green Building Design: Passive Design Strategies, Bio climatic design, Optimum Design, Solar geometry, climate responsive building design, thermal comfort, visual comfort, acoustic comfort, Performing Insulation Solution, Ventilation; Active Strategies: Equipment, Renewable Energy; Retrofitting; Net Zero Building Design.

UNIT – IV

Embodied Energy Estimation; Life Cycle Assessment Analysis, Sustainable building procedure requirement, Blower door test, Thermography, Indoor Comfort, Air Quality, Noise Protection, Day light Performance and Non-Glaring, Emulation, Monitoring and Energy Management, Conscious handling of resources- Energy benchmark as target values for design, regenerative energy resources, primary energy demand for indoor climate conditioning, Energy demand for Lifecycle of a building, Water requirement, Case study.

Textbook(s):

1 Green Building Technology Guide: Volume 1 - Residential, Fred Andreas, Academic Press Inc., 1st Ed. (2020).
2. The Idea of Green Building, A. K. Jain, Khanna Publishers, First Edition, (2014).

References:

1. Sustainable Construction: Green Building Design and Delivery, Charles Kibert, John Wiley & Sons, (2005).
2. Energetics Perspective on the Environmental and Human Impact of Buildings, Teodora Melania Soimosan and Ligia Mihaela Moga, Business Science Reference, (2020).
3. Alternative Energy Systems in Building Design, Peter Gevorkian, McGraw-Hill Education, First Edition, (2009).

PLC and SCADA Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	CI-EAE	CI-EAE-1	CI-306T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Understand the features of PLC
2.	Knowlwdge of role of programming in PLC
3.	Analyse various functions of PLC
4.	Understand operation and importance of various parts of SCADA system

Course Outcomes (CO)

CO 1	Understand the features of PLC
CO 2	Assess the role of programming in PLC
CO 3	Analyse various functions of PLC
CO 4	Understand operation and importance of various parts of SCADA system

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT-I

Programmable Logic Controller (PLC) Basics: Introduction, Parts of PLC, Principles of operation, PLC size and applications, PLC Advantages and Disadvantages, PLC Manufacturers, PLC hardware components, I/O section, Analog I/O modules, Digital I/O modules, CPU- Processor memory module, Programming devices, Devices which can be connected to I/O modules, Relay, Contactor, SPST, Push Buttons, NO/NC Concept

UNIT-II

Programming of Programmable Logic Controller: General PLC Programming Procedures, Contacts and Coils, Program SCAN, Programming Languages, Ladder Programming, Relay Instructions, Instruction Addressing, Concept of Latching, Branch Instructions, Contact and Coil I/O Programming Examples, Relation of Digital Gate Logic to Contact/Coil Logic.

UNIT-III

Programmable Logic Controller Functions: Timer Instructions: ON DELAY Timer and OFF DELAY timer, Counter Instructions: UP/DOWN Counters, Timer and Counter Applications, Program Control Instructions: Master Control Reset, Jump and Subroutine,
Math Instructions- ADD, SUB. Data Handling: Data Move, Data Compare, Data Selection, Electro-pneumatic Sequential Circuits and Applications.

UNIT-IV

SCADA: Definition of SCADA, Applicable Processes, Elements of SCADA System, A Limited Two-Way System. Real Time Systems: Communication Access and Master-Slave determining scan interval. Introduction to Remote Control, Communications-A/D Conversion, Long Distance Communication, Communication System components in brief- Protocol, Modems, Synchronous/Asynchronous telephone cable/radio, Half Duplex, Full Duplex System, Brief introduction to RTU and MTU, Applications-Automatic Control, Advisory Applications.

Text Books:
1. Frank D. Petruzella “Programmable Logic Controllers”, McGraw-Hill Book Company.
2. John w. Webb and Ronald A. Reis, “Programmable Logic Controllers”, PHI

Reference Books:
1. Stuart A.Boyer “Supervisors Control and Data Acquisition”, ISA
2. William I. Fletcher “An Engineering Approach to Digital Design”, PHI.
3. Simpson, Colin “Programmable Logic Controllers”, Englewood Cliffs NJ PHI.
4. Gray Dunning, “Introduction to Programmable Logic Controllers”, Delmar Thompson Learning
5. Stenerson, John “Fundamentals Logic Controllers Sensors, & Communications”, 1993. Prentice Hall.
6. Programmable Logic Controllers, W.Bolton, Elsevier

PLC and SCADA Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	CI-EAE	CI-EAE-1	CI-306P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (PLC and SCADA Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study hardware and software used in PLC
2. Develop an Interfacing of lamp and button with PLC for ON/OFF operation.
3. Multiple push button operation with delayed lamp for ON/OFF operation.
4. Study combination of Counter & Timer for Lamp ON/OFF operation using PLC.
5. Observe the effect of change in Proportional Band, Integral gain and Derivative gain values on PID performance
6. PLC interfaced with SCADA and status read/ command transfer operation
7. Develop an Alarm annunciation using SCADA
8. Reporting and Trending in SCADA System.
9. Perform an experiment of parameter reading of PLC in SCADA
10. Perform an experiment of sensing Temperature using SCADA

Pollution Control and Monitoring	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	6	PCE	PCE-2	CEE-316

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn about the air pollutants, sources and its effects.
2.	To have a clear understanding on the air quality standards and its techniques
3.	To find the Properties of air pollution and its control measures.
4.	To learn about the effects and the sources of noise pollution

Course Outcomes (CO)

CO 1	Understand basic concepts and terminologies of air & noise pollution, sources and effects on environment
CO 2	Understand air & noise pollution indices, various acts and legislations
CO 3	Discuss air & noise pollution standards and measurement methods
CO 4	Analyze removal techniques to control air & noise pollution

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	3	-	-	-	3	3	-	-	-	-	-
CO 2	-	2	-	-	-	3	3	-	-	-	-	3
CO 3	-	2	-	3	-	3	3	-	-	-	-	-
CO 4	-	3	3	-	-	3	3	-	-	-	-	3

UNIT-I

Air pollution: composition and structure of atmosphere, global implications of air pollution, classification of air pollutants: particulates, hydrocarbon, carbon monoxide, oxides of sulphur, oxides of nitrogen and photochemical oxidants. Indoor air pollution. Effects of air pollutants on humans, animals, property and plants.

UNIT-II

Air pollution chemistry, meteorological aspects of air pollution dispersion; temperature lapse rate and stability, wind velocity and turbulence, plume behaviour, dispersion of air pollutants, the Gaussian Plume Model, stack height and dispersion.

UNIT-III

Ambient air quality and standards, air sampling and measurements. Control of particulate air pollutants using gravitational settling chambers, cyclone separators, wet collectors, fabric filters (Bag-house filter), electrostatic precipitators (ESP) Control of gaseous contaminants: Absorption, Adsorption, Condensation and Combustion, Control of sulphur oxides, nitrogen oxides, carbon monoxide, and hydrocarbons. Automotive emission control, catalytic convertor, Euro-I, Euro-II and Euro-III specifications, Indian specifications.

UNIT – IV

Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise control methods.

Textbook(s):

1. Peavy, Rowe and Tchobanoglous: Environmental Engineering.
2. Martin Crawford: Air Pollution Control Theory.

References:

1. Mycock, McKenna and Theodore: Handbook of Air Pollution Control Engineering and Technology.Suess and Craxford: W.H.O. Manual on Urban Air Quality Management
2. C.S. Rao, Air Pollution and Control
3. Advanced Air and Noise Pollution Control by Lawrence K. Wang, Norman C. Pereira & Yung IseHung.
4. Noise Pollution and Control by S. P.Singhal , Narosa Pub House
5. Textbook of Noise Pollution and Its Control by S. C. Bhatia, Atlantic; Edition

Power Electronics	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	5	PC	PC	EEC-309

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn the operation characteristics and firing circuits of power electrons devices.
2.	To acquire knowledge of controlled rectifier and choppers control DC Motors
3.	To get the exposure of square wave, Quashi square wave PWM and multilevel inverters there use to control AC drives
4.	apply AC controllers cycloconverter and matrix converter to control induction motors

Course Outcomes (CO)

CO 1	Understand the operation characteristics and firing circuits of power electronic devices
CO 2	Gained the knowledge of controlled rectifier, choppers and their use to control DC Motors
CO 3	Analyse and design square wave, quashi wave, and multilevel inverters to control AC drive
CO 4	Design AC converter, AC controller, cyclo converter and matrix converter to control induction motor

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	2	3	3	1	1	1	2	3
CO 2	3	3	3	3	3	3	3	1	1	1	2	3
CO 3	3	3	3	3	3	3	3	1	1	1	2	3
CO 4	3	3	3	3	3	3	3	1	1	1	2	3

UNIT- I

Introduction: Characteristics and switching behaviour of Power Diode, SCR, UJT, TRIAC, DIAC, GTO, MOSFET, IGBT, MCT and power BJT, two-transistor analogy of SCR, firing circuits of SCR and TRIAC, SCR gate characteristics, SCR ratings. Protection of SCR against over current, over voltage, high dV/dt, high dI/dt, thermal protection, Snubber circuits, Methods of commutation, series and parallel operation of SCR, Driver circuits for BJT/MOSFET.

UNIT- II

A.C. to D.C. Converter: Classification of rectifiers, single and three phase controlled rectifiers, fully controlled and half controlled rectifiers and their performance parameters, , single-phase and three phase dual converter.

D.C. to D.C. Converter: Classification of choppers as type A, B, C, D and E, principle of operation, switching mode regulators: Buck, Boost, Buck-Boost, Cuk regulators.

DC Motor Drives: DC motor speed control, , controlled rectifier fed dc drives, chopper controlled dc drives.

UNIT- III

D.C. to A.C. Converter: single phase single pulse inverter: Square wave, quasi square. Three phase single pulse inverters (120° and 180° conduction) Modulation Techniques and reduction of harmonics, PWM techniques, SPWM techniques, SVM, Carrier less modulation. , PWM Inverter, Bidirectional PWM converters, voltage source inverters and current source inverter, Multi level Inverter: cascaded and NPC Inverters. Introduction of AC drives

UNIT-IV

A.C. to A.C. Converter: AC voltage Controllers**,** Cyclo-converters : single phase to single phase, three phase to single phase, three phase to three phase Cyclo-converter circuit and their operation, Matrix converter.
Induction Motor Drives: Three phase induction motor starting, braking, , speed control from stator and rotor sides, stator voltage control, variable frequency control from voltage sources and current sources

Textbooks:

1. M.H. Rashid, “Power Electronics: Circuits, Devices and Applications” Pearson Publications.
2. Daniel W. Hart, “Power Electronics “Tata McGraw-Hill
3. H.C. Rai, “Power Electronics Devices, Circuits, Systems and Application”, Galgotia Publications, 3rd Edition

References Books:

1. Singh, Kanchandani, “Power Electronics”, Tata McGraw-Hill.
2. Ned Mohan, Tore M. Undeland and Robbins, “Power Electronics: Converters, Applications and Design” Wiley India Publication
3. V R Moorthi, “Power Electronics: Devices, Circuits and Industrial Applications”, Oxford Publication.
4. Kassakian, Schlecht, Verghese, “Principles of Power Electronics” , Pearson Publications
5. M.S. Jamil Asghar, “Power Electronics” PHI Publication
6. P. S. Bimbhra “Power Electronics”, Khanna Publishing.

Power Electronics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	5	PC	PC	EEC-357

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Power Electronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study and analyze V-I characteristics of SCR and TRIAC.
2. To study the switching characteristics of MOSFET and IGBT
3. To study R and RC and UJT based firing circuits using SCR.
4. To study single phase Semi-converter and Full converters feeding R and RL load
5. To study A.C phase control using SCR (half and full wave) using DIAC and TRIAC for dimmer application.
6. To study single-phase cyclo- converter feeding R and RL loads.
7. To study the operation and duty cycle control of buck and boost converter feeding R loads.
8. To study the operation and duty cycle control of Type-C chopper.
9. To study the THD in operation of single phase Square wave and Quasi square wave Inverter.
10. To study the operation of SPWM Inverter.

Power Plant Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-2	MEE-318T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To make the students familiar with the properties of coal and its firing methods.
2.	To make the students understand about the various components of steam power plant.
3.	To teach the students the working of Nuclear and hydraulic power plant.
4.	To learn about instrumentation and control system in steam power plant.

Course Outcomes (CO)

CO 1	To learn the properties of coal and its firing methods.
CO 2	To understand the working of Boiler its mountings and accessories and need of combined cycle.
CO 3	To understand working of Nuclear power plant and hydraulic power plant.
CO 4	To acquire the importance of instrumentation and control system in steam power plant

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	1	-	-	-	-	2
CO 2	3	2	2	2	2	-	1	-	-	-	-	2
CO 3	3	2	2	2	2	-	2	-	-	-	-	2
CO 4	3	2	2	2	2	-	2	-	-	-	-	2

UNIT – I

Coal fired Power Plants: Indian energy scenario, Indian coals: formation, properties, analysis, calculation of heating value of coals; coking and non-coking coals, fuel handling systems; coal gasification. Classification of power plants, base load and Peak load power stations, co-generated power plant, captive power plant, and their fields of application. coal pulverization, pulverized fuel firing system, combustion process, need of excess air, cyclone furnace, fluidized bed boiler

UNIT – II

Steam Generators: High pressure utility boiler, natural and forced circulation, Boiler mountings and accessories its function and working, placement of evaporator, economizers, super heaters, re-heaters, air pre-heater in the boiler, de-aeration, boiler blow- down, ash collection by bag house, gravity separation, electrostatic precipitators and wet scrubbers, boiler efficiency calculations, water treatment: external and internal treatment

Combined Cycle Power Plants: Binary vapour cycles, coupled cycles, gas turbine- steam turbine power plant.

Combined cycle with and without supplementary firing.

UNIT – III

Other power plants: Nuclear power plants - working and types of nuclear reactors, boiling water reactor, pressurized water reactor, fast breeder reactor, controls in nuclear power plants, hydro power plant - classification and working of hydroelectric power plants, tidal power plants, diesel and gas power plants.

UNIT – IV

Instrumentation and Controls in power plants: Important instruments used for temperature, flow, pressure, water/steam conductivity measurement; flue gas analysis, drum level control, combustion control, super heater and re-heater temperature control, furnace safeguard and supervisory system (FSSS), auto turbine run-up system(ATRS), interlocks and protection of turbines.
Environment Pollution and Energy conservation: Economics of power generation: load duration curves, power plant economics, pollution from power plants, disposal/management of nuclear power plant waste

Textbooks:
1. Power Plant Engineering by M.M. Elwakil, Tata McGraw Hill.
2. Power Plant Engineering by P.K Nag, Tata McGraw Hill.

References:
1. Steam and Gas turbines by A Kostyuk and V Frolov, MIR Publishers, ISBN9785030000329.
2. Modern Power Plant Engineering by J Wiesman and R Eckart, Prentice hall India Ltd, ISBN- 97801359725.
3. Applied Thermodynamics by T.D Eastop and McConkey, Longman Scientific and Technical, ISBN-0582305351.

Power Plant Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-2	MEE-318P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Power Plant Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study and Simulate Boiler Internals.
2. To study and simulate Superheater and Reheaters.
3. To study and simulate Regenerative Feed Water Heaters.
4. To study and Simulate Turbine Vaccum system.
5. To draw Heat Balance sheet of a Boiler.
6. To study the working of Gas Turbine Cycle.
7. To study Combined Cycle and determine effect of Pressure ratio on thermal efficiency.
8. To conduct performance test on four-stroke diesel engine.
9. To conduct performance test on four-stroke petrol engine.
10. To conduct performance test on hydraulic power plant.
11. To determine dryness fraction of given steam sample.
12. To study working of Nuclear Power Plant.
13. Visit to thermal/Hydraulic/Nuclear Power Plant.

Power Plant Instrumentation

L	P	C
3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-4	ICE-411T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1. To provide an overview of different methods of power generation and various measurements involved in it.
2. To impart basic knowledge in nuclear and hydro power plant.
3. To Learn thebasic concept of Thermal power plant and power from renewable energy.
4. To provide knowledge about the different types of devices used for analysis.

Course Outcomes (CO)

CO 1	Identify the resources of power generation and implementation.
CO 2	Interpret the knowledgeof nuclear and hydro power plant.
CO 3	Recognise the renewable and non-renewable energy resources.
CO 4	Evaluate the safety, boiler control system as well as recognise various analyzer in power plant

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	2	-	2	3	3	-	-	-	-	3
CO 2	3	2	3	1	2	3	-	3	3	-	-	3
CO 3	3	3	2	2	2	3	2	3	-	-	-	3
CO 4	3	2	3	3	2	3	-	3	3	3	-	3

Unit I

Introduction to Power Generation: Energy sources, energy scenario of India, Classification of renewable and Non-renewable resources, Brief survey of methods of power generation – hydro, thermal, nuclear, solar and wind power. Importance of instrumentation in power generation, thermal power plants, building blocks, details of boiler processes.

Unit II

Nuclear and Hydro Power Plant: Basics of Nuclear Reactors, Nuclear power plant instrumentation, P&I diagram of different types of nuclear power plant, nuclear reactor control systems and allied instrumentation,process sensors for nuclear power plants,Safety and reliability aspects.

Introduction to Hydro power generation: Governing system in hydro power plant, water turbine control, regulation & monitoring of voltage & frequency of output power. Safety and reliability aspects.

Unit III

Thermal power plant and power from renewable energy: Main Equipment: Boiler, Steam turbines, Generator types, Boiler Feed Pump and Condensate Extraction Pump, Deaerators, layout and energy conversion process, Rankine cycle, types of turbines and control, types of generators condensers.
Hydro-electric power plant- classification, typical layout, associated components including turbines. Principle, Construction and working of Wind, Tidal, Solar, Photo voltaic (PV), Geo-Thermal etc.

Unit IV

Analysis of Power Plant: Thermal conductive type, paramagnetic type, hydrogen purity meter-chromatography-PH meter, fuel analyzer, pollution monitoring and control.
Introduction to Turbine monitoring and control, Speed, vibration, shell temperature monitoring and control, cooling system.

Textbooks:

1. P.K. Nag, Power Plant Engineering, Tata McGraw-Hill Education, 3rd edition, 2007.
2. Power Plant Instrumentation, K. Krishnaswamy, M. PonniBala, PHI Learning Pvt. Ltd., 2011.

References:

1. Liptak B.G., Instrumentation in Process Industries, Chilton, 1973.
2. P. Tamilmani, Power Plant Instrumentation, SAMS Publishers, Chennai.
3. David Lindsley, Power-plant Control and Instrumentation: The Control of Boilers and HRSG, Systems, IET, London, 2000.
4. E. L. Wakil, M. M. Power Plant Technology, McGraw Hill, 1984
5. Rajput R.K., A Text book of Power plant Engineering. 5th Edition, Lakshmi Publications, 2013.
6. Elonka, S.M. and Kohal A.L.Standard Boiler Operations, McGraw Hill, New Delhi, 1994.

Power Plant Instrumentation Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-4	ICE-411P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Power Plant Instrumentation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study and Performance of distinct turbines used for Power Plant.
2. To study low pressure boilers and their accessories and mountings.
3. To study high pressure boilers and their accessories and mountings.
4. To study cooling tower and find its efficiency.
5. To find calorific value of a sample of fuel using Bomb calorimeter.
6. Modelling of wind turbine and governor system.
7. Simulation study of effect of Temperature Variation on Photovoltaic Array.
8. Simulation study on Solar PV Energy System.
9. Simulation study on Hybrid (Solar-Wind) Power system.
10. Simulation study on Intelligent controllers for Hybrid energy systems.

Power Quality for Microgrids	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	MT-EAE	MT-EAE-5	MT-423T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To classify quantify and analyse the power quality problems.
2.	To study various standards prescribed on power quality issues.
3.	To impart the knowledge of micro grid features with all its essential components and functions.
4.	Analyze power quality issues and control operation of micro grid and to study compensation techniques.

Course Outcomes (CO)

CO 1	Ability to understand of power quality problems.
CO 2	To impart knowledge about power quality standards and its monitoring.
CO 3	Ability to analyse different micro grid architectures, its features.
CO 4	Ability to apply various operational strategies and control schemes suitable for micro grid using power electronic converters.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	3	2	3	3	1	2	3	2	3
CO 2	2	3	2	2	2	1	3	3	2	3	2	3
CO 3	2	3	2	3	3	1	3	2	2	3	3	3
CO 4	3	3	3	3	3	2	3	2	2	3	3	3

UNIT I

Power Quality - An Introduction: Introduction to power quality, Classification of power quality issues, characterization and problems of electric power quality: poor load power factor, nonlinear and unbalanced loads, transients, sources of voltage fluctuations and interruptions, waveform distortion, power frequency variations, harmonic distortion, harmonics creating loads; characterization of nonlinear loads, fundamentals of harmonics, harmonic sources from commercial loads, effects of harmonic distortion, inter-harmonics, devices for controlling harmonic distortion, harmonic propagation studies in large network - FFT analysis.

UNIT II

Power Quality Standards and Monitoring: Introduction, power quality standards and monitoring, IEEE guidelines and recommendations on power qualities: terminologies, requirements for harmonic control in electric power systems, practices for individual consumers, utilities, monitoring techniques, standards;

compensation techniques of power quality problems, web based power quality monitoring.

UNIT III

Basics of Microgrid: Microgrid: need & application, drivers and benefits, comparison with conventional power system, review of sources of microgrids, typical structure and configuration; energy storage technologies, microgrid layouts, AC and DC microgrids, hybrid layouts, power electronics interfaces in AC and DC microgrids.

Unit IV

Control and Operation of Microgrid: Modes of operation and control of microgrid, grid connected and islanded mode, active and reactive power control, anti-islanding schemes: passive, active and communication based techniques; micro grid communication infrastructure, power quality issues in grid connected and autonomous micro grids, compensation of power quality problems: passive filters, various types, analysis and design; basics of P-Q theory, clarke‘s and park transformations (abc-dq), synchronous reference frame theory (SRF), distortion and voltage unbalance compensation by DVR, hybrid power filters and unified power quality conditioner (UPQC).

Textbook(s):
1. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, "Power Quality Problems and Mitigation Techniques", John Wiley & Sons Limited, 2015.
2. Arindam Ghosh, Gerard Ledwich, “Power Quality Enhancement using custom Power Devices”, Penguin Books Limited.

References:
1. S. Chowdhury, P. Crossley, “Microgrids and Active Distribution Networks”, Institution of Engineering and Technology, 2009
2. Nikos Hatziargyriou, “Microgrids Architectures and Contro”l John Wiley Sons, 2014
3. Gevork B. Gharehpetian, S. Mohammad Mousavi Agah, “Distributed Generation Systems: Design, Operation and Grid Integration”, Butterworth Heinemann, 2017
4. Hassan Bevrani, BrunoFrançois, Toshifumi Ise, “Microgrid Dynamics and Control” John Wiley Sons, 2017
5. Amirnaser Yezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modeling, Control and Applications”, IEEE John Wiley Publications, 2009.

Power Quality for Microgrids Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	MT-EAE	MT-EAE-5	MT-423P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Power Quality for Microgrids) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To design three leg VSC-based three-phase-three-wire DSTATCOM using MATLAB/SIMULINK.
2. To design three leg VSC-based three Phase Four wire DSTATCOM.
3. To design SRF Control based VSC.
4. To design DVR using MATLAB/SIMULINK.
5. To determine performance of synchronous reference frame theory based battery energy system supported DVR.
6. To design photovoltaic based renewable energy System.
7. To design photovoltaic based battery supported renewable energy System.
8. To design wind energy system.
9. To design renewable energy powered micro grid system.
10. To study various renewable energy systems.
11. To study various power quality issues.
12. To study power quality enhancement using custom power devices.

Power System Analysis and Stability	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	PS-EAE	PS-EAE-5	PS-435T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To development the impedance diagram (p.u) and formation of Ybus.
2.	To study the different load flow methods
3.	To study short circuit calculation for symmetrical faults
4.	To study the rotor angle stability of power systems.

Course Outcomes (CO)

CO 1	Draw impedance diagram for a power system network and to understand per unit quantities..
CO 2	Understand the load flow solution of a power system using different methods.
CO 3	Find the fault currents for all types faults to provide data for the design of protective devices
CO 4	Analyze the steady state, transient and dynamic stability concepts of a power system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	2	3	1	2	1	2	2	3	3
CO 2	2	1	2	1	2	2	2	1	2	3	3	2
CO 3	3	2	1	2	2	1	2	1	2	3	3	2
CO 4	3	1	1	2	3	1	2	1	2	1	3	3

UNIT-I

Introduction: Need for system planning and operational studies,Power scenario in India,Power System components,Representation,Single line diagram,Per Unit Quantities,P.U. impedance diagram,P.U. Reactance Diagram ,Network graph, Bus Incidence Matrix, Primitive parameters, Bus Admittance Matrix from primitive parameters ,Representation of off nominal transformer, Formation of bus admittance matrix of large power network.

UNIT-II

Power Flow Studies: Necessity of power flow studies ,Derivation of static power flow equations, Power flow solution using Gauss-Seidel Method,Newton Raphson Method (Rectangular and polar coordinates form,, Decoupled and Fast Decoupled methods ,Algorithmic approach ,Problems on 3–bus system only.

UNIT-III

Symmetrical Component & Fault Analysis: Definition of symmetrical components ,symmetrical components of unbalanced three phase systems,Power in symmetrical components,Sequence impedances: Synchronous generator,Transmission line and transformers,Sequence networks,Various types of faults LG– LL– LLG and LLL on unloaded alternator–unsymmetrical faults on power system for numerical problems only.

UNIT – IV

Power System Stability Analysis: Elementary concepts of Steady state,Dynamic and Transient Stabilities, Description of Steady State Stability Power Limit, Transfer Reactance, Synchronizing Power Coefficient , Power Angle Curve and Determination of Steady State Stability,Derivation of Swing Equation,Determination of Transient Stability by Equal Area Criterion ,Applications of Equal Area Criterion,Methods to improve steady state and transient stability.

Textbook(s):
1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
2. Modern Power system Analysis – by I.J.Nagrath & D .P.Kothari: Tata McGraw Hill, 2nd Edition

References:
1. Power System Analysis – by A.R.Bergen, Prentice Hall, Inc.
2. Power System Analysis by HadiSaadat – TMH Edition.
3. Power System Analysis by B.R.Gupta, Wheeler Publications.
4. Power System Analysis and Design by J.Duncan Glover, M.S.Sarma, T.J. Overbye– Cengage Learning.

Power System Analysis and Stability Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
EAE	7	PS-EAE	PS-EAE-5	PS-435P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Power System Analysis and Stability) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Formation of Bus Admittance and Impedance Matrices using Matlab.
2. Transient Stability Analysis –Multi Machine Infinite Bus Systemusing Matlab using Matlab.
3. Modelling of Transmission line parameters.
4. To study Small Signal Stability analysis of a single machine infinite bus system with field circuit, exciter and power system stabilizer.
5. Measurement of Sinusoidal voltages and currents using Matlab .
6. Simulation of Single Line to Ground fault using Matlab
7. Matlab program to solve Swing Equation using Point by Point method
8. Power flow analysis by Newton-Raphson method and Fast decoupled method using Matlab.
9. Simulation of Line To Line fault Analysis using Matlab.
10. Simulation of Double Line to Ground fault using Matlab.
11. To analyse the effect of transients in a power system using Matlab.
12. Matlab program to formulate Z & Y bus matrix for a four bus system.

Power System Operation and Control	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	PS-EAE	PS-EAE-3	PS-431T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge about the significance of power system operation and control
2.	Design of power frequency controller and real power –frequency interaction
3.	Maintaining the voltage profile against varying system load
4.	Design SCADA and its applications for real time operation

Course Outcomes (CO)

CO 1	Ability to understand the day to day operation of electric power system
CO 2	Analyse the control actions to be implemented in order to meet variations of system demand
CO 3	Ability to understand the real power frequency and reactive power voltage interaction
CO 4	Ability to design SCADA and its applications

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	3	1	1	1	1	2	1	1	2	2	1
CO 2	2	2	2	1	2	2	1	1	1	2	1	1
CO 3	3	2	2	2	1	2	1	1	2	2	1	1
CO 4	1	2	1	1	2	1	2	2	1	1	1	1

UNIT-I

Automatic Generation and Voltage Control: Introduction, Load frequency control (single area case), load frequency (Two Area System) control-tie line modelling, block diagram representation, load frequency control with GRC, Speed Governor Dead Band and its effects.

UNIT-II

Economic Load Despatch: Introduction, Statement of economic dispatch problem- input and output characteristics of thermal plant, System constraint, Economic Dispatch Neglecting losses, Optimum load dispatch including transmission losses, Exact Transmission loss formula, Automatic load dispatching.

UNIT-III

Restructuring of Power System: Introduction, Reason for restructuring or deregulation of power industry, Understanding the restructuring process, introduction to issues involved in deregulation, reasons and objectives of deregulation of various power system across the world, Transmission Congestion management.

UNIT – IV

Reactive Power and Voltage Control: Bases of reactive power control, Excitation System, Operation of transmission line under no load and heavy load condition, Voltage Regulation of transmission line and its relation with reactive power, Modeling. Generation and Absorption of Reactive Power, Relation between voltage, power and reactive power at node, methods of voltage control.

Textbook(s):

1. I.J. Nagrath & D.P. Kothari, Power System Engineering, Mc Graw Hill, 2007.
2. S. Sivanagaraju, Power System Operation and Control, Pearson Education India, 2009.

Reference Books:

1. P.Kundur, Power System Control and Stability, Mc Graw Hill.
2. Power System Stability Volume-I: E.W. Kimbark, John Wiley & Sons.
3. Dr. K. Uma Rao, Power System: Operation and Control, Wiley-India.
4. Loi Lei Lai —Power System Restructuring and deregulation: Trading Performance & Information Technology, John Wiley & Sons.
5. Chakravarti & Halder, Power System Analysis: Operation & control Prentice Hall of India.

Power System Operation and Control Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	PS-EAE	PS-EAE-3	PS-431P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Power System Operation and Control) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To determine sinusoidal voltages and currents.
2. To simulate models of different power system components such as Transmission lines.
3. To determine the parameters of equivalent circuit of transformer from OC SC test data.
4. To obtain step response of rotor angle and generator frequency of a synchronous machine.
5. To obtain the frequency response of single and two area power system using MATLAB.
6. Write a MATLAB program for Swing Equation using point-by-point method.
7. Write a MATLAB program for analysing the small-signal stability of a single machine infinite bus system assuming classical model for the generator.
8. Simulate the model IEEE excitations systems in MATLAB simulink.
9. Modelling of Turbine and Governor System using MATLAB Simulink
10. Modelling of Facts devices using MATLAB Simulink.

Note: The above practical list is based on model. However, Hands on MATLAB/Sim Power System Toolbox simulation based models related to the course contents can be carried out.

Power Systems – II	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	5	PC	PC	EEC-303

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the concepts and constructional features and operation of relays, and protection of generators and transformers
2.	Familiarise students with various protection schemes of transmission lines
3.	Knowledge of fuse and circuit breakers
4.	Explore stability analysis

Course Outcomes (CO)

CO 1	To analyse construction and operating characteristics of protective relays, and protection of generators and transformers
CO 2	Gain knowledge of various methods of prote, transmission lines,
CO 3	Familiarise with the working and applications of fuse and circuit breakers
CO 4	Able to analyse stability of systems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	1	2	3	3	1	1	2	1	3
CO 2	3	3	3	3	3	3	3	3	3	3	2	3
CO 3	3	3	3	3	1	3	1	1	3	3	2	3
CO 4	3	3	3	3	1	1	1	2	3	3	3	3

Unit – I

Classification of Relays: Electromechanical, static and numerical relays: Construction, operating characteristic and their applications.
Protection of Generators and Transformers: Differential Protection, protection of stator windings, rotor earth fault protection, protection against unbalanced loading, loss of excitation and prime mover failure; Protection of motors (induction and synchronous) and bus bars.
Transformer Protection: Types of faults, percentage differential protection, Buchholz relay

Unit – II

Protection of Transmission Lines: Over current protection, Grading of over current relays, distance protection, types of distance relays and their characteristics, carrier current protection, protection against surges, surge diverters, surge absorbers, use of ground wires on transmission lines, methods of grounding

Unit – III

Fuses and Circuit Breakers: Types & Applications of Fuse and MCB, RCCB, ELCB Current interruption theories, types of Circuit Breakers: Air, air-blast, Oil, SF6 and Vacuum circuit breakers-Principle, ratings and applications, HVDC Circuit breaker, Testing of circuit breakers

Unit – IV

Stability and Load Dispatch: Swing equation, steady state stability, equal area criteria, critical clearing angle, point by point method, Load frequency control, load frequency control with GRC, Speed Governor Dead Band and its effects. Load despatch analysis in power system.

Textbooks:

1. Paithanker, Bhide ,"Fundamentals of Power System Protection " PHI 2014
2. BadriRam"Power System Protection and Switchgear" TMH Publications 2nd Edition

References:

1. J. J. Grainger & W.D. Stevenson, "Power System Analysis" TMH Publication, 2003
2. Paul M. Anderson "Power System Protection" IEEE Press.
3. C L Wadhva, "Electrical Power System" Wiley Eastern Ltd., 3rd edition 2000
4. D.P. Kothari and I.J. Nagrath "Modern Power System Analysis " TMH 4th Edition

Power Systems – II Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	5	PC	PC	EEC-351

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Power Systems – II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study single line to Ground fault as practical application in transmission lines. (Using Experimental setup)
2. To study three phase fault as practical application in transmission lines. (Using Experimental setup)
3. To determine the characteristics of the given differential relay and to apply the relay for the protection of a transformer against internal faults. (Using Experimental setup)
4. To study instantaneous over current relay. (Using Experimental setup)
   a. Study the construction of relay.
   b. Study the operating and deoperating of relay.
   c. Study the current vs. time characteristics.
5. To study over voltage relay static type and draw its characteristics. (Using Experimental setup)
6. To study the characteristics of miniature-circuit breaker. (Using Experimental setup)
7. To study the operating characteristics of HRC fuse. (Using Experimental setup)
8. To obtain the characteristics of thermal bimetallic relay. (Using Experimental setup)
9. To study the characteristics of IDMT Earth fault relay. (Using Experimental setup)
10. Simulation based on Network Reduction.

Powerline Carrier Communication	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EEE	6	PCE	PCE-1	EEE-314

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Understand characterization of PLCC
2.	To understand Digital Transmission Techniques used in PLCC
3.	To understand PLC network
4.	Create PLC systems and their implementation

Course Outcomes (CO)

CO 1	Understand characterization of PLCC
CO 2	Understand Digital Transmission Techniques used in PLCC
CO 3	Understand PLC network
CO 4	Create PLC systems and their implementation

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	2	-	2	-	-	-	2	-	1	-
CO 2	2	2	2	-	1	-	-	-	2	-	1	-
CO 3	2	2	2	-	2	-	-	-	1	-	1	-
CO 4	1	1	2	-	2	-	-	-	1	-	1	-

UNIT- I

Channel Characterization: Introduction, channel modelling fundamentals, model for outdoor channel, models for indoor channels, noise and disturbances measuring techniques, PLC channel emulation tools. Coupling: Introduction, filtering basics, transformer and capacitor coupler design, impedance adaptation concepts.

UNIT- II

Digital Transmission Techniques: Introduction, Architecture of PLC system, Narrowband and broadband PLC systems, Modulation and coding for narrow band and broad band PLC systems, Error Handling.

UNIT- III

PLC Networks : Introduction, Organisation and structure of PLC networks, Media Access Control layer, Multiple Access Schemes, Protocols for PLC, Traffic control, Supporting Energy Management Systems, Quality of service(QOS), International standards on PLC networking Technology .

UNIT-IV

Systems and Implementations: PLC smart grid systems, PLC broadband Access systems, Multimedia PLC systems, DC-PLC systems, PLC in emerging countries

Textbooks:

1. Hendrik C. Ferreira, Lutz Lampe John Newbury, TheoG.Swart,"PLC: Theory and Applications for narrow band and broad band communication over power lines". Wiley and Sons.
2. Halid Hrasnica, Abdelfatteh Haidine, Ralf Lehnert,"Broad Band Power line Communications: Network Design" Wiley and sons.

References:

1. Gilbert Held, "Understanding Broadband over Power line", Auerbach Publications

Pressure Vessels and Piping Technology	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	DMS-EAE	DMS-EAE-5	DMS-423T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To give exposure to engineering problems involved in the design of pressure vessel
2.	To learn about the tests and analysis for various components of pressure vessels.
3.	To familiarize the buckling and fracture analysis of pressure vessel under various load conditions.
4.	To acquire knowledge of piping, piping layout and designing of pipes.

Course Outcomes (CO)

CO 1	Acquire skills to design pressure vessels.
CO 2	Demonstrate the skills to test and analyze various components of pressure vessels.
CO 3	Familiarized to the buckling and fracture analysis of pressure vessel under various load conditions.
CO 4	Acquire adequate knowledge of piping, piping layout and designing of pipes.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	-	2	-	-	-	-	-	2
CO 2	3	2	2	3	-	3	-	-	-	-	-	2
CO 3	2	2	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	2	3	-	3	-	-	--	-	-	2

UNIT- I

Introduction- Methods for determining stresses Terminology and Ligament Efficiency and applications. Stresses in a circular ring, cylinder Membrane stress Analysis of Vessel Shell components, Cylindrical shells, spherical Heads, conical heads, Thermal Stresses, Discontinuity stresses in pressure vessels.

UNIT- II

Bending of circular plates and determination of stresses in simply supported and clamped circular plate. Stress concentration in plate having circular hole due to bi-axial loading, Excessive elastic deformation, Plastic instability, Brittle rupture and creep. Theory of reinforced opening and reinforcement limits, design of composite analysis, wind and seismic load consideration in the design of pressure vessel

UNIT- III

Buckling phenomenon, Elastic Buckling of circular ring and cylinders under external pressure, collapse of thick walled cylinders or tubes under external pressure, Effect of supports on Elastic Buckling of Cylinders, Buckling under combined External pressure and axial loading

UNIT- IV

Flow diagram, piping layout and piping stress analysis; Flexibility factor and stress intensification factor; Design of piping system as per B31.1 piping code. Piping components - bends, tees, bellows and valves. Types of piping supports and their behaviour; Introduction to piping Codes and Standards.

Textbooks:
1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 1987.
2. Dennis K. Williams, James F. McCabe, Dominique Moinereau, "Pressure Vessels and Piping Division", American Society of Mechanical Engineers, 2003.

Referencess:
1. Brownell L. E & Young. E. D, "Process equipment design", Wiley Eastern Ltd., India.
2. Smith P, "Fundamentals of Piping Design", Elsevier.
3. Henry H Bednar, "Pressure vessel Design Hand book", CBS Publishers and Distributors.

Pressure Vessels and Piping Technology Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	DMS-EAE	DMS-EAE-5	DMS-423P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Pressure vessels and Piping Technology) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Rectangular & Circular Plate bending analysis using FEA
2. Determination of shear centre for thin walled cellular structure and its FEA
3. Analysis of cylinder subjected to internal and/or external pressure
4. Shrink fitted Rotating Disk Analysis
5. Analysis of Elastic Buckling of circular ring and cylinders under external pressure
6. Stress Analysis of piping components (bends, tees, bellows and valves) using FEA
7. Unsymmetrical Bending Analysis for different sections of beam
8. Determining Flexibility factor and stress intensification factor for suitable pipe design
9. Design of piping system as per B31.1 piping code
10. Contact stress analysis with Cylinder to Cylinder, Sphere to flat face, Cylinder to Sphere in contact

Principles of Entrepreneurship Mindset	L	P	C
	2		2

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
All	7	HS/MS	MS	MS-401

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand basic aspects of establishing a business in a competitive environment
2.	To apply the basic understanding to examine the existing business ventures
3.	To examine various business considerations such as marketing, financial and teaming etc.
4.	To assess strategies for planning a business venture

Course Outcomes (CO)

CO 1	Understand basic aspects of establishing a business in a competitive environment
CO 2	Apply the basic understanding to examine the existing business ventures
CO 3	Examine various business considerations such as marketing, financial and teaming etc.
CO 4	Assessing strategies for planning a business venture

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	1	2	-	2	-	-	1	2	3	2
CO 2	2	2	1	2	-	2	-	-	1	2	3	2
CO 3	2	2	1	2	-	2	-	-	1	2	3	2
CO 4	2	2	1	2	-	2	-	-	1	2	3	2

UNIT-I

Entrepreneurial perspective: Foundation, Nature and development ofentrepreneurship, importance of entrepreneurs,Entrepreneurial Mind, Individual entrepreneur Typesof entrepreneurs, Entrepreneurship in India

UNIT-II

Beginning Considerations: Creativity and developing business ideas; Creatingand starting the venture; Building a competitiveadvantage; Opportunity recognition, Opportunityassessment; Legal issues

UNIT-III

Developing Financial Plans: Sources of Funds,Managing Cash Flow,Creating a successful Financial PlanDeveloping a business plan

UNIT - IV

Developing Marketing Plans: Developing a powerful Marketing Plan, E-commerce,Integrated Marketing Communications
Leading Considerations: Developing Team, Inviting candidates to join team,Leadership model

Textbook(s):
1. Robert D Hisrich, Michael P Peters & Dean A Shepherd, "Entrepreneurship" 10th Edition,McGraw Hill Education, 2018

References:
1. Norman M. Scarborough and Jeffery R. cornwell, "Essentials of entrepreneurship and small business management" 8th Edition, Pearson, 2016
2. Rajiv Roy, "Entrepreneurship", 2nd Edition, Oxford University Press, 2011
3. Sangeeta Sharma, "Entrepreneurship Development", 1st Edition, Prentice-Hall India, 2016
4. John Mullins, "The New Business Road Test: What entrepreneurs and investors should dobefore launching a lean start-up" 5th Edition, Pearson Education, 2017
5. Charantimath, Entrepreneurship Development and Small Business Enterprise, Pearson Education.

Principles of Management for Engineers	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
All	6	HS/MS	MS	MS-302

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To describe the functions, roles and skills of managers and illustrate how the manager’s job is evolving.
2.	To evaluate approaches to goal setting, planning and organizing in a variety of circumstances.
3.	To evaluate contemporary approaches for staffing and leading in an organization
4.	To analyze contemporary issues in controlling for measuring organizational performance.

Course Outcomes (CO)

CO 1	Examine the relevance of the political, legal, ethical, economic andcultural environments in global business
CO 2	Evaluate approaches to goal setting, planning and organizing in a variety of circumstances.
CO 3	Evaluate contemporary approaches for staffing and leading in an organization
CO 4	Analyze contemporary issues in controlling for measuring organizational performance.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	1	2	-	2	-	-	1	2	3	2
CO 2	2	2	1	2	-	2	-	-	1	2	3	2
CO 3	2	2	1	2	-	2	-	-	1	2	3	2
CO 4	2	2	1	2	-	2	-	-	1	2	3	2

UNIT-I

Introduction to Managers and Management: Management an Overview: Introduction, Definition ofManagement, Role of Management, Functions of Managers,Levels of Management, Management Skills andOrganizational Hierarchy, Social and EthicalResponsibilities of Management: Arguments for and againstSocial Responsibilities of Business, Social Stakeholders,Measuring Social Responsiveness and Managerial Ethics,Omnipotent and Symbolic View, Characteristics andimportance of organizational culture, Relevance of political,legal, economic and Cultural environments to globalbusiness, Structures and techniques organizations use asthey go international .

UNIT-II

Planning: Nature & Purpose, Steps involved in Planning, Objectives, Setting Objectives, Process of Managing by Objectives, Strategies, Policies & Planning Premises, CompetitorIntelligence, Benchmarking, Forecasting, Decision-Making.

Directing: Scope, Human Factors, Creativity and Innovation,Harmonizing Objectives, Leadership, Types of Leadership,Directing, Managers as leaders, Early LeadershipTheories…Trait Theories, Behavioral Theories, ManagerialGrid, Contingency Theories of Leadership, Directing ...PathGoal Theory, contemporary views of Leadership, CrossCultural Leadership, Leadership Training, Substitutes ofLeadership

UNIT-III

Organizing: Organizing ,Benefits and Limitations-De-Centralization andDelegation of Authority, Authority versus Power,Mechanistic Versus Organic Organization ,CommonOrganizational Designs, Contemporary OrganizationalDesigns and Contingency Factors, The LearningOrganization Nature and Purpose, Formal and InformalOrganization, Organization Chart, Structure and Process,Departmentalization by difference strategies, Line and Staffauthority- Benefits and Limitations-De-Centralization andDelegation of Authority Versus, Staffing,Human ResourceInventory, Job Analysis , Job Description, Recruitment and

UNIT - IV

Controlling: Controlling, Introduction to Controlling System and processof Controlling, Requirements for effective control, Theplanning Contol link, The process of control, types ofcontrol The Budget as Control Technique, InformationTechnology in Controlling, Productivity, Problems andManagement, Control of Overall Performance, Direct andPreventive Control, Financial Controls, Tools formeasuring organizational Performance, Contemporaryissues in control Workplace concerns, employee theft,employee violence

Textbook(s):

1. Tripathi PC. Principles of management. Tata McGraw-Hill Education; 6th Edition 2017.

References:

1. Koontz H, Weihrich H. Essentials of management: an international, innovation, and leadershipperspective. McGraw-Hill Education; 10th Edition 2018.
2. Principles of Management Text and Cases, Pravin Durai , Pearson ,2015
3. Robbins, S.P. &Decenzo, David A. Fundamentals of Management,7th ed., Pearson, 2010
4. Robbins, S.P. & Coulter, Mary Management; 14 ed.,Pearson , 2009

Principles of Programming Languages	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	6	PCE	PCE-1	CIE-320

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand and describe syntax and semantics of programming languages.
2.	To understand Data, Data types, and Bindings
3.	To learn the concepts of functional and logical programming
4.	To explore the knowledge about concurrent Programming paradigms.

Course Outcomes (CO)

CO 1	Describe syntax and semantics of programming languages
CO 2	Explain data, data types, and basic statements of programming languages
CO 3	Design and implement subprogram constructs, Apply object - oriented, concurrency, pro and event handling programming constructs
CO 4	Develop programs in various programming languages

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1		3	-	-	-	2	-	2	-	-	3	2
CO 2		-	2	-	-	-	2	-	-	3	-	-
CO 3	-	-	-	2	3	-	-	3	-	-	2	-
CO 4	3	-	3	-	-	3	3	-	3	-	-	3

UNIT-I

Introduction: Syntax, semantics and pragmatics; Formal translation models, Variables, Expressions & Statements, Binding time spectrum; Variables and expressions; Assignment; I-values and r-values; Environments and stores; Storage allocation; Constants and initialization; Statement-level control structure.

UNIT-II

Primitive Types: Pointers; Structured types; Coercion; Notion of type equivalence; Polymorphism: overloading, inheritance, type parameterization, Abstract data types; Information hiding and abstraction; Visibility, Procedures, Modules, Classes, Packages, Objects and Object-Oriented Programming.

UNIT-III

Storage Management: Static and dynamic, stack-based, and heap-based storage management. Sequence

Control: Implicit and explicit sequencing with arithmetic and non-arithmetic expressions; Sequence control between statements. Subprogram Control: Subprogram sequence control, data control and referencing environments; parameter passing; static and dynamic scope; block structure.

UNIT-IV

Concurrent Programming: Concepts, Communication, Deadlocks, Semaphores, Monitors, Threads, Synchronization. Logic programming: Introduction; Rules, Structured Data and Scope of the variables; Operators and Functions; Recursion and recursive rules; Lists, Input and Output; Program control; Logic Program design.

Textbooks:

1. Programming Languages – Pratt T.V. (Pearson Ed).
2. Introduction to Programming Languages: Programming in C, C++, Scheme, Prolog, C# and SOA – Chen Y., Tsai W-T. (Kendall).
3. Programming Languages: Design & Implementation – Pratt T.W., Zelkowski M.V. (PHI). [4] Programming Languages, Adesh K Pandey, Narosa Publishing House

References:

1. Programming Languages: Principles and Practice – Louden K.C. (Addision-Wesley).
2. Programming languages – Grover P.S. (S. Chand).
3. Programming Languages: Principles and Paradigms - Tucker A., Noonan R. (TMH).

Privacy and Security in Wireless Networks	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	WMC-EAE	WMC-EAE-5	WMC-459

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide overview of different network attacks, vulnerabilities and privacy issues in wireless networks.
2.	To understand detection and prevention mechanisms for different attacks in the wireless networks.
3.	To understand basic concepts of cryptography.
4.	To impart the knowledge of security models for Wi-Fi, LTE, WLAN, Bluetooth etc. based networks.

Course Outcomes (CO)

CO 1	Able to understand the various types of attacks in wireless networks, its vulnerabilities and privacy issues.
CO 2	Able to understand, analyze & apply detection and prevention mechanisms for different attacks in the wireless networks.
CO 3	Able to understand & apply basic concepts of cryptography & cryptography algorithms.
CO 4	Able to understand & analyze security issues, architectures & standards for Wi-Fi, 3G, 4G LTE, WLAN etc. based networks.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	2	1	1	1	1	1	-	1	-	3
CO 2	2	3	2	2	2	2	1	2	-	1	1	3
CO 3	3	3	1	2	3	1	1	2	-	2	1	3
CO 4	1	2	3	2	1	2	2	1	2	3	1	3

UNIT I

Key requirements for secure communication such as authenticity, confidentiality etc., design principles or process phases for security systems, basic elements of wireless security such as authentication, encryption etc.; emerging privacy concerns such as location & tracking; firewall building- Interception, denial of service (DOS) & distributed DOS (DDOS) attacks, different types of DDOS & other attacks, intrusion detection systems for DDOS attacks & comparison with firewall technology, DDOS defense mechanisms, intrusion prevention systems mechanisms, security issues comparison for Wi-Fi and cellular data networks, security threats & features in logical OSI layers.

UNIT II

Basic cryptographic concepts – Kerchoff's principles, cryptographic functions, cryptographic methods for securing systems, symmetric encryption methods, hash functions, public-key cryptography, cryptanalysis & deception attack approaches.

UNIT III

Key elements of 3G & 4G architecture (a review), 3GPP systems, Introduction to LTE standardization, security features required in GSM, SIM cloning, GSM security mechanism – subscriber authentication in GSM, GSM & GPRS encryption, subscriber identity confidentiality, limitations or weaknesses of GSM security, 3G security: major principles, 3G security mechanisms, overview of 3G cryptographic algorithms, handovers between GSM & 3G from security perspective, network domain security (NDS) architecture.

UNIT IV

3G-WLAN Interworking: Extensible Authentication Protocol (EAP) framework – Architectural model, role of link layer security, security mechanisms of WLAN direct IP access & WLAN 3GPP IP access; Evolved-packet-system (EPS) overview, EPS security threats & features, security requirements for the base station platforms; Overview of WEP, WAP & Bluetooth security models; security issues for VOIP.

Textbooks:

1. John R. Vacca, "Guide to Wireless Network Security", Springer, NY, 2006.
2. Dan Forsberg, Günther Horn, Wolf-Dietrich Moeller, Valtteri Niemi, "LTE Security", 2nd Edition, John Wiley and Sons Ltd., 2013.

References:

1. Randall Nichols, Panos Lekkas, "Wireless Security: Models, Threats, and Solutions", McGraw-Hill, 2000.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security: Private Communication in a Public World (2nd Edition)", Prentice Hall, 2002.
3. Kaveh Pahlavan and Prashant Krishnamurthy, "Principles of Wireless Networks: A Unified Approach", Prentice Hall, 2006.
4. William C. Y. Lee, "Mobile Communications Engineering: Theory and Applications", 2nd Edition, McGraw Hill Telecommunications, 1998.

Privacy and Security issues in IoT	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-IoT	7	PC	PC	IOT-449T
EAE	7	IOT-EAE	IOT-EAE-5C	IOT-449

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To know the state-of-the-art methodologies in Cyber Physical system
2.	To impart knowledge on Model threats and countermeasures.
3.	To explore the Privacy Preservation and Trust Models in Internet of Things (IoT)
4.	To apply the concept of Internet of Things Security in the real-world scenarios

Course Outcomes (CO)

CO 1	Ability to understand the Security requirements in IoT.
CO 2	Understand the cryptographic fundamentals for IoT
CO 3	Ability to understand the authentication credentials and access control
CO 4	Understand the various types Trust models and Cloud Security.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	2	-	1	-	1	-	-	-	2	-	2
CO 2	2	1	1	-	-	2	-	-	2	-	2	-
CO 3	-	1	-	-	3	1	-	-	-	1	-	2
CO 4	1	-	2		2	-	1	-	-	2	-	1

UNIT-I

Securing the Internet of Things: Security Requirements in IoT Architecture - Security in Enabling Technologies - Security Concerns in IoT Applications. Security Architecture in the Internet of Things -Security Requirements in IoT - Insufficient Authentication/Authorization – Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT. Vulnerabilities – Secrecy and Secret-Key Capacity - Authentication/Authorization for Smart Devices - Transport Encryption – Attack & Fault trees

UNIT-II

Cryptographic Fundamentals for IOT: Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes –Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IoT messaging and communication protocols – IoT Node Authentication

UNIT-III

Identity & Access Management Solutions for IOT: Identity lifecycle – authentication credentials – IoT IAM infrastructure – Authorization with Publish / Subscribe schemes – access control

UNIT - IV

Cloud Security for IOT: Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing

Textbook(s):
1. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations

References:
1. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren
2. Securing the Internet of Things Elsevier

Process Control	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-1	ICE-306T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce technical terms and nomenclature associated with Process control domain.
2.	To understand concepts of PID controller as well as different modes of controllers.
3.	To illustrate several forms of control methods, including model-based control, feed-forward control, and cascade control.
4.	To impart the knowledge of compensators and multi-loop controllers.

Course Outcomes (CO)

CO 1	Understand the basic concepts of process control and their static and dynamic behaviour
CO 2	Design and tuning of classical controller and test their response under various test inputs.
CO 3	Implementation of feedback control processes and its dynamic behaviour.
CO 4	Apply the concepts of cascade control, split and ratio control to distinct process applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	2	1	2	-	-	-	-	-	-	3
CO 2	3	3	-	3	3	-	2	-	3	2	3	3
CO 3	3	3	-	3	3	-	2	3	-	-	-	3
CO 4	3	2	3	3	3	3	-	3	3	3	-	3

Unit I

Introduction to Process Control System: Incentives of Process control system,Design aspects of process control systems. Dynamic and modelling of distinct processes: self-regulating, interacting, and non-interacting processes. Dynamic behaviour of First order system, second order system and higher –order systems. Process lag, load disturbance and their effect on processes.

UNIT – II

Controller Modes: Basic control action, two position, multi-position, floating control modes. Continuous controller modes: proportional, integral, derivative. Composite controller modes: P-I, P-D, P-I-D, Integral wind-up, and prevention. Response of controllers for different test inputs

UNIT - III

Introduction to Feedback Control: Dynamic Behaviour of feedback-controlled processes, stability Analysis of feedback systems. Design problems of controllers, Selection of type of feedback controller, time–Integral performance criterion, Process Reaction Curve and frequency response characteristic, Ziegler-Nichol Rule, effect of dead time, dead time compensator and inverse response compensator.

UNIT – IV

Study of Multiple Loops Controller: Cascade Control System, Selective control system, Split Range Control, Feed forward and Ratio control, Adaptive and Inferential control systems. Interaction and De-coupling of control loops, relative gain array and selection of the loops.

Textbooks:
1. G. Stephanopoulos, Chemical Process Control-An Introduction to Theory and Practice. PHI, 3rd Ed, 2008.
2. B.W. Bequette, Process Control Modeling, Design and Simulation. PHI, 2004.

References:
1. Curtis Johnson, “Process Control Instrumentation Technology”, 8th Ed., Pearson, New Delhi.
2. D. E. Seborg, T. F. Edgar, and D. A. Mellichamp, “Process Dynamics and Control”, 2nd ed., Wiley.
3. B. G. Liptak, “Process Measurement and Analysis”, 4th edition. Instrument Engineer’s HandBook, CRC Press
4. F. G. Shinskey, “Process Control System”, McGraw-Hill.

Process Control Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-1	ICE-306P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Process Control) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To implement SILO Control using PLC.
2. To control the PH of reaction Vessel using PLC.
3. To Control the operation of Bottling plant using PLC.
4. To control a chemical process using PLC.
5. To control the operation of Washing Machine using PLC.
6. To implement cascade control using Process Control Trainer.
7. To study the operation of PID Control using Process control Trainer.
8. To implement feed forward control using Process Control Trainer.
9. To implement ON-OFF control using Process Control Trainer.
10. To study the characteristics of Control Valve using Process Control Trainer.

Process Control	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	6	PCE	PCE-3	EEE-360
OAE	7	ICE-OAE	ICE-OAE-3	OICE-433

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce technical terms and nomenclature associated with Process control domain.
2.	To understand concepts of PID controller as well as different modes of controllers.
3.	To illustrate several forms of control methods, including model-based control, feed-forward control, and cascade control.
4.	To impart the knowledge of PLC, SCADA, DCS and multi-loop controller.

Course Outcomes (CO)

CO 1	Understand the basic concepts of process control and their static and dynamic behaviour
CO 2	Apply the concepts of PLC, SCADA and DCS to distinct process applications.
CO 3	Implementation of feedback control processes and its dynamic behaviour.
CO 4	Designing and tuning of classical controller and test their response under various test inputs.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	2	1	2	-	-	-	-	-	-	3
CO 2	3	3	-	3	3	-	2	-	3	2	3	3
CO 3	3	3	-	3	3	-	2	3	-	-	-	3
CO 4	3	2	3	3	3	3	-	3	3	3	-	3

Unit I

Introduction to Process Control System: Incentives of Process control system,Design aspects of process control systems. Dynamic and modelling of distinct processes: self-regulating, interacting, and non-interacting processes. Dynamic behaviour of First order system, second order system and higher –order systems. Process lag, load disturbance and their effect on processes.

UNIT – II

Controller Modes: Basic control action, two position, multi-position, floating control modes. Continuous controller modes: proportional, integral, derivative. Composite controller modes: P-I, P-D, P-I-D, Integral wind-up, and prevention. Response of controllers for different test inputs. Selection of control modes for processes like level, pressure, temperature, and flow.

UNIT - III

Introduction to Feedback Control: Dynamic Behaviour of feedback-controlled processes, stability Analysis of feedback systems. Design problems of controllers, Selection of type of feedback controller, time–Integral performance criterion, Process Reaction Curve and frequency response characteristic, Ziegler-Nichol Rule, effect of dead time, dead time compensator and inverse response compensator.

UNIT – IV

Study of Multiple Loops Controller: Cascade Control System, Selective control system, Split Range Control, Feed forward and Ratio control, Adaptive and Inferential control systems.Interaction andDe-coupling of control loops, relative gain array and selection of the loops.
Introduction to Programmable Logic Controller (PLC), Supervisory Control & Data Acquisition (SCADA) Systems, Distributed Control System (DCS).

Textbooks:
1. G. Stephanopoulos, Chemical Process Control-An Introduction to Theory and Practice. PHI, 3rd Ed, 2008.
2. B.W. Bequette, Process Control Modeling, Design and Simulation. PHI, 2004.

References:
1. Curtis Johnson, “Process Control Instrumentation Technology”, 8th Ed., Pearsoned.
2. D. E. Seborg, T. F. Edgar, and D. A. Mellichamp, “Process Dynamics and Control”, 2nd ed., Wiley.
3. B. G. Liptak, “Process Measurement and Analysis”, 4th edition. Instrument Engineer’s HandBook, CRC Press
4. F. G. Shinskey, “Process Control System”, McGraw-Hill.

Programming in C for Embedded Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	ES-EAE	ES-EAE-3A	ES-401T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Apply embedded C programming and its salient features for embedded systems
2.	Illustrate the software and hardware architecture for 8051miccrocontroller in embedded systems.
3.	Develop a solution for problems by using the concept learnt in programming using the embedded controllers
4.	Develop simple applications with 8051 by using its various features and interfacing with various external peripherals.

Course Outcomes (CO)

CO 1	Apply embedded C programming and its salient features for embedded systems
CO 2	Illustrate the software and hardware architecture for 8051miccrocontroller in embedded systems.
CO 3	Develop a solution for problems by using the concept learnt in programming using the embedded controllers
CO 4	Develop simple applications with 8051 by using its various features and interfacing with various external peripherals.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	-	-	-	2	-	-	2	-	3
CO 2	3	2	-	-	-	-	2	-	-	2	-	3
CO 3	3	3	2	2	-	-	3	-	2	3	2	3
CO 4	3	3	3	3	-	-	3	-	3	3	3	3

Unit I

Characteristics of embedded systems and Embedded C: Embedded System, applications and purpose of embedded systems, Categories of embedded systems Difference between C and Embedded C , Embedded Compiler, Embedded C program structure, Control Structure in Embedded C.

Unit II

Programming Embedded C: Inputs and Outputs in embedded C, Operations, Conditional Statements, Arrays, Pointers and String Basics, Functions and Loops, Variables, Types, Constants, and Expressions, Structures and Unions, Arithmetic operations in Embedded C.

Unit III

8051 Microcontroller: 8051 Microcontroller, Architecture, Timers, Interrupts, Serial communication, I/O programming in 8051, Logic operations in 8051, Data conversion program in 8051 Accessing code ROM space in 8051, Data serialization using 8051.

Unit IV

Peripherals Interfacing and Development Environment: ADC interfacing, DAC interfacing, Sensor interfacing-Temperature Sensor Interfacing (LM35), LCD interfacing, Stepper motor interfacing. Development and Debugging Tools: Software and Hardware tools like Cross-Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyzer etc.

Textbooks:

1. Michael J Pont, “Embedded C”, Addison-Wesley, An imprint of Pearson Education, 2002.
2. Rajkamal, ‘Embedded system-Architecture, Programming, Design’, TataMcgraw Hill, 2011

References:

1. Muhammad Ali Mazidi, 8051 Microcontrollers, Pearson, 2006

Programming in C for Embedded Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	ES-EAE	ES-EAE-3A	ES-401P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Programming in C for Embedded Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Configure timer control registers of 8051 and develop a program to generate given time delay.
2. Port I/O: Use one of the four ports of 8051 for O / P interfaced to eight LED’s. Simulate binary counter (8 bit) on LED’s.
3. Serial I/O: Configure 8051 serial port for asynchronous serial communication with serial port of PC exchange text messages to PC and display on PC screen. Signify end of message by carriage return.
4. Interface 8051 with D/A converter and generate square wave of given frequency on oscilloscope.
5. Interface 8051 with D/A converter and generate triangular wave of given frequency on oscilloscope.
6. Using D/A converter generate sine wave on oscilloscope with the help of lookup table stored in data area of 8051.
7. Interface Stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clock wise direction.
8. Design a Minor project to generate traffic signal using 8051 Microcontroller.
9. Design a Minor project to build Temperature controller.
10. Write a C program to perform addition of ten consecutive numbers stored at 1000H onwards

Programming in Java

L	P	C
3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	CSE-OAE	CSE-OAE-2B	OCSE-342T
OAE	6	SD-OAE	SD-OAE-1C	OSD-332T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand and gain knowledge of characteristics of Java, JVM, instruction set, control flow, programming and the sandbox model.
2.	To learn the Java programming, use of exceptional handling and inheritance.
3.	To understand threads, thread synchronization, AWT components and event handling mechanism.
4.	To understand the concepts of I/O streams, JDBC, object serialization, sockets, RMI, JNI, Collection API interfaces, Vector, Stack, Hash table classes, list etc.

Course Outcomes (CO)

CO 1	Ability to understand the compilation process of Java, role of JVM as an emulator and various types of instructions.
CO 2	Ability to learn and apply concepts of Java programming, exceptional handling and inheritance.
CO 3	Ability to understand the use of multi-threading, AWT components and event handling mechanism in Java.
CO 4	Ability to understand the concepts of I/O streams, IDBC, object serialization, sockets, RMI, JNI, Collection API interfaces, Vector, Stack, Hash table classes, list etc.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT-I

Overview and characteristics of Java, Java program Compilation and Execution Process Organization of the Java Virtual Machine, JVM as an interpreter and emulator, Instruction Set, class File Format, Verification, Class Area, Java Stack, Heap, Garbage Collection. Security Promises of the JVM, Security Architecture and Security Policy. Class loaders and security aspects, sandbox model

UNIT-II

Java Fundamentals, Data Types & Literals Variables, Wrapper Classes, Arrays, Arithmetic Operators, Logical

Operators, Control of Flow, Classes and Instances, Class Member Modifiers Anonymous Inner Class Interfaces and Abstract Classes, inheritance, Package, throw and throws clauses, user defined Exceptions, The String Buffer Class, tokenizer, applets, Life cycle of applet.

UNIT-III

Threads: Creating Threads, Thread Priority, Blocked States, Extending Thread Class, Runnable Interface, Starting Threads, Thread Synchronization, Synchronize Threads, Sync Code Block, Overriding Synced Methods, Thread Communication, wait, notify and notify all.
AWT Components, Component Class, Container Class, Layout Manager Interface Default Layouts, Insets and Dimensions, Border Layout, Flow Layout, Grid Layout, Card Layout Grid Bag Layout AWT Events, Event Models, Listeners, Class Listener.

UNIT – IV

Input/Output Stream, Stream Filters, Buffered Streams, Data input and Output Stream, Print Stream Random Access File, JDBC (Database connectivity with MS-Access, Oracle, MS-SQL Server),
Collection API Interfaces, Vector, stack, Hashtable classes, enumerations, set, List, Map, Iterators.

Textbook(s):

1. Patrick Naughton and Herbertz Schidt, “Java-2 the Complete Reference”,TMH
2. Kathy Sierra & Bert Bates, “Head First Java”, O'Reilly.

References:

1. E. Balaguruswamy, “Programming with Java”, TMH
2. Horstmann, “Computing Concepts with Java 2 Essentials”, John Wiley.
3. Decker & Hirshfield, “Programming Java”, Vikas Publication.

Programming in Java Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	CSE-OAE	CSE-OAE-2B	OCSE-342P
OAE	6	SD-OAE	SD-OAE-1C	OSD-332P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Programming in Java) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a java program to implement stack and queue concept.
2. Write a java program to produce the tokens from given long string.
3. Write a java package to show dynamic polymorphism and interfaces.
4. Write a java program to show multithreaded producer and consumer application.
5. Create a customized exception and also make use of all the 5 exception keywords.
6. Convert the content of a given file into the uppercase content of the same file.
7. Write a program in java to sort the content of a given text file.
8. Develop an analog clock using applet.

Programming in Linux Environment	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OSD-455T
OAE	7	SD-OAE	SD-OAE-5B	OSD-455T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand and make effective use of Linux utilities and Shell scripting language (bash) to solve problems.
2.	To implement in C some Standard Linux utilities such as ls, mv, cp, etc. using system calls, file and directory commands.
3.	To develop the skills necessary for systems programming including process and signal management.
4.	To develop the basic skills of inter process communication and write network programs using sockets.

Course Outcomes (CO)

CO 1	Understand the role of Linux utilities and apply shell scripting to solve problems.
CO 2	Ability to run basic linux utilities, file and directory commands.
CO 3	Ability to understand process environment and signals.
CO 4	Ability to understand interprocess communication and socket programming.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	-	2	-	-	-	-	-	-	2
CO 2	3	2	-	-	2	-	-	-	-	-	-	2
CO 3	3	2	-	-	2	-	-	-	-	-	-	2
CO 4	3	3	-	-	2	-	-	-	-	-	-	2

UNIT-I

Linux Utilities: File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text Processing utilities and backup utilities.

sed- scripts, operation, address, commands, applications, awk- execution, fields and records, scripts, operations, patterns, actions, associative arrays, string and mathematical functions, system commands in awk, applications.

Shell programming with the Bourne again shell(bash): Introduction, shell responsibilities, pipes and Redirection, Here documents, Running a shell scripts, The shell as a programming language, Shell meta characters, File name substitution, Shell variables, Command substitution, Shell commands, The environment, Quoting, Test command, control structures, arithmetic in shell, shell script examples, interrupt processing, functions, debugging shell scripts

UNIT-II

Files and Directories: File Concept, File types, File system Structure, File meta data – Inodes, Kernel support for files, System calls for I/O operations – open, create, read, write, lseek, dup2. File status information – stat family, file and record locking, fcntl function, Links – Soft links & hard links – symlink, link, unlink.
Directories – creating, removing, changing directories – mkdir, rmdir, chdir, obtaining current working directory – getcwd, directory contents, scanning directories – opendir, readdir, closedir, rewinddir functions.

UNIT-III

Process: Process concepts, layout of C program image in main memory, process environment –environment list, environment variables, getenv, setenv, Kernel support for process, process identification, process control-process creation. Replacing a process image, Waiting for a process, process termination, zombie process, orphan process, system call interface form process management – fork, vfork, exit, wait, waitpid, exec family, process groups, session and controlling terminal, difference between threads and processes.
Signal- Introduction to signals, Signal generation and handling, Kernel support for signal, Signal function, unreliable signals, reliable signals, Kill, raise, alarm, pause, abort, sleep functions.

UNIT - IV

Interprocess Communications:- Introduction to IPC, IPC between processes on a single computer, IPC between processes on different systems, pipes – creating, IPC between related processes using Unnamed Pipes, FIFOs – creation, IPC between unrelated processes using FIFO (named pipes), difference between named and unnamed pipes, popen and pclose library functions.
Message Queues – kernel support for messages, APIs for Message Queues, client/server examples.
Semaphores – Kernel support for semaphores, APIs for semaphores, FILE locking with semaphores.
Sockets**:** Introduction to Berkeley Sockets, IPC over a network, client/server model, Sockets Address Structure(UNIX Domain & Internet Domain),]

Textbook(s):
1. Unix System Programming using C++, T. Chan, PHI,(UNIT III to UNIT VIII)
2. Unix Concepts and Applications, 4th Edition, Sumitabha Das, TMH.
3. Beginning Linux Programming, 4th Edition, N.Matthew, R.Stones, Wrox, Willey India Edition.

References:
1. Linux System Programming. Robert Love, O’Reilly, SPD.
2. Advanced Programming in the Unix environment, 2nd Edition, W.R.Stevens, Pearson Education.
3. Unix Network Programming, W.R.Steven, PHI.
4. Unix for Programming and users, 3rd Edition, Graham Glass, King Ables, Pearson Edition.
5. Unix and Shell Programming, B.A.Forouzan and R.F.Koretsky, S.A.Sarawar, Pearson edition.

Programming in Linux Environment Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OSD-455P
OAE	7	SD-OAE	SD-OAE-5B	OSD-455P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Programming in Linux Environment) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. a) Study of Unix/Linux general purpose utility command list man, who, cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown.

   b) Study of vi editor.

   c) Study of Bash shell, Bourne shell and C shell in Unix/Linux operating system.

   d) Study of Unix/Linux file system (tree structure).
2. Write a C program to emulate the UNIX ls –l command.
3. Write a C program that illustrates how to execute two commands concurrently with a command pipe. Ex: - ls –l | sort.
4. Write a shell script to count lines, words & characters in its input. (do not use wc).
5. Implement message queue form of IPC.
6. Write a shell script to compute GCD & LCM of two numbers.
7. Write a shell script to find whether a given number is prime2.
8. Write a C program that makes a copy of a file using standard I/O, and system calls.
9. Write a C program that illustrates two processes communicating using shared memory.
10. Write shell script for-
    a) Showing the count of users logged in
    b) Printing Column list of files in your home directory.
    c) Listing your job with below normal priority
11. Write a Socket program to print system date and time (Using TCP/IP).

Programming in Python	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-2	CIE-332T
CSE-IoT/CSE-ICB	6	PC	PC	IOT-320T
EAE	6	IOT-EAE	IOT-EAE-2B	IOT-330T
EAE	6	ICB-EAE	ICB-EAE-2B	IOT-330T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Learn the syntax and semantics of Python Programming Language.
2.	Write Python functions to facilitate code reuse and manipulate strings.
3.	Illustrate the process of structuring the data using lists, tuples and dictionaries.
4.	Demonstrate the use of built-in functions to navigate the file system.

Course Outcomes (CO)

CO 1	Demonstrate the concepts of control structures in Python.
CO 2	Implement Python programs using functions and strings.
CO 3	Implement methods to create and manipulate lists, tuples and dictionaries
CO 4	Apply the concepts of file handling and regExusing packages.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT-I

Introduction, Python Basics: Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Dissecting Your Program. Flow control: Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit().

UNIT-II

Functions: def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling. Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods. Dictionaries and Structuring Data: The

Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things. Manipulating Strings - Working with Strings, Useful String Methods.

UNIT-III

Reading and Writing Files: Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the pprint.pformat() Function. Organizing Files: The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile Module.

UNIT – IV

Web Scraping: Project: MAPIT.PY with the web browser Module, Downloading Files from the Web with the requests Module, Saving Downloaded Files to the Hard Drive, HTML.

Textbooks:

1. Al Sweigart, “Automate the Boring Stuff with Python”, William Pollock, 2015, ISBN: 978-1593275990.

References:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755.
2. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014.
3. Wesley J Chun, “Core Python Applications Programming”, 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365.
4. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, “Data Structures and Algorithms in Python”, 1st Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176.
5. Reema Thareja, “Python Programming using problem solving approach”, Oxford University press, 2017. ISBN-13: 978-0199480173

Programming in Python Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-2	CIE-332P
CSE-IoT/CSE-ICB	6	PC	PC	IOT-320P
EAE	6	IOT-EAE	IOT-EAE-2B	IOT-330P
EAE	6	ICB-EAE	ICB-EAE-2B	IOT-330P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Programming in Python) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Basic data types and operators: Create a program that prompts the user for their name and age and prints a personalized message.
2. Conditional statements: Create a program that prompts the user for their age and tells them if they can vote in the next election.
3. Loops: Create a program that calculates the factorial of a number entered by the user using a loop.
4. Lists and arrays: Create a program that prompts the user for a list of numbers and then sorts them in ascending order.
5. Strings and string manipulation: Create a program that prompts the user for a string and then prints out the string reversed.
6. Functions: Create a program that defines a function to calculate the area of a circle based on the radius entered by the user.
7. Classes and objects: Create a program that defines a class to represent a car and then creates an object of that class with specific attributes.
8. File input/output: Create a program that reads data from a file and writes it to another file in a different format.
9. Regular expressions: Create a program that uses regular expressions to find all instances of a specific pattern in a text file.
10. Exception handling: Create a program that prompts the user for two numbers and then divides them, handling any exceptions that may arise.
11. GUI programming: Create a program that uses a graphical user interface (GUI) to allow the user to perform simple calculations.
12. Web scraping: Create a program that uses a web scraping library to extract data from a website and then stores it in a database.
13. Data visualization: Create a program that reads data from a file and then creates a visualization of that data using a data visualization library.
14. Machine learning: Create a program that uses a machine learning library to classify images based on their content.
15. Networking: Create a program that uses a networking library to communicate with a server and retrieve data from it.

Programming in R and Python	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	6	PC	PC	DS-342T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Learn Fundamentals of R.
2.	Learn the Basics of statistical data analysis with examples.
3.	Learn the basis of python
4.	Compile and visualize data using statistical functions.

Course Outcomes (CO)

CO 1	Impart the basic knowledge of R Fundamentals.
CO 2	How data is analysed and visualized using statistic functions
CO 3	Impart the basic knowledge of python programming
CO 4	Understand the loading, retrieval techniques of data.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	-	2	-	3	2	-	-	-	3	-
CO 2	-	3	-	3	-	-	-	-	-	-	-	-
CO 3	3	-	-	2	-	3	3	-	-	-	2	-
CO 4	3	2	2	-	3	-	-	-	-	-	-	-

UNIT-I

R Basics: Basic operations in R, Math operations in R, working with null values, Import & Export files in R, Data-frame, Joins, One-way and Two way tables, Arrays, Factors, R - Variables: Variable assignment, Data types of Variable, Deleting Variables - R Operators: Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators, R Decision Making: if statement, if – else statement, if – else if statement, switch statement – R Loops: repeat loop, while loop, for loop - Loop control statement: break statement, next statement.

UNIT-II

R-Function : function definition, Built in functions: mean(), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, calling a function without an argument, calling a function with argument values - R-Strings – Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower() - R Vectors – Sequence vector, rep function, vector access, vector names, vector math, vector recycling, vector element sorting - R List - Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging

Lists, Converting List to Vector - R Matrices – Accessing Elements of a Matrix, Matrix Computations: Addition, subtraction, Multiplication and Division- R Arrays: Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculation Across Array Elements - R Factors –creating factors, generating factor levels gl().

UNIT-III

Python Basics Objects and Functions, Identifiers, Variables and Datatypes, Operators, Python Flow, Function Arguments, Recursive functions ,Lambda, Exception Handling , Iterators, Generators and Decoders, Numpy and Pandas Numpy: Arrays, Vectorization, Boolean Indexing, Matrix multiplication, Tuple, Join/Merge data, Unicode strings etc. Pandas: Data Structure, Data frame, Reading data, Handling missing data.

UNIT - IV

Mathematics for Data science Probability, Statistics, Linear Algebra, Gradient Descent, Calculus for data science, ANOVA, Hypothesis testing, Data Visualization using GGPLOT2 and Matplotlib, Data Pre-processing, Data Transformation, Data Reduction, Feature Extraction. Univariate and Multi-variate analysis.

Textbook(s):
1. Introduction to Machine Learning with Python, A. C. Muller & S. Guido, O'Reilly
2. Data analytics with R by Dr. Bharti Motwani , wiley publication
3. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (India), 2017.

References:
1. Python for R Users: A Data Science Approach by A. Ohri, Wiley India
2. Python and R for the Modern Data Scientist ,Rick J Scavetta, Boyan Angelov, O'Reilly

Programming in R and Python Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-DS	6	PC	PC	DS-342P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Programming in R and Python) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Demonstrate the following functions/methods which operates on lists in Python with suitable examples: i) list( ) ii) len( ) iii) count( ) iv) index ( ) v) append( ) vi) insert( ) vii) extend() viii) remove( ) ix) pop( ) x) reverse( ) xi) sort( ) xii) copy( ) xiii) clear( ).
2. Demonstrate the following kinds of Parameters used while writing functions in Python. i) Positional Parameters ii) Default Parameters iii) Keyword Parameters iv) Variable length Parameters.
3. Demonstrate lambda functions in Python with suitable example programs.
4. Python program to perform read and write operations on a file.
5. Create a CSV file by entering user-id and password, read and search the password for given user id.
6. Write an R program that takes input from the user and display the values. Also print the version of R installation.
7. Write a R program to list containing a vector, a matrix and a list and give names to the elements in the list.
8. Write a R program to create an empty data frame.
9. Write a R script, to create R objects for calculator application and save in a specified location in disk
10. Write a R program to find basic descriptive statistics using summary and find subset of dataset by using subset().
11. Reading different types of data sets (.txt, .csv) from web and disk and writing in file in specific disk location and reading Excel data sheet and XML dataset in R.
12. Find the data distributions using box and scatter plot.Find the outliers using plot and plot the histogram, bar chart and pie chart on sample data.
13. Find the correlation matrix and analyse variance (ANOVA), if data have categorical variables on iris data. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.

Programming in Windows Environment	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	OSD-330T
OAE	6	SD-OAE	SD-OAE-1B	OSD-330T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	The course Provides an insight into the windows programming environment
2.	The course peeps into windows file systems and memory management techniques.
3.	The course provides the information about process & thread management in windows
4.	The course provides ability to use windows sockets and manage windows services

Course Outcomes (CO)

CO 1	Manage windows file system & outline windows principles
CO 2	Handle exceptions and make efficient use of memory in windows environment
CO 3	Create processes/threads and synchronize threads in windows environment
CO 4	Create sockets and manage services in windows environment

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1	3	1	-	-	-	-	-	3
CO 2	3	2	1	1	3	1	-	-	-	-	-	3
CO 3	3	2	1	1	3	1	-	-	-	-	-	3
CO 4	3	2	1	1	3	1	-	-	-	-	-	3

UNIT-I

Windows File System: Windows Evolution, Windows, Standards, and Open Systems, Windows Principles, 32-bit and 64-bit Source Code Portability. Windows File Systems, Standard Devices, File and Directory Management, Console I/O, The 64-Bit File System, File Processing Strategies , File Locking, The Registry, Registry Management.

UNIT-II

Windows Memory Management & Exception Handling: Windows Memory Management Architecture, Managing Heap Memory, Memory-Mapped Files, Dynamic Link Libraries, The DLL Entry Point, DLL Version Management. Exceptions and Their handlers, Errors and exceptions, Vectored Exception Handling.

UNIT-III

Windows Process Management: Windows Processes and Threads, Process Creation, Processes in a Multiprocessor Environment, Process Execution Times, Generating Console Control Events, Jobs. Thread, Thread Management, Using C library in threads, Performance Impact, Introduction to Program Parallelism, Process and Thread Priority and Scheduling, Fibers, Thread Synchronization.

UNIT – IV

Windows Sockets & Services: Windows Sockets, Socket Server Function, Socket Client Function, Data grams, Berkley Sockets Vs Windows sockets, Overlapped I/O with Windows sockets. Writing Windows services, The service Control Handler, Managing windows services, Service Operation and management Debugging a service

Textbook(s):

1. Windows System Programming, J.M. Hart, Addison Wesley

References:

1. Windows 10 System Programming, P. Yosifovich, Leanpub
2. Programming Windows Chales Petzold, Microsoft Press

Programming in Windows Environment Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	OSD-330P
OAE	6	SD-OAE	SD-OAE-1B	OSD-330P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Programming in Windows Environment) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Note: Write Following programs in Windows Environment using C.

1. Printing the Current Directory
3. File Listing and Directory Traversal
4. File Processing with Error and Exception Recovery
5. Sorting a File with Memory Mapping
6. Create an Index File
7. Cerate a DLL with Explicit linking
8. Parallel Searching using multiple processes
9. Create, List, and Kill Background Jobs
10. Multithreaded Pattern Searching
11. Write a socket based client
12. Socket-Based Server with In-Process Servers
13. Write code for A Service Wrapper using existing services

Project Management	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	SD-OAE	SD-OAE-3B	OSD-447T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To apply the basic concepts of project management such as features, objectives, life cycle, model and management, in a given context
2.	To analyze projects and their associated risks by understanding the various theoretical frameworks, non-numerical and numerical models in order to make correct selection decisions
3.	To evaluate the stages of project management and identify and determine correct techniques for planning and scheduling
4.	To evaluate management processes for budgeting, controlling and terminating projects in order to achieve overall project success

Course Outcomes (CO)

CO 1	Apply the basic concepts of project management such as features, objectives, life cycle, model and management, in a given context
CO 2	Analyze projects and their associated risks by understanding the various theoretical frameworks, non-numerical and numerical models in order to make correct selection decisions
CO 3	Evaluate the stages of project management and identify and determine correct techniques for planning and scheduling
CO 4	Evaluate management processes for budgeting, controlling and terminating projects in order to achieve overall project success

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1		3	2	2	3			3			3	2
CO 2	3		3		2		3	3			2	3
CO 3	3	2		3	3			2	3	2		
CO 4		2	3			3		2			2	

UNIT-I

Intoruction: Characteristics of project; Life Cycle of Project; Project Model; Project Management as discipline; Contemporary aspects of Project Management

Project Selection: Theoretical Models; Non-numeric models; Numeric Models; Financial Models; Project Portfolio process, Significance and applicability of Monte Carlo simulation

UNIT-II

Project Organization, Manager and Planning: Pure Project organization; Functional Organizations; Mixed organizations; Matrix organizations; Role, Attitudes and Skills of Project Manager, Project Coordination, Systems Integration, Work Breakdown Structure, Linear Responsibility Charts.
Risk Managemen: Theoretical Aspects of risk, Risk Management process, Numeric Techniques, Hillier model, Sensitivity Analysis, Certainty Equivalent approach and Risk adjusted discount rates, Game theory.

UNIT-III

Project Scheduling and Resource Allocation: Theoretical aspects-Importance, Focus Area-PERT/CPM, AOA and AON charts, Probability Analysis, Gantt Charts, Crashing of Projects- Time and Cost tradeoff, Basics Resource Leveling and Loading.

UNIT - IV

Budgeting, Control and Project Termination: Estimating Project Budgets, Improving the process of cost estimation, Basics, Importance, Purpose of control, Types of Control, Desirable features of Control, Control Systems, Critical Ratio Method, Control of creative activities, Control of change and scope creep, Why Termination, Types of termination, typical termination activities

Textbook(s):
1. Meredith, Mantel, Project Management-A Managerial Approach, 10th Edition, Wiley Publications,2017

References:
1. Timmothy Kloppenborg, Contemporary Project Management, 5th Edition, Cengage Learning, 2017
2. Harold Kerzner, Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 12th Edition, Wiley Publications,2017
3. Wysocki, R.K., Effective Project Management: Traditional, Agile, Extreme, Hybrid, 8th Edition, Wiley, 2018
4. Vohra, N. D., Quantitative Techniques in Management, 5thEdition, Tata McGraw Hill, 2017

Project Management Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	SD-OAE	SD-OAE-3B	OSD-447P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Project Management) as this is the practical component of the corresponding theory paper.
2. The allotment and guidelines for the project work shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered.

Create a mini project on any topic and create a report consisting of all the phases of project management. Some suggested topics, but not limited to, are as follows:

1. Inventory Management System
2. Event Management System
3. University Admission Management System
4. Hotel Management System
5. Airline Reserversation System
6. Railway Reserversation System
7. E-commerce

The students shall be asked to write a complete documentation consisting of Requirements Analysis, WBS, Scheuduling Charts, Metrics, Financial Planning, Resource Allocation, Team Organisation, etc.

Public Health Engineering	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	7	CE-OAE	CE-OAE-4	OCE-403

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn the principles for identification of sources of surface and subsurface water
2.	To learn calculation of population and requirement of drinking water
3.	To understand the plotting of water supply scheme highlighting different features
4.	To know evaluation of characteristics and treatment of sewage

Course Outcomes (CO)

CO 1	Identify the sources of surface and subsurface water
CO 2	Draw labelled layout for water supply scheme.
CO 3	Estimate the quantity of drinking water required for a population
CO 4	Evaluate characteristics and suggest treatment of sewage.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	-	-	-	-	-	-	-	-	-	-
CO 2	1	3	1	2	-	-	-	-	-	-	-	-
CO 3	1	2	1	2	-	-	-	-	-	-	-	-
CO 4	-	3	-	-	-	-	-	-	-	-	-	-

UNIT-I

Sources, Demand and Quality of Water: Water supply schemes - Objectives, components, Surface and Subsurface sources of water, Intake Structures, Definition and types, Factors governing the location of an intake structure, Types of intakes. Demand of water: Factors affecting rate of demand, Variations of water demands, Forecasting of population. Methods of forecasting of population, (Simple problems on forecasting of population) Design period, estimating of quantity of water supply required for city or town. Quality of water: Need for analysis of water, Characteristics of water- Physical, Chemical and Biological, testing of water for Total solids, hardness, chlorides, dissolved Oxygen, pH, Fluoride, Nitrogen and its compounds, Bacteriological tests, E coli, B coli index, MPN, Sampling of water, Water quality standards as per IS 10500.

UNIT-II

Purification of Water: Objectives of water treatment, Aeration objects and methods of aeration, Plain sedimentation, Sedimentation with coagulation, principles of coagulation, types of coagulants, Jar Test, process of coagulation, types of sedimentation tanks, Clariflocculator. Filtration - mechanization of filtration, classification of filters: slow sand filter, rapid sand filter, pressure filter. Construction and working of slow sand filter and rapid sand filter, operational problems in filtration. Disinfection: Objects, methods of disinfection, Chlorination- Application of chlorine, forms of chlorination, types of chlorination practices, residual chlorine and its importance, Flow diagram of water treatment plants. Miscellaneous water Treatments: Introduction to water softening, Defluoridation techniques.

UNIT-III

Conveyance and Distribution of Water: Conveyance: Types of Pipes used for conveyance of water, choice of pipe material, Types of joints & Types of valves- their use, location and function on a pipeline.
Distribution of water: Methods of distribution of water Gravity, pumping, and combined system, Service reservoirs – functions and types, Layouts of distribution of Water-Dead end system, grid iron system, circular system, radial system; their suitability, advantages and disadvantages.

UNIT - IV

Domestic Sewage and System ff Sewerages: Building Sanitation: Necessity of sanitation, Necessity to treat domestic sewage, Definitions- Sewage, silage, types of sewage. Definition of the terms related to Building Sanitation Civil Engineering Curriculum Structure 122 Water pipe, Rain water pipe, Soil pipe, Sullage pipe, Vent pipe. Building Sanitary Fittings Water closet – Indian and European type, flushing cistern, wash basin, sinks, Urinals. Traps types, qualities of good trap. Systems of plumbing - one pipe, two pipe, single stack, choice of system. Principles regarding design of building drainage, inspection and junction chambers, their necessity, location, size and shape Systems of Sewerage and Sewer Appurtenances: Types of Sewers, Systems of sewerage, self-cleansing velocity and non-scouring velocity, Laying, Testing and maintenance of sewers, Manholes and Drop Manhole-component parts, location, spacing, construction details, Sewer Inlets, Street Inlets.

Textbook(s):
1. Sharma S.C, Environmental Engineering, Khanna Publishing House, New Delhi
2. Garg, S.K., Environmental Engineering Vol. I and Vol. II, Khanna Publishers

References:
1. Gupta, O.P., Elements of Environmental Pollution Control, Khanna Publishing House, Delhi
2. Rao, C.S., Environmental Pollution Control Engineering, New Age International
3. Peavy H S, Rowe D R, and Tchobanoglous G, Environmental Engineering, McGraw
4. Basak N N, Environmental Engineering,McGraw Hill Publisher

Quality and Safety Management	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	CTM-EAE	CTM-EAE-3	CEC-413

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To study the concepts of quality assurance and control techniques in construction.
2.	To familiarize with clauses for quality management in construction Industry
3.	To study the various construction accidents and cost of construction injuries
4.	To study and understand the various safety concepts and requirements applied to construction industry.

Course Outcomes (CO)

CO 1	Understand different aspects of quality and related tools.
CO 2	Apply techniques of total quality assurance and quality control programme and cost implication.
CO 3	Understand importance of various aspects of safety during construction activity.
CO 4	Apply principles of environmental safety to construction projects.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	1	3	-	-	-	-	1	-	-	-	-
CO 2	3	1	2	-	-	-	1	1	-	-	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-
CO 4	3	1	-	2	1	-	1	-	-	-	-	-

UNIT-I

Quality Management: Quality policy in construction Industry-Consumer Satisfaction-Ergonomics, Time of Completion-Statistical Tolerance-Taguchi's concept of quality- Contract and construction Programming-Inspection procedures.
Quality Assurance and Control: Total QA/QC Program and cost implication. Different aspects of Quality-Appraisals, failure mode analysis, Stability methods and tools, Influence of drawings, detailing, specification.

UNIT-II

Construction Accidents: Safety in construction - Cost of Accidents - Safety norms - Safety aids Injury and Accidents- Causes, Investigations and Prevention of Accidents, Hazards – Types, Nature, Causes and Control Measures - Identifications and Control Techniques - Cost of Construction Injuries-Legal Implications - Site management with regard to safety –Safety training and implementation - Construction safety and health manual. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety.

UNIT-III

Safety in Construction Operations: Excavation and filling - Under- water works - Underpinning & Shoring - Ladders & Scaffolds - Tunnelling - Blasting - Dismantling - Confined space Temporary Structures. noise standards and limit values; noise instrumentation and monitoring procedure.

Construction Machinery: safety in material handling and equipment's-Safety in storage & stacking of construction materials. Safety in the use of construction equipment/vehicles. Safety in temporary power supply and fire safety at construction site.

Safety in Demolition Work: keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition.

UNIT – IV

Safety Policy: Need- Safety provisions -Factory Act-Laws related to the Industrial Safety-Measurement of Safety Performance, Safety Audit, Problem Areas in Construction Safety-Elements of an Effective Safety Programme-Job site Safety assessment- Safety Meetings-Safety Incentives

Safety Organization: Safety Policy, Safety Record Keeping, Safety Culture-Safe Workers-Safety and First Line Supervisors- Middle Managers-Top Management Practices, Company Activities and Safety-Sub contractual obligation, Project Coordination and Safety Procedures

Textbook(s):

1. Managing Quality, Dale B. G, Fourth Edition, Blackwell Publishing, Oxford, (2003).
2. Reese. C.D and Eidson J.V, Handbook of OSHA Construction Safety and Health, 2nd Ed, CRC Press, Boca Raton, (2006)

References:

1 Construction Safety, Jimmie W. Hinze, Prentice Hall of India, (1997).

2. Modern Construction Management, Harris .F, McCaffer .R and Edum-Fotwe .F, 6th Edition, Blackwell Publishing, Oxford, (2006).
3. Principles of Construction Safety, Holt S. J, Blackwell Publishing, Oxford, (2008).

Quality Management & Quality Control	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	DMS-EAE	DMS-EAE-2	DMS-314T
EAE	6	DT-EAE	DT-EAE-1	DMS-314T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concept of Quality.
2.	To understand the Implication of Quality on Business.
3.	To understand the implications of quality management standards and systems.
4.	To have exposure to challenges in Quality Improvement Programs.

Course Outcomes (CO)

CO 1	Understand the importance of significance of quality.
CO 2	Review the quality management and its importance for individuals, organization and society.
CO 3	Identify requirements of quality improvement programs.
CO 4	Examine control charts and process engineering techniques used for enhancing the quality of a system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	-	2	-	-	-	2	-	-	2	-	-
CO 2	3	-	2	2	2	2	-	2	2	-	-	3
CO 3	3	3	3	3	3	-	-	-	-	-	-	2
CO 4	3	3	2	3	2	3	-	-	--	-	-	2

UNIT-I

Basic concepts, definitions and history of quality control. Quality function and concept of quality cycle. Quality policy and objectives. Economics of quality and measurement of the cost of quality. Quality considerations in design

UNIT-II

Process control: Machine and process capability analysis. Use of control charts and process engineering techniques for implementing the quality plan.

UNIT-III

Acceptance Sampling: single, double and multiple sampling, lot quality protection, features and types of acceptance sampling tables, acceptance sampling of variables and statistical tolerance analysis. Quality education, principles of participation and participative approaches to quality commitment.

UNIT - IV

Emerging concepts of quality management: Taguchi's concept of off-line quality control and Ishikawa's cause and effect diagram, Approach to Six sigma quality.

Textbook(s):

1. Besterfield D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
2. Quality Control and Applications by Housen & Ghose.

References:

1. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
2. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
3. Industrial Engineering Management by O.P. Khanna.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

Quality Management & Quality Control Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	DMS-EAE	DMS-EAE-2	DMS-314P
EAE	6	DT-EAE	DT-EAE-1	DMS-314P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Quality Management & Quality Control) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To perform Quality considerations in design.
2. To perform Process control with set of given data.
3. To perform machine and process capability analysis of a given specimen.
4. To perform use of control charts and process engineering techniques for implementing thequality plan.
5. To perform Acceptance sampling with given data.
6. To perform statistical tolerance analysisof case study.
7. To apply Taguchi's concept of off-line quality control.
8. To construct Ishikawa's cause and effect diagram of any case study.
9. To studySix sigma quality tools and its application.
10. To study qquality function and concept of quality cycle.

Quantum Computing	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-2	CIE-334

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic knowledge of Quantum Computing.
2.	To revise mathematics required for Quantum Computing.
3.	To understand building blocks of quantum computing and design algorithms.
4.	To understand quantum hardware principles and tools for quantum computing.

Course Outcomes (CO)

CO 1	Appraise various mathematical models required for quantum computing.
CO 2	Illustrate building blocks of quantum computing through architecture and programming models.
CO 3	Identify and apply the various quantum algorithms.
CO 4	Discuss various quantum hardware building principles.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	2	3	2	1	1	1	2	1	2	2
CO 2	3	3	2	3	3	1	1	2	1	1	2	2
CO 3	3	3	2	3	3	1	1	1	2	2	1	2
CO 4	3	3	2	2	2	1	1	1	1	1	1	2

UNIT-I

Mathematical Foundations for Quantum Computing. Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors. Origin of Quantum Computing, Overview of major concepts of Quantum Computing, Quantum Computing vs Classical Computer. Introduction to Quantum Mechanics, Qubits and multi-qubits states, Block Sphere representation, Quantum Superposition, Quantum Entanglement, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc)

UNIT-II

Architecture of a Quantum Computing platform. Details of q-bit system of information representation: Quantum superposition of qubits (valid and invalid superposition), Quantum Entanglement, Useful states from quantum algorithmic perceptive e.g. Bell State. Operation on qubits: Measuring and transforming using gates. Quantum Logic gates and Circuit. No Cloning Theorem and Teleportation. Programming model for a Quantum Computing Program. Steps performed on classical computer. Steps performed on Quantum Computer. Moving data between bits and qubits.

.

UNIT-III

Quantum Algorithms and Error Correction. Quantum Algorithms, Shor‘s Algorithm, Grover‘s Algorithm. Deutsch‘s Algorithm, Deutsch -Jozsa Algorithm. Quantum error correction using repetition codes 3 qubit codes, Shor‘s 9 qubit error correction Code. NISQ era Quantum Algorithms (VQE/QAOA and industrial applications).

UNIT - IV

Quantum Hardware. Ion Trap Qubits, The DiVincenzo Criteria, Lagrangian and Hamiltonian Dynamics in a Nutshell: Dynamics of a Translating Rotor. Quantum Mechanics of a Free Rotor. The Cirac-Zoller Mechanism: Quantum Theory of Simple Harmonic Motion, A Phonon-Qubit Pair Hamiltonian, LightInduced Rotor-Phonon Interactions, Trapped Ion Qubits. Cavity Quantum Electrodynamics (cQED): Eigenstates of the Jaynes-Cummings Hamiltonian Circuit QED (cirQED): Quantum LC Circuits, Artificial Atoms, Superconducting Qubits. Quantum computing with spins: Quantum inverter realised with two exchange coupled spins in quantum dots, A 2-qubit spintronic universal quantum gate.

Textbook(s):

1. Michael A. Nielsen, Issac L. Chuang, Quantum Computation and Quantum Information, 10th Ed., Cambridge University Press, 2010.
2. Parag K Lala, Mc Graw Hill Education, Quantum Computing, A Beginners Introduction, First edition, 2020.

References:

1. Chris Bernhardt, The MIT Press; Reprint edition (2020), Quantum Computing for Everyone.
2. David McMahon, Quantum Computing Explained, Wiley, 2008.
3. Bernard Zygelman, A First Introduction to Quantum Computing and Information,2018

Radar and Satellite Communications	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-348

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To explain the radar basics and various types of radar systems.
2.	To explain the phase array radar and signal detection.
3.	Understand of satellite orbits and launching and transmission theory.
4.	Identify satellite access by various users and satellite navigation systems

Course Outcomes (CO)

CO 1	Understand the basics of radar systems and detection of radar signals.
CO 2	Analyze the phased array radar systems
CO 3	Understand the concept of satellite communication systems
CO 4	Design of satellite prototype and test analog and digital satellite communication systems as per given specifications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	3	2	2	3	1	3	2	1	1
CO 2	2	2	2	2	3	2	2	2	2	32	3	2
CO 3	2	3	3	3	2	3	2	3	3	3	1	1
CO 4	2	2	3	3	3	2	1	2	3	3	2	1

UNIT-I

Radar Basics: general definition of radar, radar range equation, receiver noise, probability of detection and signal-to-noise ratio, RCS, CW, FMCW and multiple frequency CW radars, delay line canceler, error signal of conical-scan radar, mono pulse radars, clutter, jamming, doppler shift, Radar waveforms, waveform matched filter, pulse burst waveform, frequency-modulated pulse compression waveforms

Unit-II

Phase Array Working and Feed Systems of Radar: Synthetic aperture radars (SAR), pulse compression techniques, Doppler processing, Alternate forms of the Doppler spectrum, Moving target indication (MTI), Pulse Doppler processing, Dwell-to-dwell stagger, Clutter mapping and the moving target detector, Detection of radar signals in noise.

Unit III

Satellite Sub-systems: Attitude and Orbit control systems, Telemetry, Tracking and command control system, Power supply system, Introduction to satellite link design, basic transmission theory, system noise temperature and G/T ratio, design of downlink and uplink, design of satellite links for specified C/N, satellite data communication protocols.

Unit IV

Direct broadcast satellite television and radio, satellite navigation and the global positioning systems, GPS position location principle, GPS receivers and codes, Satellite Signal Acquisition, GPS navigation Message, GPS Signal Levels, Timing Accuracy, GPS Receiver Operation.

Textbooks:

1. Mark A. Richards "Fundamentals of Radar Signal Processing"McGraw-Hill, 2nd edition, 2014.
2. S. Haykins, "Adaptive Radar Signal Processing" John Wiley & Sons, Inc. 1st edition, 2007.
3. B.Pratt, A.Bostian, "Satellite Communications", Wiley India.
4. D. Roddy, "Satellite Communications", McGrawhill Education.

References:

1. C. Chen and H. Ling, "Time-Frequency Transforms for Radar Imaging and Signal Analysis", Artech House, 1st edition, 2002.
2. Bruce R Elbert. "Introduction to satellite communication". Artech house, 2008.

Radio and Television Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-2	ECE-336T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the in depth knowledge of various electronic audio devices and systems.
2.	To study the analysis and synthesis of TV Pictures, Composite Video Signal and Receiver Picture Tubes.
3.	To impart the knowledge about the various Color Television systems.
4.	To impart the knowledge of the basic principle and working of various consumer electronics devices.

Course Outcomes (CO)

CO 1	Develop the basic knowledge about the various audio devices and systems.
CO 2	Acquire knowledge in Fundamentals of Television, Monochrome TV transmitter and receiver.
CO 3	Interpret the essentials of colour TV and various colour TV systems.
CO 4	Analyze and compare various consumer electronics gadgets/goods/devices.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	3	2	2	2	2	-	-	1	2	3
CO 2	2	2	3	2	2	2	2	-	-	1	2	3
CO 3	2	2	3	2	2	2	2	-	-	1	2	3
CO 4	2	2	3	2	3	3	2	-	-	1	2	3

UNIT I

Audio System: Microphones, Construction, Working principles and applications of microphone: Carbon, Moving coil, velocity, crystal, condenser type, Cordless microphone, Dynamic & wireless microphone.
Loud Speakers: Direct radiating, horn loaded, woofer, tweeter and squeaker, baffles and enclosures.
Sound recording on magnetic tape its principles, block diagram and tape transport mechanism, Wow, Flutter & Rumble distortion. Relationship between gap width, tape speed and frequency. Optical recording and reproduction system, Blue ray technology, VCD & DVD system, HI- Fi system, condition for good acoustic features, stereo amplifiers

UNIT II

Television: Monochrome TV Communication**:** Elements of TV communication system; Scanning – its need for picture transmission; Need synchronizing and blanking pulses; Progressive scanning, interlaced scanning, ell effect, resolution and band width requirement, Composite Video signal (CVS)at the end of even and odd fields, advantage & disadvantage of negative modulation, need of pre & post Equalizing pulses; Monochrome picture

tube– construction and working, comparison of magnetic and electric of Construction and working of camera tube: vidicon and plumbicon, night vision camera.
Block Diagram of a TV Receiver: function of each block and wave form at the input and output of each block; Frequency range of various VHF bands and channels used in India, Major specification of the CCIR B standard. Typical circuits of scanning and EHT stages of TV receiver, keyed AGC,SAW filter; trap circuit, Identification of faulty stage by analyzing the symptoms and basic idea of a few important faults and there remedies.

UNIT III

Color TV: Primary colors, trisimulus values, trichromitc coefficients, concepts of additive and subtracting mixing of colours, concepts of luminance, Hue and saturation, Compatibility of colour TV system with monochrome system. Block diagram of colour TV camera, Construction and working principles of Trinitron, delta gun and PIL types of colour picture tubes. Concepts of degaussing, purity, beam shifting; burst signal and its need, chrominance signal; analysis of G-Y signal is not transmitted, Block diagram of PAL TV receiver.

UNIT IV

Comparison and overview of digital TV LCD, LED, OLED, QLED, HDTV, Plasma TV &Three dimension TV.
Cable Television**:** Block diagram and principle of working of STB and DTH, Fuzzy logic washing machine, study of digital camera, RFID & Bluetooth technology, study of Smart watches, Smart TV and iPods, block diagram of microwave oven and its function of each block.

Textbook(s):

1. R. R. Gulati, “Modern Television Practice” New Age International, 2nd Edition.
2. S. P. Bali, “Consumer Electronics” Pearson Education, 1st Edition.

Reference Books:

1. A. Dhake, “Television & Video Engineering” TMH – 2nd Edition.
2. R.R. Gulati, “Monochrome & Colour Television” New age International Publisher, 2nd Edition.
3. R.G. Gupta, “Audio & Video Systems” TMH – 2nd Edition

Radio and Television Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-2	ECE-336P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Radio and Television Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Familiarization with consumer and technician control & safety precautions.
2. To study the working and circuit description of Tape recorder.
3. To study the working of superheterodyne receiver.
4. To study the three band AM/ FM/ SW radio trainer kit.
5. Identify different components and section in TV receiver (B/W & Color)
6. Signal injection and signal tracing in black & white & Color TV
7. Colour TV adjustments, gray scale tracking, Colour killer, focus, chroma traps, sound traps, saturation control, black level.
8. To study the working of color TV receiver and its voltage measurement.
9. Familiarization with specification, operation and use of TV set equipment, DVM, TVM Monochrome & Colour pattern generators, sweep generator, X-Y display wobbuloscope etc.
10. To study the working of Microphone.
11. To Test TV antenna and booster.
12. To study the working of LCD/ Plasma TV.
13. To study the working of LED/ OLED.

Random Processes and Stochastic Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-2	ECE-334T
EAE	6	WMC-EAE	WMC-EAE-1B	WMC-334T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic knowledge of random variable
2.	To impart the knowledge of both temporal and spectral characteristics of Random Process
3.	To familiarize the students with several stochastic processes specially Markov process ,Poisson process, and renewal processes
4.	To be acquainted with systems involving random signals.

Course Outcomes (CO)

CO 1	To evaluate the statistical properties of random variables and can handle probabilistic transformations.
CO 2	To understand the temporal and spectral characteristics of Random Process
CO 3	To understand the basic properties of the Markov process ,Poisson process, and renewal processes in general
CO 4	To understand how to estimate certain performance measures associated with aspects of a stochastic system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Random Variable: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete and Continuous, Mixed Random Variable, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Methods of defining Conditioning Event, Conditional Density, Properties. Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem: Unequal Distribution, Equal Distributions.

UNIT II

Random Processes – Temporal Characteristics: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second-order and Wide-Sense Stationarity, Nth-order and Strict-Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and its Properties, Cross- Correlation Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.

Random Processes - Spectral Characteristics: The Power Density Spectrum: Properties, Relationship between Power Density Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross Power Density Spectrum and Cross-Correlation

UNIT III

Classification of Stochastic Processes: Bernoulli, Markov Process: Markov chains in continuous time, Principles of discrete event simulation, Markov chain models of queueing systems,Gaussian Process, Martingales, Diffusions, Brownian Motion and White Noise, Poisson Processes, Renewal Processes: Generalized Renewal Processes and Renewal Limit.

UNIT IV

Random Signal Response of Linear Systems: Linear System with random input: Spectral factorization theorem and its importance, Convolution, Mean and Mean squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output.

Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output, Band pass, Band Limited and Narrowband Processes, Properties. Noise Definitions: White Noise, colored noise and their statistical characteristics, Ideal low pass filtered white noise, RC filtered white noise. Innovation process and whitening filter**.**

Textbook(s):

1. Probability, Random Variables and Random Signal Principles – Peyton Z. Peebles, TMH, 4th Edition, 2001.
2. Probability, Random Variables, and Stochastic Processes 3rd and 4th Editions by A. Papoulis.

.

Reference Books:

1. Bernd Probability, Random Processes and Estimation Theory for Engineers, Henry Stark & John W. Woods
2. Probability Methods of Signal and System Analysis by George R. Cooper, Clave D. MC Gillem, 3rd Edition, Oxford, 1999.

Random Processes and Stochastic Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-2	ECE-334P
EAE	6	WMC-EAE	WMC-EAE-1B	WMC-334P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Random Processes and Stochastic Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to plot the Deterministic and Stochastic (Continuous) signals
2. Write a program to generate the random variables: a Uniform random variable, a Gaussian random variable, and a Rayleigh distributed random variable of appropriate length
3. Write a program to generate discrete random variable using Binomial and Bernoulli Distribution
4. Write a program to plot time properties of signals (Time shifting, time scaling and time reversing)
5. Write a program to plot the stochastic properties of signal (Mean, variance, auto correlation, cross correlation, auto covariance)
6. Write a program to generate samples of a zero-mean stationary Gaussian vector process on [0, T] using the FFT algorithm
7. Write a program to estimate the auto- or cross-covariance function of a stationary, ergodic process.
8. Write a program to provide an estimate of the cross covariance function of stationary processes X and Y, given one sample of each.
9. A probability class has N students enrolled. Write Program to compute the probability of at least two students have birthday on same day.
10. To simulate continuous time Markov chain for n × n state transition matrix Q, and initial state probabilities vector p0 of length n
11. To simulate Brownian motion stochastic process with vector t holding an ordered sequence of inspection times, alpha the scaling constant of a Brownian motion process such that the ith increment has variance $\alpha(t_i - t_{i-1})$.
12. To simulate Poisson process with lambda is the arrival rate of a Poisson process, t is a vector of "inspection times'

Rapid Prototyping Tooling and Manufacturing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-4	MEE-409T
MAE	7	OAE-MAE	OAE-1	MAO-429T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand technology and Recognized importance of rapid prototyping in advance manufacturing process.
2.	Acquire knowledge, techniques, and skills to select relevant rapid prototyping and tooling process.
3.	Comprehend the potential of rapid prototyping and tooling in different industrial sectors.
4.	Illustrated 3D printing technology for Rapid prototyping and tooling.

Course Outcomes (CO)

CO 1	Identify, Explain, and solve problems related to rapid prototyping and tooling for manufacturing complex geometries.
CO 2	Select suitable process and materials for rapid prototyping and tooling.
CO 3	Distinguish technique of CAD and reverse engineering for geometric transformation in rapid prototyping and tooling.
CO 4	Determine part orientation, apply suitable slicing algorithm, and generate toolpath for minimum build time.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	2	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	3	3	-	-	--	-	-	2

UNIT-I

Introduction: Evolution, basic principle, concept, procedure and need of rapid prototyping and tooling, Classification of rapid prototyping and tooling processes (Additive/Subtractive/Deformative), Classifications of materials used for Rapid prototyping and tooling, Industrial applications of rapid prototyping and tooling, most used processes for rapid prototyping.

UNIT-II

Stereolithography Apparatus (SLA), Fused Deposition Modelling (FDM), Selective Deposition Lamination (SDL), Laminated Object Manufacturing (LOM), Ultrasonic Consolidation, Laser Engineered Net Shaping (LENS), Electron Beam Free Form Fabrication (EBFFF), Selective Laser Sintering (SLS), Electron Beam Melting (EBM). Convectional Tooling Vs Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect rapid tooling methods.

UNIT-III

CAD for rapid prototyping and tooling: Preparation of 3D-CAD model in STL format, Reverse engineering, Reconstruction of 3DCAD model using reverse engineering, Part orientation and support generation, STL Conversion, STL error diagnostics, Slicing and generation of codes for tool path.

UNIT - IV

Post processing in rapid prototyping and tooling: Support material removal, Surface texture improvement, Accuracy improvement, Aesthetic improvement, Property enhancements using non-thermal and thermal techniques.

Textbook(s):

1. Chua C.K., Leong K.F., and Lim C.S., “Rapid Prototyping: Principles and Applications”, Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2003.

References:

1. Patri K. Venuvinod and WeiyinMa, “Rapid Prototyping: Laser-based and Other Technologies”, Springer, 2004.
2. D.T. Pham, S.S. Dimov, “Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and RapidTooling”, Springer, 2001.
3. Rafiq Noorani, “Rapid Prototyping: Principles and Applications in Manufacturing”, John Wiley & Sons, 2006.
4. Amit Bandyopadhyay, Susmita Bose, “Additive Manufacturing, Second Edition”, CRC Press Taylor & Francis Group, 2020.
5. Ian Gibson, “Software Solutions for Rapid Prototyping”, Professional Engineering Publishing Limited, UK, 2002.

Rapid prototyping Tooling and Manufacturing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-4	MEE-409P
MAE	7	OAE-MAE	OAE-1	MAO-429P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Rapid prototyping Tooling and Manufacturing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To Study the working of Stereo lithography (SL) rapid prototyping machine.
2. To Study the working of Material Jetting rapid prototyping machine.
3. To Study the working of Binder Jetting rapid prototyping machine.
4. To Study the working of Fused Deposition Modelling (FDM) rapid prototyping machine.
5. To Study the working of Sheet Lamination rapid prototyping machine.
6. To Study the working of Selective Laser Sintering (SLS) rapid prototyping machine.
7. To Study the working of Electron Beam melting (EBM) rapid prototyping machine.
8. To Study the working of Electron Beam melting (EBM) rapid prototyping machine.
9. Manufacture the part by any rapid prototyping process without Support Material.
10. Manufacture the part by any of rapid prototyping process with Support Material.
11. Prepare the 3D-CAD model in STL format of single point cutting tool.
12. Prepare the 3D-CAD model in STL format of multi point cutting tool.
13. Improve the accuracy of part manufacture by any rapid prototyping process by post process technique.
14. Manufacture the hollow part by any of rapid prototyping process.
15. Reconstruction the 3D-CAD model of part using reverse engineering and manufacture the part by any RP process.

Real Time Embedded System Programming	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	ES-405T
EAE	7	ES-EAE	ES-EAE-4	ES-405T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the basic knowledge of Embedded system Design.
2.	Develop Real time applications with the MSP430 controller.
3.	To understand some case studies related to hardware design applications.
4.	Learn to apply operating system concepts for real time applications.

Course Outcomes (CO)

CO 1	To describe the embedded system, also recognize the classification of embedded systems.
CO 2	To explain the architecture of the MSP 430 processor and its programming aspects (Embedded C).
CO 3	To become aware of interrupts, hyper threading and software optimization.
CO 4	To design real time embedded systems using the concepts of RTOS.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	3	-	-	-	3	3	2	3
CO 2	3	2	3	2	3	2	-	-	3	3	2	3
CO 3	3	2	2	2	3	-	-	-	3	3	2	3
CO 4	3	2	2	2	3	2	-	-	3	3	2	3

UNIT I

Introduction to Embedded Real-time Systems, Embedded nitty-gritty, The Build Process for Embedded Systems, Types of Memory, Memory Management in Embedded Real-time Systems, Interrupts and ISRs, Core of Embedded system: RISC vs CISC controllers, Harvard vs Von Neumann architecture, Introduction to Real-time Theory, Real-time Operating Systems, Requirement Engineering, Architecture and Design of an Embedded System, Implementation Aspects in Embedded Systems, Estimation Modelling in Embedded System, Validation and Debugging of Embedded Systems.

UNIT II

Introduction to MSP430 Microcontroller. Architecture. Programming Methods for MSP430. Fundamentals of Physical Interfacing. Connecting Input Devices. Advanced Physical Interfacing. Multiplexing displays including Charlieplexing. Shaft encoder. Programming the MSP430. Introduction to Embedded C. Interfacing LEDs and Switches with MSP430 using Digital Input and Output. MSP430 Clock and Reset System. Custom Waveform generation using MSP430.

Interfacing examples.

UNIT III

Operating system overview, Operating system concepts. Processes, Tasks and Threads, Scheduling, Memory allocation, Clocks and timers, Inter task synchronisation, Device driver models, Bus drivers. Power management, Examples and overview of Real time OS. Case studies of embedded systems using MSP430 processors.

UNIT IV

Elements of Network Embedded Systems, RTOS: RT-Linux introduction, RTOS kernel, Real-Time Scheduling, Bus structure: Time multiplexing, serial, parallel communication bus structure. Bus arbitration, DMA, PCI, AMBA, I2C and SPI Buses.

Textbook(s):

1. Raj Kamal, "Embedded Systems Architecture, Programming, and Design," Tata McGraw Hill.
2. K.V. Shibu, "Introduction to Embedded Systems," Tata McGraw Hill.
3. MSP430 Microcontroller Basics. John H. Davies. Elsevier.
4. Designing Embedded Hardware, John Catsoulis. 2nd edition. Shroff Publishers and Distributors.

References:

1. The Design of Small-Scale embedded systems, Tim Wilmshurst, Palgrav, 2003.
2. Embedded System Design, Marwedel, Peter, Kluwer Publishers 2004.
3. Programming Embedded Systems in C and C++. Micheal Barr. Shroff Publishers and Distributors.

Real Time Embedded System Programming Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	ES-405P
EAE	7	ES-EAE	ES-EAE-4	ES-405P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Real Time Embedded System Programming) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to MSP430 launchpad and Programming Environment.
2. Read input from switch and Automatic control/flash LED (soft-ware delay).
3. Interrupts programming example using GPIO.
4. Configure watchdog timer in watchdog & interval mode.
5. Configure timer block for signal generation (with given frequency).
6. Read Temperature of MSP430 with the help of ADC.
7. Test various Power Down modes in MSP430.
8. PWM Generator.
9. Use Comparator to compare the signal threshold level.
10. Speed Control of DC Motor
11. Master slave communication between MSPs using SPI.
12. Networking MSPs using Wi-Fi

Real Time Operating Systems	**L**	**P**	**C**
	4		**4**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	ES-304
EAE	6	ES-EAE	ES-EAE-2A	ES-304
ECE	7	PCE	PCE-5	ECE-425

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Describe the key characteristics and requirements of real-time systems, understanding their fundamental differences from general-purpose systems.
2.	Differentiate between various types of operating systems, particularly RTOS, and justify the selection of RTOS in embedded applications based on its advantages and suitability.
3.	Designing and implementing tasks with inter-process communication in a chosen RTOS. They will also gain expertise in applying different task synchronization mechanisms to ensure efficient resource management and overcome priority inversion challenges.
4.	Analyse and troubleshoot synchronization issues in RTOS-based systems, utilizing profiling techniques to optimize task performance and evaluate and select the most suitable scheduling algorithms for specific embedded applications.

Course Outcomes (CO)

CO 1	Understand and analyse the basic concepts of real-time systems, task creation, scheduling, termination mechanisms, and different interprocess communication and synchronization methods in RTOS.
CO 2	Design and implement task scheduling algorithms and different task synchronization mechanisms to solve priority inversion problems in RTOS.
CO 3	Implement memory pools and dynamic memory allocation strategies and develop device drivers for different hardware peripherals in an RTOS to analyse and optimize interrupt handling enhanced real-time responsiveness.
CO 4	Implement real-time communication protocols to interface with external devices in embedded systems to analyse and design real-time systems considering timing constraints.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	1	1	-	-	-	-	-	-	-
CO 2	1	1	3	2	1	-	-	-	-	-	-	-
CO 3	3	3	3	2	3	-	-	-	-	-	-	-
CO 4	2	2	3	2	3	-	-	-	-	-	-	2

UNIT-I

Introduction to RTOS: Overview of embedded systems and their applications, Introduction to real-time systems and their characteristics, Fundamentals of operating systems and their role in embedded systems, Real-Time Operating Systems (RTOS) vs. General-Purpose Operating Systems, Tasks and processes in RTOS: creation, scheduling, and termination, Inter-process communication and synchronization mechanisms in RTOS, Case studies of popular RTOS used in embedded systems (e.g., FreeRTOS, VxWorks, RTLinux)

UNIT-II

Task Management and Scheduling: Task management in RTOS: task states, priorities, and context switching, Task scheduling algorithms: pre-emptive vs. non-pre-emptive, priority-based, round-robin, Rate monotonic scheduling (RMS) and earliest deadline first (EDF) algorithms, Task synchronization and communication: semaphores, mutexes, message queues, Deadlock and priority inversion issues in RTOS, Task profiling and performance analysis in real-time systems

UNIT-III

Memory Management and Device Drivers in RTOS: Memory management in embedded systems and its challenges, Memory partitioning and protection mechanisms in RTOS, Memory pools and dynamic memory allocation in RTOS, Introduction to device drivers and their role in embedded systems, implementing device drivers for peripherals in RTOS, Interrupt handling and real-time responsiveness in device drivers, Case study: Writing a device driver for a specific hardware peripheral in an RTOS environment

UNIT – IV

Real-Time Communication and System Design: Interfacing with external devices and communication protocols (UART, SPI, I2C), Real-time communication protocols (CAN, Ethernet) and their importance in industrial applications, Introduction to real-time constraints and analysis in system design, System-level design and considerations for real-time applications, Introduction to software engineering principles in RTOS projects, Real-time debugging and testing techniques in embedded systems, Any one Real-time case study and application (robotics, automotive systems, medical devices)

Textbook(s):

1. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011
2. Embedded Systems- Architecture, Programming and Design by Rajkamal, TMH, 2007.

References:

1. Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 2nd Edition.
2. Embedded Systems: Real-Time Operating Systems for Arm Cortex-M Microcontrollers by Jonathan Valvano, Vol 3, 4th Edition, 2017
3. **Mastering the FreeRTOS Real-Time Kernel: A Hands-On Tutorial Guide by Richard Barry**

Recent Construction Technologies	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	7	PCE	PCE-4	CEE-403
EAE	7	CTM-EAE	CTM-EAE-5	CEC-417

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn the application of prefabricated structure.
2.	To understand the application of modular construction structure.
3.	To know about the concept of high rise building.
4.	To learn the latest bridge construction techniques.

Course Outcomes (CO)

CO 1	Identify various construction techniques and their limitations.
CO 2	Analyse productivity and economics in construction techniques.
CO 3	Comprehend modular construction practices.
CO 4	Implement advanced construction techniques for Civil Engineering projects

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	2	2	3	1	-	-	-	-	-	-
CO 2	3	1	2	2	3	1	-	-	-	-	-	-
CO 3	3	1	2	2	3	2	-	-	-	-	-	-
CO 4	3	1	2	2	3	2	-	-	-	-	-	-

UNIT-I

Prefabricated Structures: Introduction to Prefabricated structures, Planning for pre-casting, Selection of equipment for fabrication, Transport and erection of prefabricated components, Quality measures, Design considerations of precast elements, Safety measure during erection.
Pre-Engineered building: Introduction to Pre-Engineered building, methods of construction, Design consideration in Pre-engineered building. Applications of prefabricated structures

UNIT-II

Modular Construction Practices: Introduction to Modular Construction, Modular coordination, Modular Standardization, Modular System Building, Limitation and Advantages of Modular Construction, Types of modular construction, Modular construction process, modular construction comparison between modular and conventional building.

UNIT-III

High Rise Buildings: Definition of high rise building in different context, need, scope- advantage and Disadvantages, History of high rise structure New Design Trends in Geometrical Forms, Construction Techniques of High Rise Buildings, Specification of high rise buildings, Advance Brick work, Selected High-Tech High-Rise Buildings concrete, current tall buildings and their salient features.

UNIT - IV

Bridge construction techniques: Introduction, Embankments and Foundations, Conventional Bridge Construction Techniques, Factors affecting selection of bridge, Site selection, preliminary data to be collected, Codes used in bridge designing. Accelerated Bridge Construction, Prefabricated Bridge Construction. Cable-stayed bridge, Balanced cantilever bridge, Incremental Launching method of Bridge Construction.

Textbook(s):

1. Construction Planning, Equipment, and Methods, Robert L. Peurifoy, Clifford J. Schexnayder, Robert Schmitt and Aviad Shapira, McGraw-Hill Education, 2018, Ninth Edition.
2. Construction Equipment and Management, S. C. Sharma, Khanna Publishing, 2019, First Edition.

References:

1. Principles and Practices of Commercial Construction, Cameron Andres, Ronald Smith and W. Woods, Pearson, 2018, Tenth Edition.
2. Construction Materials and Techniques, D. S. Vijayan, S. Arvindan and A. Paulmakesh, Notion Press, 2021, First Edition.
3. Fundamentals of Building Construction: Materials and Methods, Edward Allen and Joseph Iano, Wiley, 2019, Seventh Edition

Refrigeration and Airconditioning	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-2	MEE-316T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand fundamental types of refrigeration system, refrigerants and their properties.
2.	To understand the working of vapour compression and absorption refrigeration systems.
3.	To understand about instrumentation, control and different components of refrigeration system.
4.	To understand the Psychometric chart &table and processes.

Course Outcomes (CO)

CO 1	Classify the refrigerants and analyze the various air refrigeration systems.
CO 2	Explain the working of vapour compression and absorption refrigeration systems and identify different methods of performance improvement.
CO 3	Illustrate the different components of refrigeration systems.
CO 4	Analyze the different psychometric processes & evaluate cooling and heating loads.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	1	3	-	-	-	-	2
CO 2	3	3	3	3	-	1	1	-	-	-	-	2
CO 3	3	2	2	1	-	1	-	-	-	-	-	2
CO 4	3	3	3	3	-	1	-	-	--	-	-	2

UNIT-I

Introduction to Refrigeration: Brief history and need of refrigeration and air conditioning,methods of producing cooling, Heat pump, Unit of refrigeration, Coefficient of performance.

Air Refrigeration systems: Bell Coleman Cycle, Dense Air System, Open Air System, Aircraft refrigeration, working and analysis of Simple Air Refrigeration Cycle.

Refrigerants: ASHRAE Nomenclature, Eco Friendly Refrigerants, Properties of Refrigerants, Introduction to Azeotropic& Non Azeotropic Refrigerant Mixtures (NARM).

UNIT-II

Vapour Compression Refrigeration System: Simple Saturated Cycle, Use of T-S & P-h diagrams, COP, Dry and Wet Compression, Effect of operating parameters, Effect of sub cooling and super heating, Liquid-Suction Heat Exchanger, Actual vapour compression cycle.

Compound Vapour Compression System: Liquid Flash cooler, Flash Inter cooler, Back pressure valves, Individual Expansion valves, Multiple expansion valves.

Vapour Absorption Refrigeration System: Vapour absorption refrigeration system for NH_3-H_2O & LiBr-H_2O, Carnot COP, Electrolux Refrigerator.

UNIT-III

Instruments & Controls: Sensing and Actuating Elements, H.P and L.P cut out, Thermostat, Solenoid valve, Rotameter, Humidistat, Anemometer etc.

Components of Refrigeration System: Types, construction, working, comparison and selection of compressors, Condensers, Expansion devices and Evaporators, Classification of compressors, reciprocating compressor, Clearance Volume and Volumetric efficiency, Need for Multistage Compression.

UNIT – IV

Psychrometry: Brief History of Air Conditioning, Working substance in Air Conditioning system, Dalton's Law of Partial Pressures, Psychometric Properties and Psychometric Chart, Psychometric Processes, Concept of Room Sensible Heat Factor, Grand Sensible Heat Factor, Apparatus Dew point, Effective Sensible Heat Factor, High Latent Heat Load applications, Human comfort, Summer & Winter Air Conditioning.

Heat Load Estimation: Inside and Outside design conditions, Solar heat gain through glass and structures, Occupancy load, Lighting load and miscellaneous loads, Infiltration and Ventilation,

Duct Design: Function, classification and economic factors influencing duct layout, Equal friction, Velocity reduction and Static regain methods of duct design.

Textbook(s):

1. C.P. Arora, “Refrigeration & Air Conditioning”, Tata McGraw Hill Publication.
2. R.C. Jordand & G.B. Prister, “Refrigeration & Air Conditioning”, Prentice Hall of India Publication.

References:

1. W.F. Stocker & J.W. Jones, “Refrigeration & Air Conditioning”, Tata McGraw Hill Publication.
2. M. Prasad, “Refrigeration & Air Conditioning”, Wiley Eastern.
3. S. Domkundwar, “A Course in Refrigeration & Air Conditioning”, Dhanpat Rai & Sons.

Refrigeration and Airconditioning Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-2	MEE-316P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Refrigeration and Airconditioning) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To determine COP and other performance indicators of vapor compression test rig.
2. To determine COP and other performance indicators of Ice plant test rig.
3. To determine COP and other performance indicators of Air conditioning test rig.
4. To determine COP and other performance indicators of vapor absorption refrigeration system.
5. To study of installation/operation/maintenance practices for refrigeration systems.
6. To determine the refrigeration load in cold storage (case study/visit).
7. To visit any refrigeration or air conditioning plant.
8. To conduct thermodynamic analysis (energy and exergy) of any refrigeration system.
9. To determine the COP of mechanical heat pump.
10. To determine the COP of cascade refrigeration system.
11. To determine the COP of ejector expansion refrigeration system.
12. To carry out the charging of any refrigeration system.
13. To carry out the different psychometric processes and make basic calculation for properties of moist air.
14. To determine the effect of operating variables on the performance of refrigeration system.

Reinforcement Learning and Deep Learning	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AIML	7	PC	PC	ML-409T
EAE	7	AIML-EAE	AIML-EAE-4	ML-409T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the foundation of Reinforcement learning foundation and Q Network algorithm)
2.	To understand policy optimization ,recent advanced techniques and applications of Reinforcement learning
3.	To introduce the concept of deep learning and neural network
4.	To understand the concept of NLP and computer vision in deep learning

Course Outcomes (CO)

CO 1	Learn how to define RL tasks and the core principals behind the RL, including policies, value functions, deriving Bellman equations and underst and work with approximate solution(deep Q Network based algorithms)
CO 2	Learn the policy gradient methods from vanilla to more complex cases and learn application and advanced techniques in Reinforcement Learning
CO 3	Apply neural networks for problem solving
CO 4	Able to Analyse images and have basic understanding of NLP in deep learning

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	3	2	2	-	-	-	-	2
CO 2	3	2	3	3	3	2	2	-	-	-	-	2
CO 3	3	2	3	3	3	2	2	-	-	-	-	2
CO 4	3	2	3	3	3	2	2	-	-	-	-	2

UNIT-I

Reinforcement Learning Foundation: Introduction to Reinforcement learning and its terms,Features and elements of RL, Defining RL Framework and Markov Decision Process , Polices, Value Functions and Bellman Equations, Exploration vs. Exploitation, Code Standards and Libraries used in RL (Python/Keras/Tensorflow)
Tabular Methods and Q-networks: Planning through the use of Dynamic Programming and Monte Carlo, Temporal-Difference learning methods (TD(0), SARSA, Q-Learning), Deep Q-networks (DQN, DDQN, Dueling DQN, Prioritised Experience Replay)

UNIT-II

Policy Optimization: Introduction to policy-based methods, Vanilla Policy Gradient, REINFORCE algorithm and stochastic policy search, Actor-critic methods (A2C, A3C) ,Advanced policy gradient (PPO, TRPO, DDPG),
Model-Based RL: Model-based RL approach
Recent Advances and Applications: Meta-learning. Multi-Agent Reinforcement Learning, Partially Observable Markov Decision Process, Applying RL for real-world problems

UNIT-III

Introduction to Deep learning: Introduction to deep learning and its application,Examples of deep learning
Introduction to Neural Network: Introduction to Neural Network its types and application,Introduction to keras,Introduction to ANN Perceptron and its uses,Multilayer perceptron and deep neural network,Activation function and its working TanH function,sigma ,relu etc ,Feed forward network, Cost function, Backpropagation, Gradient Descent, Regulariztion and dropout technique, Batch normalization.
Types of Neural Network: Convolutional Neural network,CNN Pooling,CNN Layers,Flattening and Full connection,Preparing a fully connected neural network,Introduction to RNN, Deep RNN, Long Short Term Memory, GRU, Transfer Learning,

UNIT – IV

Deep Learning for Natural Language Processing: Introduction to NLP and Vector Space Model of Semantics Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of-Words model (CBOW), Glove, Evaluations and Applications in word similarity, analogy reasoning
Deep Learning for Computer Vision: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models. Attention models for computer vision tasks.

Textbook(s):

1.Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", 2nd Edition, MIT Press, 2019
2. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. "Deep learning." MIT press, 2016.
3. Antonio Gulli and Sujit Pal,"Deep learning with Keras"

References:

1. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning: Adaptation, Learning, and Optimization" (2012)
2. Daniel Slater, Gianmario Spacagna and Peter Roelants, "Python Deep Learning", Packt Publication.

Reinforcement Learning and Deep Learning Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AIML	7	PC	PC	ML-409P
EAE	7	AIML-EAE	AIML-EAE-4	ML-409P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Reinforcement Learning and Deep Learning) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Setting up the Spyder IDE Environment and Executing a Python Program
2. Installing Keras, Tensorflow and Pytorch libraries and making use of them
3. Implement Q-learning with pure Python to play a game
    - Environment set up and intro to OpenAI Gym
    - Write Q-learning algorithm and train agent to play game
    - Watch trained agent play game
4. Implement deep Q-network with PyTorch
5. Python implementation of the iterative policy evaluation and update.
6. Chatbot using bi-directional LSTMs
7. Image classification on MNIST dataset (CNN model with fully connected layer)
8. Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU
9. Applying the Deep Learning Models in the field of Natural Language Processing
10. Applying the Convolution Neural Network on computer vision problems

Reliability & Maintenance Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-2	MEE-322T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about the fundamental concepts, the necessary knowledge and the basic skills related to systems reliability and systems maintenance function.
2.	To understand the techniques of Reliability calculations and related characteristics of components.
3.	To understand necessary engineering techniques used for analysing, planning and controlling Maintenance systems.
4.	To understand about different ways for scheduling maintenance works and know how to use them.

Course Outcomes (CO)

CO 1	Develop a sound understanding of the important role of systems reliability and systems maintenance.
CO 2	Estimate systems reliability both for the independent & dependent cases as well as related characteristics and design systems for better reliability.
CO 3	Analyse and estimate systems maintainability as well as related characteristics and design systems for better maintainability.
CO 4	Understand and apply necessary knowledge about the types of maintenance and know how to use them when designing maintenance systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	3
CO 2	3	3	3	3	-	3	-	-	-	2	-	3
CO 3	3	3	3	3	-	3	-	-	2	2	-	3
CO 4	3	3	3	2	-	3	-	-	2	2	-	3

UNIT-I

Definition and basic concepts: Definition of Reliability, Availability and Maintainability. Random events, Frequency distributions and measures of location, Random variables with examples and probability distributions. Failure data, failure modes: Mean time to failure, MTBF, Failure analysis, Fault tree analysis, FMECA.

Reliability in terms of hazard rate and failure density function: Reliability function, Hazard rate function, PDF, CDF. Hazard models and bath tub curve: Constant, linear and non-linear hazard models. Applicability of Weibull distribution. Reliability calculation: Series, parallel and parallel-series systems, Low level and High level redundancy.

UNIT-II

Reliability calculations for maintained and stand-by systems: Markov analysis, Load sharing system, standby systems, and Three component standby systems.

UNIT-III

Types of Maintenance: Definition of maintenance, Role and scope of maintenance in total organizational context. Objectives and characteristics of maintenance; Centralised vs Decentralised maintenance. Corrective, planned, preventive and predictive maintenance. Factors affecting maintenance; Opportunistic maintenance. Measurement of maintenance work: Mean time to repair, Median time to repair, Mean system down time, Mean time to restore.

UNIT – IV

Rating of maintenance work and allowances: Maintenance performance indices. Maintenance cost budgets; Maintenance planning and scheduling; MIS in maintenance.
Measurement of maintenance effectiveness and maintenance audit.

Textbook(s):

1. Mechanical Reliability Engineering by ADS Carter, Macmilan.
2. Reliabilities for the technologies by L.A. Doty, Industrial Press Inc.

References:

1. Introduction to Reliability Engineering by Dhilon & Singh.
2. Reliability Evaluation of Engineering Systems by Roy Billington and R.N. Allen, Pitman.

Reliability & Maintenance Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-2	MEE-322P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Reliability & Maintenance Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To conduct Failure analysis of a given component.
2. To perform Reliability in terms of hazard rate and failure density function of a given component.
3. To perform Reliability calculation: Series, parallel and parallel-series systems of a given specimen.
4. To perform Markov analysis of given test specimen.
5. To calculate maintenance performance indices of any component.
6. To perform measurement of maintenance work: Mean time to repair for any specimen.
7. To prepare maintenance cost budgets.
8. To perform maintenance audit.
9. To determine the Failure data, failure modes of any component.
10. To determine Mean time to failure of concrete beam.

Remote Sensing Image Analysis and Classification	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IPCV-EAE	IPCV-EAE-4C	IPCV-457T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic knowledge about remote sensing.
2.	To impart knowledge about satellites and sensors.
3.	To impart knowledge about image analysis and image classification.
4.	To impart knowledge about image segmentation and shape analysis.

Course Outcomes (CO)

CO 1	The ability to understand concept, history and scope of remote sensing.
CO 2	To have an understanding about importance and applications of satellites and sensors.
CO 3	The ability to understand about various techniques of image analysis and image classification.
CO 4	To have a good idea about image segmentation and shape analysis.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Overview Of Remote Sensing: Definition, Concept, History & Scope, Energy Resources, Radiation Principles, Electromagnetic Radiation (EMR) and Electromagnetic Spectrum (EMS), Black Body Radiation, Laws of Radiation, Interaction of EMR with Earth's Surface and Atmosphere.

UNIT II

Satellites: Characteristics – Geo-stationary and Sun-synchronous, Earth Resources Satellites -LANDSAT, SPOT, IRS, IKONOS Satellite Series, Meteorological Satellites – INSAT, NOAA, GOES.
Sensors: Types and their characteristics, Across Track (whiskbroom) and Along Track (pushbroom) scanning, Optical Mechanical Scanners – MSS, TM, LISS, WiFS, PAN, Concept of resolution – spatial, spectral, temporal, radiometric, Basic concept and principles of thermal, microwave and hyperspectral sensing.

UNIT III

Image Analysis: Recognizing, Differentiating and Quantifying different types of images, Gray scale and Colour images.
Image Classification: Supervised, Unsupervised Classification, Classification algorithms: Maximum Likelihood, Distance to Mean, Parallel Piped, Classification Accuracy: Error Matrix, Errors of Commission and Omissions, Kappa Statistics Advanced Classification Technique.

UNIT IV

Segmentation Techniques: Thresholding Approaches, Region Growing, Relaxation, Line and Edge Detection Approaches, Edge Linking, Supervised and Unsupervised Classification Techniques, Remotely Sensed Image Analysis and Applications.
Shape Analysis: Gestalt Principles, Shape Number, Moment Fourier and Other Shape Descriptors, Hough Transform, Topological and Texture Analysis, Shape Matching. Practical Applications – Finger Print Classification, Text Recognition.

Textbook(s):

1. Floyd, F. Sabins, Jr: Remote Sensing Principles and Interpretation, Freeman and Co., San Franscisco, 1978
2. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing‘, Pearson, Third Edition, 2010.
3. Illesand and Kiefere: Remote Sensing and Image interpretation, John qwiley, 1987.

References:

1. Bernd Jahne, “Digital Image Processing”, 5th Ed., Springer, 2002.
2. William K Pratt, “Digital Image Processing: Piks Inside”, John Wiley & Sons, 2001.
3. Manual of Remote Sensing Vol. I&II, 2nd Edition, American Society of Photogrammetry.
4. Remote Sensing: The quantitative approach, P.H. Swain and S.M. Davis, McGraw Hill.
5. Imaging Radar for Resource Survey: Remote Sensing Applications, 3, W Travelt, Chapman & Hall.
6. Remote sensing Notes –Edited by Japan Associates of Remote sensing- JARS 1999
7. Anil K. Jain: Fundamentals of Digital Image Processing, Pearson, 2002.
8. John R. Jensen: Introductory Digital Image Processing: A remote sensing perspective, Prentice Hall.

Remote Sensing Image Analysis and Classification Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	IPCV-EAE	IPCV-EAE-4C	IPCV-457P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Remote Sensing Image Analysis and Classification) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of Remote Sensing Imagery for identification of geological, geomorphologic and cultural forms (IRSIA & 1B).
2. Study of Remote Sensing Imagery for Water resources studies (TMIRS & SPOT).
3. Study of Remote Sensing Imagery for Environmental Impact assessment (SPOT).
4. Analysis of spectral reflectance curves.
5. Visual interpretation of satellite images.
6. To implement a Low Pass blurring filter for an image.
7. To implement a High Pass sharpening filter for an image.
8. To implement edge detection on an image. Perform performance comparison of at least two techniques.
9. To implement line detection on an image by using Hough Transform.
10. To implement watershed segmentation on an image.

Renewable Energy and Policies	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	7	PCE	PCE-4	EEE-407

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To explain the concept of solar energy.
2.	To analyse wind and small hydro energy.
3.	To understand non-conventional energy resources.
4.	To analyse the importance of grid connectivity.

Course Outcomes (CO)

CO 1	Determine the need of solar energy and its applications.
CO 2	Utilise the technology for harnessing the wind and small hydro power energy
CO 3	Compare other known conventional energy sources biomas geothermal
CO 4	Discuss the importance of grid connectivity and in providing continuous power

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	-	-	1	3	-	-	-	-	3
CO 2	3	3	2	-	-	2	3	-	-	-	-	3
CO 3	3	-	-	-	-	-	3	-	-	-	-	1
CO 4	3	-	-	-	-	-	-	-	-	-	-	1

UNIT- I

Solar Energy: radiation – extra terrestrial, spectral distribution, solar constant, solar radiation on earth, measurements; solar thermal system – solar thermal power and its conversion, solar collectors, flat plate, solar concentrating collectors, - types and applications; photovoltaic(PV) technology - photovoltaic effect, efficiency of solar cells, semi-conductor materials, solar PV system, standards and applications, tracking.

UNIT- II

Wind and Small Hydropower Energy: wind data, properties, speed and power relation, power extracted, wind distribution and speed prediction, wind map of India; wind turbines and electric generators. fundamentals – types of machines and their characteristics, horizontal and vertical wind mills, elementary design principle, wind energy farms, off-shore plants; small, mini and micro hydro power plants and their resource assessment, plant layout with major components shown.

UNIT- III

Other Non-conventional Energy Sources: biomass – photosynthesis and origin of biomass energy, resources, cultivated resources, waste to biomass, terms and definitions – incineration, wood and wood waste, harvesting super tree, energy forest, phyrolysis, thermo-chemical biomass conversion to energy, gasification, anaerobic digester, fermentation, gaseous fuel; geothermal – resources, hot spring, steam system, principle of working, site selection, associated problems in development; ocean and tidal energy – principle of ocean thermal energy conversion, wave energy conversion machines, problems and limitations, fundamentals of tidal power, conversion systems and limitations; hydrogen energy – properties of hydrogen, sources, production and storage, transportation, problems for use as fuel; fuel cells – introduction with types, principle of operation and advantages.

UNIT-IV

Grid Connectivity: wind power interconnection requirement - low-voltage ride through (LVRT), ramp-rate limitations, supply of ancillary services for frequency and voltage control, load following, reserve requirement, impact of connection on stead-state and dynamic performance of power system; interfacing dispersed generation of solar energy with the grid, protective relaying, islanding, voltage flicker and other power quality issues; role of non-conventional energy system in smart grid.

Textbooks:

1. Tiwari and Ghosal, “Renewable Energy Resources: Basic Principle & Application”, NarosaPub.
2. S N Bhadra ,D, Kastha,’Wind Electrical Systems” Oxford Publication 2014

References:

1. John Twidell, “Renewable Energy Sources”, Taylor and Francis
2. Godfrey Boyle, “Renewable Energy: Power for a Sustainable Future”, Oxford University Press
3. Ewald F. Fuchs, “Power Conversion of Renewable Energy Systems”, Springer
4. B. H. Khan, “Non Conventional Energy”, Tata McGraw Hill
5. D P kothari ,”Wind energy System and applications” Narosa Pub 2014

Research Methodology for Electrical & Electronics Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-2	EEE-334T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand different types of research methodology
2.	To create datasheet and its analysis
3.	To implement optimization techniques
4.	To design research papers

Course Outcomes (CO)

CO 1	Ability to understand different types of research methodology
CO 2	Ability to create datasheet and its analysis
CO 3	Ability to implement optimization techniques
CO 4	Ability to design research papers

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT I

Research Formulation and Design: Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

UNIT II

Data Collection and Analysis: Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools,data analysis with statically package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing

UNIT III

Soft Computing: Computer and its role in research, Use of statistical software SPSS, GRETL etcin research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems

UNIT IV

Research Ethics, IPR and Scholary Publishing: Ethics-ethical issues, ethical committees (human & animal); IPR-intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

Textbooks:
1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.

References:
1. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
2. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.

Research Methodology for Electrical & Electronics Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-2	EEE-334P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Research Methodology for Electrical & Electronics Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the different types of research methodology.
2. To understand how to create datasheet, processing and do its analysis.
3. Take one research paper and do literature survey for the same.
4. To study different soft computing techniques and learn how to implement it on your research.
5. To do practice to identify the research problem based on literature survey.
6. To learn how to determine research objectives based on research problem.
7. Try to implement the research objectives in the system by using software tool like MATLAB, Python etc.
8. Write research paper based on your system results and check its plagiarism.

RF and Microwave Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-1	ECE-314T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	An understanding of metallic waveguides and network analysis.
2.	A through understanding is presented on microwave active and passive components along with methods to evaluate device performance.
3.	Realize the need for microwave sources and understand the principle of microwave tube
4.	An ability to perform microwave measurements

Course Outcomes (CO)

CO 1	Understand the basic concepts of two port network of RF and Microwave systems and different parameters like Scattering parameters and ABCD parameters
CO 2	Analyze the performance parameters of RF and microwave passive components and active components.
CO 3	Evaluate and analyze the Performance of RF and microwave source.
CO 4	Perform measurements on microwave devices and networks using power meter and VNA etc

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	2	3	3	3	2	3	1	3	2	1	2
CO 2	3	3	2	2	3	2	1	-	2	3	-	2
CO 3	2	3	3	2	2	1	2	2	3	3	1	-
CO 4	2	2	3	3	3	2	2	2	3	3	2	1

UNIT-I

Introduction of Microwave and RF Engineering, Applications of Microwave and RF Engineering: Maxwell`s equation, wave equation and their solution (in rectangular coordinates). **Rectangular waveguide**: TE and TM modes, field configurations, dominant and degenerative modes, propagation characteristics. Power transmission and power loss in waveguide. **Solutions of Wave Equations in Cylindrical Coordinates;** TE Modes in Circular Waveguides, TM Modes in Circular Waveguides.

Two Port Network Theory: Impedance and Equivalent Voltages and Currents, Impedance and Admittance Matrices, Network parameters for microwave Circuits, The Scattering Matrix, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, ,

Unit II

Microwave Waveguide Components: E -plane Tee, H-plane - Tee, Magic-Tee Directional Coupler, Power Divider, Magic Tee, Circulator, Isolator and Resonator.
Microwave Solid State Devices: Tunnel diode, Varactor diodes, Schottky Barrier diodes, PIN diodes, Gunn Diodes, IMPATT and TRAPATT diodes, Varactor Diodes.
Microwave Field Effect Transistor; Junction Field effect Transistors; Physical Structure, Principles of Operation, Current-Voltage Characteristics, Metal-Semiconductor Field-Effect Transistors; Physical Structures, Principles of Operation, Performance characteristics; High Electron Mobility Transistor (HEMT): Physical Structures, Principles of Operation, Performance characteristics

Unit III

Linear Beam Tubes: Review of conventional vacuum, High frequency effects in vacuum Tubes; Two cavity klystron (working, principle, velocity modulation, bunching process) Reflex klystron (working principle, bunching process, condition of oscillation), application of klystrons. Travelling Wave tube, slow wave structure, helix TWT (construction and working).
Cross Field Tubes: Cylindrical magnetron (construction, working principle, Hull cut-off Equations), application of magnetron.

Unit IV

Microwave Measurements: Measuring Instruments: Principle of operation and application of VSWR meter, Power meter, Spectrum analyzer, Network analyzer, Measurement of Impedance, Frequency, Power, VSWR, Q factor

Textbooks:
1. D.M Pozar, “Microwave Engineering”, Wiley Publications.
2. Samuel y. Liao, ‘microwave devices and circuits’ third edition
3. Robert E Colin, “Foundations for Microwave Engineering”, John Wiley & Sons Inc, 2005
4. Annapurna Das, Sisir K.Das- Microwave engineering, (TMG)

References:
1. Reinhold Ludwig and Gene Bogdanov, “RF Circuit Design: Theory and Applications”, Pearson, 2011
2. Mathew M Radmanesh, “RF and Microwave Electronics”, Prentice Hall, 2000

RF and Microwave Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-1	ECE-314P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (RF and Microwave Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To measure the frequency and wavelength using slotted line section and frequency meter.
2. To measure the Isolation and Insertion loss of Isolator and Circulator.
3. To study E-plane, H-plane and Magic Tee.
4. To measure Coupling Factor, Directivity and Isolation of directional coupler.
5. To measure VSWR and Reflection coefficient of different loads.
6. To study the characteristics of Klystron and Gunn diode.
7. Simulation of Transmission line: Waveguide and Coaxial line.*
8. Simulation of directional coupler.*
9. Simulation of E-plane and H-plane Tee.*
10. Study of micro strip line and LPF using MIC kit/Software.*
11. Study of BPF using MIC kit/ Software.* *

* These experiments may be performed using simulation software like HFSS, CST or IE3D (for planar circuits) etc.

RF Components and Circuit Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-4	ECE-403T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To comprehend the analysis of RF circuits understanding the concepts of RF circuits
2.	Realize the perceptions of the RF active and passive components
3.	To communicate the expertise of design attributes of RF amplifiers
4.	To study the amplifier & Oscillators

Course Outcomes (CO)

CO 1	To understand the basic of Passive components.
CO 2	To Comprehend different RF active Components
CO 3	Able to exploit the models of the RF amplifier.
CO 4	To develop RF oscillator and analyse characteristics of mixer.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Overview to RF Electronics: Importance of RF Design, RF Behavior of Passive Components: High Frequency Resistors, High-Frequency Capacitors, High-Frequency Inductors. Chip Components and Circuit Board Considerations: Chip Resistors, Chip Capacitors, Surface-Mounted Inductors

UNIT II

Active RF Components: Semiconductor Basics – Physical Properties of Semiconductors, the PN-Junction, Schottky Contact. RF Diodes-Schottky Diode, PIN Diode, Varactor Diode, Tunnel Diode. Bipolar-Junction Transistor- Construction, Functionality and Frequency Response. RF Field Effect Transistors- Construction, Functionality, Frequency Response. High Electron Mobility Transistor (HEMT) Construction, Functionality, Frequency Response.

UNIT III

RF Transistor Amplifier Design: Characteristics of Amplifiers – Amplifier Circuit Configurations, Amplifier Matching Basics, Distortion and noise products, Stability Considerations, Small Signal amplifier design, Power amplifier design.

UNIT IV

Basic Oscillator and Mixer Model: Negative Resistance Oscillator, Feedback Oscillator Design, Design Steps, Quartz Oscillators. High Frequency Oscillator Configuration: Fixed Frequency Oscillators, Dielectric Resonator Oscillators, YIG-Tuned Oscillators, Voltage Controlled Oscillators, Gunn Element Oscillator. Basic Characteristics of Mixers: Basic Concepts, Frequency Domain Considerations, Single-Balanced Mixer Double-Balanced Mixer.

Textbook(s):
1. Reinhold Ludwing and Gene Bogdnov - RF Circuit Design: Theory and applications, Pearson, New Delhi 2001
2. Joseph Carr., Secrets of RF Design 3rd Ed., Tata McGraw-Hill Publishing Company Limited.

References:
1. Radio frequency and Microwave Electronics - Mathew M.Radmangh, 2001, PE Asia Publ.
2. RF Circuit Design – Christopher Bowick, Cheryl Aljuni and John Biyler, Elsevier Science, 2008.
3. D.M.Pozar, “Microwave Engineering”, Wiley India Limited, Third Edition, 2007

RF Components and Circuit Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-4	ECE-403P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (RF Components and Circuit Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Design an experiment to develop I-V characteristics of microwave Gunn diode and to measure output power and frequency as a function of bias voltage using microwave test bench.
2. Design an experimental setup to carry out square wave modulation through PIN diode.
3. Study of vector network analyzer.
4. Development of MMIC assembly (MOSFET/Frequency doubler/mixer) using EM simulated software
5. Design of microwave filter using EM simulated software
6. Measurement of performance parameters of RF mixer.
7. To plot frequency response of high frequency resistor.
8. To plot frequency response of high frequency capacitor.
9. To plot frequency response of high frequency inductor.
10. Measurement of performance parameters of microwave amplifier.
11. Measurement of performance parameters of RF Switch.
12. Measurement of performance parameters of microwave voltage-controlled oscillator.

Note: These experiments may be performed using simulation software like HFSS, CST or IE3D (for planar circuits) etc.

Robot Actuation Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	RA-EAE	RA-EAE-3	RA-437T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To expose the student will be exposed to the concepts of automation and use of various robots.
2.	To introduce the student about components of industrial robots and concepts of kinematics, dynamics.
3.	To learn the mathematical approach to calculate the dynamic forces in robots.
4.	To expose students to the industrial application of the robots in manufacturing.

Course Outcomes (CO)

CO 1	Identify various robot configuration and components and selecting appropriate actuators for robots.
CO 2	Carry out kinematic and dynamic analysis for simple serial kinematic chains.
CO 3	Perform trajectory planning for a manipulator by avoiding obstacles.
CO 4	Use knowledge of robotics for automation in manufacturing applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	-	-	-	-	-	-	-	2
CO 2	3	2	3	2	-	-	-	-	-	-	-	2
CO 3	3	2	3	2	-	-	-	-	-	-	-	2
CO 4	3	2	3	2	-	-	-	-	--	-	-	2

UNIT-I

Robot, Types of robot, uses in industry, anatomy, work volume, Drive systems, Automation and Robotics, types of automation, assembly automation equipment, material handling systems, feed systems, Automated Guided Vehicles, Automated storage and retrieval systems, Flexible Manufacturing Systems, Computer Aided Process Planning Systems, Computer Aided manufacturing. CAD/CAMand Robotics–An overview of Robotics –present and future applications–classification by coordinate system and control system.

UNIT-II

Components of Industrial Robotics: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom–Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

Motion Analysis: DH notation, Forward Kinematics and Inverse kinematics: Mapping, Homogenous transformation

UNIT-III

Jacobian, Linear and angular velocity of rigid link. Velocity Kinematics, Acceleration Kinematics. Lagrangian mechanics, formulation and numerical, Motion dynamics, Robot Dynamics

UNIT – IV

Actuators: Pneumatic, Hydraulic actuators, electric& stepper motors. Feedback components: position sensors–potentiometers, resolvers, encoders–Velocity sensors.
Robot Applications in Manufacturing: Material Transfer-Material handling, loading and unloading-Processing - spot and continuous arc welding & spray painting-Assembly and Inspection.

Textbooks:

1. R.K. Mittal, I.J. Nagrath, "Robotics & Control", Tata McGraw & Hills, 2005.
2. Saha, S.K., Introduction to Robotics, 2nd Edition, McGraw-Hill Education, New Delhi, 2014.

References:

1. John J.Craig; "Introduction to Robotics Mechanics & Control", Pearson Education, 2004.
2. Robert J. Schilling, "Fundamentals of Robotics, analysis & Control", Prentice Hall (I) P. Ltd., 2002.
3. Mark W. Spong, Seth Hutchinson, M. Vidyasagar "Robot Modeling and Control" John Wiley 2nd Ed.
4. J Srinivasan, R.V.Dukkipati, K. Ramji, "Robotics control & programming", Narosa.
5. Ghosal, Ashitava, "Robotics: Fundamental Concepts and Analysis," Oxford University Press, 2006.
6. M. Murray, M., Li, Zexiang, Sastry, S.S., "A Mathematical Introduction to Robotic Manipulation,"CC Press.
7. Mikell P Groover, Mitchell Weiss "Industrial Robotics: Technology, Programming and Application".

Robot Actuation Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	RA-EAE	RA-EAE-3	RA-437P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Robot Actuation Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study about robot and its application in industry.
2. To study the DH based parameters and orientation of a given robot.
3. To study the kinematics of robot using Robo Analyzer.
4. To study the forward kinematics for a particular robot and validate using Robo Analyzer.
5. To study the inverse kinematics for a particular robot and validate using Robo Analyzer.
6. To design a robot and calculate the robot cycle time in a work cell.
7. Positioning and orientation of a robotic arm.
8. Case study/Project work/simulation etc.
9. To study working principle of Robotic Arm.
10. To operate perform Pick and Place task using Robotic Arm
11. Image processing using Open source software Open CV.

Robot Kinematics and Dynamics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	RA-EAE	RA-EAE-1	RA-324T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Provide a mathematical and geometrical description of robotic manipulators.
2.	To Derive from first principles robot dynamics and know how to simulate them.
3.	To Understand basic robot control architectures.
4.	To Articulate result of robot dynamics and kinematics in industrial environment.

Course Outcomes (CO)

CO 1	Ability to analyze and design the motion for robotic system.
CO 2	Ability to understand the robot kinematics and differential motion.
CO 3	Ability to acquire the knowledge on robot dynamics, various actuation mechanisms and gripper/tool selection criteria.
CO 4	Ability to have knowledge about different layouts, inspection techniques and material handling using robots.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Robot, Types of robot, uses in industry, anatomy, work volume, Drive systems, Introduction to Spatial Descriptions, Motion Kinematics and parameters.

UNIT-II

DH notation, Forward Kinematics and Inverse kinematics: Mapping, Homogenous transformation Jacobian, Linear and angular velocity of rigid link. Velocity Kinematics, Acceleration Kinematics.

UNIT-III

Lagrangian mechanics, formulation and numerical, Motion dynamics, Robot Dynamics, Path Definition, Path

Control, Robot Control ,Walking and parallel Robots.

UNIT – IV

End effectors: Mechanical and other types of grippers, Tool as end effectors, Compliant and Soft robots, Physical Human –Robot Interaction.
Flexible automation, Robot cell layouts, Machine interference, Other considerations in work cell design. Work cell control, interlocks. Robot cycle time analysis.

Textbooks:

1. R.K. Mittal, I.J. Nagrath, "Robotics & Control", Tata McGraw & Hills, 2005.
2. Saha, S.K., Introduction to Robotics, 2nd Edition, McGraw-Hill Education, New Delhi, 2014.

References:

1. John J.Craig; "Introduction to Robotics Mechanics & Control", Pearson Education, 2004.
2. Robert J. Schilling, "Fundamentals of Robotics, analysis & Control", Prentice Hall (I) P. Ltd., 2002.
3. Mark W. Spong, Seth Hutchinson, M. Vidyasagar "Robot Modeling and Control" John Wiley 2nd Ed.
4. J Srinivasan, R.V.Dukkipati, K. Ramji, "Robotics control & programming", Narosa.
5. Ghosal, Ashitava, "Robotics: Fundamental Concepts and Analysis," Oxford University Press, 2006
6. M. Murray, M., Li, Zexiang, Sastry, S.S., "A Mathematical Introduction to Robotic Manipulation," CC Press, 1994.
7. Tsai, L.W., "Robot Analysis: The Mechanics of Serial & Parallel Manipulators," Wiley 1999.
8. Niku, S. B., "Introduction to Robotics: Analysis, Systems, Applications", Prentice Hall, 2001.
9. Mikell P Groover, Mitchell Weiss "Industrial Robotics: Technology, Programming and Application" Tata McGraw & Hills, 2009.

Robot Kinematics and Dynamics Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	RA-EAE	RA-EAE-1	RA-324P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Robot Kinematics and Dynamics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study about robot and its application in industry.
2. To study the DH based parameters and orientation of a given robot.
3. To study the kinematics of robot using RoboAnalyzer.
4. To study the forward kinematics for a particular robot and validate using RoboAnalyzer.
5. To study the inverse kinematics for a particular robot and validate using RoboAnalyzer.
6. To design a robot and calculate the robot cycle time in a work cell.
7. Positioning and orientation of a robotic arm.
8. Case study/Project work/simulation etc.
9. To study working principle of Robotic Arm.
10. To operate perform Pick and Place task using Robotic Arm
11. Image processing using Open source software Open CV.

Robotics Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-3	MEE-328T
MAE	7	PC	PC	MAC-409
CSE-in-EA	7	OAE-CSE-EA	OAE-2	MAC-409T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Ability to analyze and design the motion for robotic system.
2.	Ability to understand the robot kinematics and differential motion through manipulator Jacobian.
3.	Ability to acquire the knowledge on robot dynamics, various actuation mechanisms and gripper/tool selection criteria.
4.	Ability to have knowledge about the different applications of robots in industries i.e. inspection techniques and material handling.

Course Outcomes (CO)

CO 1	Define and relate the relationship between mechanical structures of robot and predict their operational workspace.
CO 2	Estimate and compute the spatial transformation to demonstrate robot kinematics thorugh Jacobian matrix.
CO 3	Associate and apply knowledge of robot dynamics and outline the gripper/tool selection criteria.
CO 4	Recognize and summarize the applications of robot in industries i.e. inspection techniques and material handling.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	3	3	1	2	3
CO 2	3	3	3	3	3	3	3	3	3	1	2	3
CO 3	3	3	3	3	3	3	3	3	3	2	2	3
CO 4	3	3	3	3	3	3	3	3	3	3	2	3

UNIT-I

Fundamentals of robot technology: Robot anatomy. Work volume. Drive systems. Control systems and dynamic performance. Accuracy and repeatability. Sensors in robotics. Robot reference frames and coordinates and robot kinematics. Path control.

UNIT-II

Robot kinematics: Matrix representation. Homogeneous transformations. Forward and inverse kinematics.

Robot dynamics: Differential motions of a frame. Jacobian, static force analysis.

UNIT-III

Configuration of a robot controller End effectors. Mechanical and other types of grippers. Tools as end effectors. Robot and effector interface. Gripper selection and design. Introduction to robot languages.
End effectors: Mechanical and other types of grippers. Tools as end effectors. Robot and effector interface. Gripper selection and design.

UNIT – IV

Applications for manufacturing: Flexible automation. Robot cell layouts. Machine interference. Other considerations in work cell design. Work cell control, interlocks. Robot cycle time analysis. Typical applications of robots in material transfer, machine loading/unloading; processing operations; assembly, and inspection.

Textbook(s):

1. Saeed B. Niku, “Introduction to Robotics analysis, Systems & Applications”, Pearson Education Singapore P. Ltd., 2002.
2. S.R. Deb, “Robotic Technology and Flexible Automation”, Tata McGraw Hill Publishing Co. Ltd., 2003.

References:

1. Robert J. Schilling, “Fundamentals of Robotics, analysis & Control”, Prentice Hall of India P. Ltd., 2002.
2. John J.Craig; “Introduction to Robotics Mechanics & Control”, Pearson Education, 2004.

Robotics Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-3	MEE-328P
MAE	7	PC	PC	MAC-461
CSE-in-EA	7	OAE-CSE-EA	OAE-2	MAC-409P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Robotics Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to RoboAnalyzer and WorkSpace 5.0
2. To make solids objects, modify them in Workspace 5.0 by importing a robot in workspace.
3. To create an auxiliary axis, robot mechanism and new robot in Workspace 5.0.
4. To study various Virtual Models of Industrial Robots in Robo Analyzer.
5. To Understand the Coordinate Frames and Transformations in Robo Analyzer.
6. To understand the robot forward kinematics in RoboAnalyzer.
7. To understand the robot inverse kinematics in RoboAnalyzer.
8. To understand the robot dynamics in Robo Analyzer.
9. To do the following task in Roboanalyzer: Select the robot in virtual robot module and learn about joint level jogging of robots.
10. Write a program for joint trajectories of 2- link arm in MATLAB.

Semiconductor Devices and Modelling	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	VLSI-EAE	VLSI-EAE-1	VLSI-328T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic operation of semiconductor devices.
2.	To impart the knowledge of semiconductor materials.
3.	To study the physics of junction device & its applications.
4.	To study FET structure & process simulation

Course Outcomes (CO)

CO 1	To understand the basic operation of semiconductor devices.
CO 2	To provide the knowledge of semiconductor materials.
CO 3	Understand the physics of junction device & its applications.
CO 4	Analyze FET structure & process simulation.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	3	3	3	2	2	-	2	2	3	3
CO 2	3	2	3	3	2	2	3	-	3	2	2	3
CO 3	3	3	3	2	3	2	3	-	2	2	3	2
CO 4	3	3	3	3	2	3	2	-	2	3	3	2

UNIT I

Review of semiconductor physics, p-n Junction diode: Physical operation, I-V characteristic and diode equation, Concept of load line, p-n junction capacitances (depletion and diffusion), small signal (low and high frequency) model, Large-signal model, Breakdown in p-n diodes, Zener diode, Poisson’s equation.
Crystals and Band structures: Crystal Structure, Lattice, Lattice with basis, Band structure evolution, Density of states, Carrier Statistics.

UNIT II

Semiconductors in Equilibrium and Carrier Transport in Semiconductors: Semiconductor Materials, Concept of intrinsic and extrinsic semiconductors, Fermi level Carrier Concentration, Carrier Drift, Carrier Diffusion, Generation and Recombination Process, Continuity Equation, Thermionic Emission, Tunnelling, High Field Effects.

.

UNIT III

Diode Applications: Rectifier circuits, Zener diode-based voltage regulators, limiting and clamping circuits, voltage multipliers, switching behaviour of p-n diode, SPICE model of p-n diode, an example of p-n diode data sheet., zener diode and LED, diode as a rectifier.

Physics of Junction Devices: Thermal Equilibrium Condition, Depletion Region, Depletion and Diffusion Capacitances, Current-Voltage Characteristics, Junction Breakdown, Metal Semiconductor Contacts, transistor (PNP and NPN) characteristics, current and voltage gain.

UNIT IV

FET: UJT, BJT, Introduction, channel transmission, Introduction to the Virtual source model, channel length modulation, drain induced barrier lowering, punch through, hot carrier effects, DC gate current, junction leakage: leakage currents, band to band tunnelling and GIDL.

Process Simulation /Process Modeling: Introduction of process simulation, modeling and simulation of oxidation and diffusion, Ion implantation, Masking, Fick’s laws, Case Study: SUPERM.

Textbook(s):

1. Introduction to Semiconductor Materials and devices by M.S Tyagi, John Wiley & Sons, 5th Edition, 2005.
2. Semiconductor Devices: Modeling and Technology by A Dasgupta, N. Dasgupta, Prentice Hall, 2004.
3. Solid State Physics by Neil W. Ashcroft, N. David Mermin, Cengage Learning, 2011.

References:

1. Physics of Semiconductor Devices by S. M. Sze and Kwok K. Ng, John Wiley & Sons, 3rd Edition, 2002.
2. Solid State Electronic Devices by Ben G. Streetman and Sanjay Banerjee, Prentice Hall, 6th Edition 2005.
3. Semiconductor Device Fundamentals by Robert F. Pierret, Addison-Wesley Publishing, 1996.
4. Semiconductor Physics and Devices by Donald A. Neamen, McGrawHill, 3 rd Edition 2003.
5. Semiconductor Devices- Basic Principles by Jasprit Singh, John Wiley and Sons Inc., 2001.

Semiconductor Devices and Modelling Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	VLSI-EAE	VLSI-EAE-1	VLSI-328P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Semiconductor Devices and Modelling) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to SPICE (Operating Point Analysis, DC Sweep, Transient Analysis, AC Sweep, Parametric Sweep, Transfer Function Analysis).
2. Measure, analyse, and model the IV characteristics of the diode
3. ZENER DIODE CHARACTERISTICS AND ZENER AS VOLTAGE REGULATOR
4. HALF -WAVE RECTIFIER WITH AND WITHOUT FILTER.
5. FULL -WAVE RECTIFIER WITH AND WITHOUT FILTER.
6. Draw the frequency response of CS amplifier using Multisim.
7. INPUT AND OUTPUT CHARACTERISTICS OF TRANSISTOR
8. Demonstrate the Volt-ampere characteristics of silicon-controlled rectifier.
9. To study the V-I characteristics of FET.
10. To study the equivalent circuit model for MOSFET.
11. To study FET model for calculating Drain Induced Barrier Lowering (DIBL).
12. To study FET model for calculating Gate induced drain leakage (GIDL).

Sensors and Transducers	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	4	PC	PC	ICC-210
MAE	5	PC	PC	MAC-311

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide an understanding about the concepts of measurement system its static and dynamic characteristics.
2.	To expose the students to various sensors and transducers for measuring mechanical quantities and their applications.
3.	To teach the basic conditioning circuits for various sensors and transducers.
4.	To introduce about advancements in sensor technology and smart sensors.

Course Outcomes (CO)

CO 1	Ability to define, understand various Sensors, their need and properties of sensors.
CO 2	Ability to apply knowledge of various types of transducers in domestic and industrial applications
CO 3	Ability to analyse various types of sensors for particular application.
CO 4	Ability to design signal conditioning circuit for various sensors and transducers.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT I

Introduction to sensors and Transducers: General concepts and terminology of measurement systems and its functional elements, transducer classification, static and dynamic characteristics of a measurement system, criteria for transducer selection.

Resistive Transducers: Principles of operation, construction, theory, signal conditioning circuits and applications of resistance potentiometers, strain gauges (metallic and semi-conductor type), resistance thermometer, thermistors, photo transistors.

UNIT II

Displacement Sensors and Transducers: Capacitive Transducers: Types of capacitive transducer, Principles of operation, construction, theory, signal conditioning circuits and applications of capacitive transducers

Inductive Transducers: Types of Inductive transducer, Principles of operation, construction, signal conditioning circuits and applications of various variable inductive transducers, LVDT , RVDT Eddy current sensors, Synchros.
Temperature and Radiation Sensors: Active Transducers: Principle of operation, construction, theory, signal conditioning and applications of Piezo-electric transducer, Magneto-strictive transducer, Hall effect transducer, Photo-voltaic transducer and Thermocouple

UNIT III

Optical transducers: photo-emissive, photo-conductive and Photovoltaic cells, photomultipliers
Digital Transducers: Optical encoders translational and rotary encoders (absolute position and incremental position encoders) and magnetic pickups.
Smart Sensors and Other transducers: Ultrasonic sensors, Vibration pickups and accelerometers and its dynamic response, stroboscope, sound and humidity sensors Microelectromechanical System (MEMS), Biosensors: Glucometer, Oxymeter, Nanosensors and its application, Smart sensor system.

UNIT IV

Chemical Sensors: Definition, Components, Recognition Methods, Transduction Methods, Sensor Configuration and Fabrication, Sensor Calibration, Sensor Figures of Merit, Sensor Arrays, Sensors in Flow Analysis Systems, Applications of Chemical Sensors.
Biosensors: Protein Structure and Properties, Enzyme Nomenclature and Classification, Enzyme Components and Cofactors, Some Enzymes with Relevance to Biosensors, Tranduction Methods in Enzymatic Biosensors.

Textbook(s):

3. D. Patranabis, Sensors and Transducers, PHI Learning Pvt. Ltd., 2nd edition.
4. D V S Murty, Transducers and Instrumentation, PHI Learning Pvt. Ltd.
5. Florinel-Gabriel Banica, Chemical Sensors and Biosensors: Fundamentals and Applications, Wiley, 2012

References:

3. E.O. Doebelin, Dhanesh N Manik, Measurement Systems, 6th Edition, McGraw Hill Edu.
4. John P. Bentely, Principles of Measurement System, 4th Edition, Pearson Prentice Hall

Sensors and Transducers Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	4	PC	PC	ICC-256
MAE	5	PC	PC	MAC-355

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Sensors and Transducers) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

12. Study of static and dynamic characteristics of sensors.
13. Measurement of displacement using LVDT
14. Measurement of strain using strain gauge transducer.
15. Measurement of displacement using potentiometer.
16. Measurement of temperature using RTD and plot the characteristics of RTD.
17. Measurement of temperature using thermister.
18. Measurement of pressure using Load cell.
19. Measurement of speed using magnetic sensor.
20. Measurement of speed using photoelectric sensors.
21. Measurement of pressure using pressure transducer.
22. Measurement of liquid level using capacitive sensor.

Service Oriented Architecture	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CST	6	PCE	PCE-2	CIE-346T
CSE-in-EA	6	OAE-CSE-EA	OAE-1	SE-352T
EAE	6	SE-EAE	SE-EAE-2A	SE-352T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn fundamentals of XML
2.	To provide an overview of Service Oriented Architecture and Web services and their importance
3.	To learn web services standards and technologies
4.	To learn service oriented analysis and design for developing SOA based applications

Course Outcomes (CO)

CO 1	Able to understand XML technologies
CO 2	Able to understand service orientation, benefits of SOA
CO 3	Able to understand web services and WS standards and use web services extensions to develop solutions
CO 4	Able to understand and apply service modeling, service oriented analysis and design for application development

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	3	2	-	-	-	3	2	2	3
CO 2	3	2	2	3	2	-	-	-	3	2	2	3
CO 3	3	2	2	3	2	-	-	-	3	2	2	3
CO 4	3	2	2	3	2	-	-	-	3	2	2	3

UNIT-I

XML: XML document structure – Well-formed and valid documents – DTD – XML Schema – Parsing XML using DOM, SAX – XPath - XML Transformation and XSL – Xquery.

UNIT-II

Service Oriented Architecture Basics: Characteristics of SOA, Benefits of SOA , Comparing SOA with Client-Server and Distributed architectures –-- Principles of Service Orientation – Service layers.

UNIT-III

Web Services and Standards: Web Services Platform – Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI – Service-Level Interaction Patterns – Orchestration and Choreography.

UNIT – IV

Web Services Extensions: WS-Addressing - WS-Reliable Messaging - WS-Policy – WS-Coordination – WS - Transactions - WS-Security – Examples.
Service Oriented Analysis and Design: SOA delivery strategies – Service oriented analysis – Service Modelling – Service oriented design – Standards and composition guidelines -- Service design – Business process design – Case Study.

Textbook(s):
1. Thomas Erl, Service Oriented Architecture: Concepts, Technology, and Design, Pearson Education, 2005.
2. Sandeep Chatterjee and James Webber, Developing Enterprise Web Services: An Architect's Guide, PHI, 2004

References:
1. James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, Java Web Services Architecure, Elsevier, 2003
2. Ron Schmelzer et al., XML and Web Services, Pearson Education, 2002.

Service Oriented Architecture Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CST	6	PCE	PCE-2	CIE-346P
CSE-in-EA	6	OAE-CSE-EA	OAE-1	SE-352P
EAE	6	SE-EAE	SE-EAE-2A	SE-352P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Service Oriented Architecture) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To create a web service for adding few numbers using NetBeans.
2. To create a web service for adding few numbers using NetBeans and write client side code to invoke the web service.
3. To Create of a web service with database connectivity using NetBeans
4. Create a SOA project with BPEL Module to compose a web service.
5. Develop at least 5 components such as Order Processing, Payment Processing, etc., using .NET component technology.
6. Develop at least 5 components such as Order Processing, Payment Processing, etc., using EJB component technology.
7. Invoke .NET components as web services.
8. Invoke EJB components as web services.
9. Develop a J2EE client to access a .NET web service.
10. Develop a .NET client to access a J2EE web service.

Simulation and Modelling	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	6	PCE	PCE-1	CIE-322T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To make students understand the concept of simulation and modeling of real time systems.
2.	Generate random numbers and random variates using different techniques.
3.	Analysis of Simulation models using input analyzer, and output analyser.
4.	Explain Verification and Validation of simulation model.

Course Outcomes (CO)

CO 1	Students will be able to describe the role of important elements of discrete event simulation and modeling paradigm.
CO 2	Students will be able to conceptualize real world situations related to systems development decisions, originating from source requirements and goals.
CO 3	Students will be able to develop skills to apply simulation software to construct and execute goal-driven system models.
CO 4	Students will be able to interpret the model and apply the results to resolve critical issues in a real world environment.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	2	1	-	-	2	2	-	1	-	-
CO 2	2	3	-	2	-	-	-	2	-	-	-	-
CO 3	3	2	2	2	-	-	2	1	-	2	-	-
CO 4	2	2	2	1	-	-	-	2	-	-	-	-

UNIT-I

Introduction to Simulation: System and System Environment, Components of System, Discrete and Continuous System, System Simulation, Model of a System, Types of Model, Use of Differential and Partial differential equations in Modeling, Advantages, Disadvantages and Limitations of Simulation, Application Areas, Phases in Simulation Study.
Simulation of Continuous System: Continuous System Models, Analog Computer, Analog Methods, Hybrid Simulation, Digital-Analog Simulators, Feedback Systems.

UNIT-II

Simulation of Discrete System: Discrete Event Simulation, Representation of time, Simulation Clock and Time

Management, Models of Arrival Processes - Poisson Processes, Non-stationary Poisson Processes, Batch Arrivals; Gathering statistics, Probability and Monte Carlo Simulation

Queuing System: Characteristics and Structure of Basic Queuing System, Models of Queuing System, Queuing notation, Single server and Multiple server Queueing Systems, Measurement of Queueing System Performance, Elementary idea about networks of Queuing with particular emphasis to computer system, Applications of queuing system.

UNIT-III

Markov Chains: Features, Process Examples, Applications.

Random Numbers: Random Numbers and its properties, Pseudo Random Numbers, Methods of generation of Random Number, Tests for Randomness - Uniformity and independence, Random Variate Generation.

Verification and Validation: Design of Simulation Models, Verification of Simulation Models, Calibration and Validation of the models, Three-Step Approach for Validation of Simulation Models, Accreditation of Models.

UNIT – IV

Analysis of Simulation Output: Confidence Intervals and Hypothesis Testing, Estimation Methods, Simulation run statistics, Replication of runs, Elimination of initial bias.

Simulation of Computer Systems: Simulation Tools, Simulation Languages: GPSS, Case Studies of different types of Simulation Models and Construction of sample mathematical models**.**

Textbook(s):

1. Jerry Banks, John S. Carson, Barry L. Nelson, David M. Nicole, “Discrete Event System Simulation”, 5th Ed., Pearson Education
2. Narsingh Deo, Systems Simulation with Digital Computer, PHI Publication.

References:

1. Geoffrey Gordon, System Simulation, Prentice Hall publication.
2. Averill M Law, W David Kelton, Simulation Modelling & Analysis, McGraw Hill International Editions

Simulation and Modelling Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	6	PCE	PCE-1	CIE-322P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Simulation and Modelling) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Implement different methods of random number generation.
2. Simulating games of dice that generate discrete random variate, using random number generation.
3. Testing of random numbers (K-S and Chi Square Test).
4. Implementing applications of Monte Carlo methods.
5. Implement applications of Markov's chain.
6. Simulation of single queue server system.
7. Simulation of 2 queue server system.
8. Program to implement simulation of Inventory System.
9. Program to implement simulation of Telephonic System.
10. GPSS models - queue, storage, facility, multi-server queue, decision making problems.

Smart and Wireless Instrumentation	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-2	ICE-324T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To develop an basic understanding of Smart & wireless instrumentation
2.	To make students capable of analyzing different node architectures.
3.	To make students capable of designing & developing applications using WSN (Wireless Sensor Network)
4.	Ability of students to apply wireless sensors for various applications.

Course Outcomes (CO)

CO 1	Understanding of Smart & wireless instrumentation
CO 2	Analysis of Node architecture.
CO 3	Design and Develop applications using WSN (Wireless Sensor Network)
CO 4	Application of wireless sensors

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	-	-	-	-	3	-	-	-	-	3
CO 2	3	3	-	-	-	-	3	3	3	-	-	3
CO 3	3	2	3	-	-	-	3	3	3	-	-	3
CO 4	3	3	-	-	-	3	3	3	3	-	3	3

Unit I

Introduction: Smart Instrumentation (Materials , automation systems, sensing and sensors, sensor classifications, Wireless sensor Networks ,History of wireless sensor Networks(WSN), Communication in a WSN, important design constraints of WSN like Energy, self Management, Wireless Networking,Decentralized Management, Design Constraints, Security etc.

Unit II

Node Architecture: The sensing subsystem, Analog to Digital converter, the processor subsystem, architectural overview , microcontroller , digital signal processor, application specific integrated circuit, field programmable gate array (FPGA), comparison, communication interfaces, serial peripheral interface, integrated circuit, the IMote node architecture, The XYZ node architecture , the Hogthrob node architecture.

Unit III

Frequency of Wireless Communication & Power Sources - Energy Harvesting: Development of wireless sensor network based on Microcontroller and communication device – Zigbee communication device.
Power Sources- Energy Harvesting: Solar & Lead Acid batteries -RF Energy/Harvesting-Energy Harvesting from vibration- Thermal Energy Harvesting – Energy management techniques, Calculation for battery selection.

Unit IV

Applications: Structural Health monitoring- sensing seisimic events, single damage detection using natural frequencies, multiple damage detection using natural frequencies, multiple damage detection using mode shapes, coherence, piezoelectric effect, traffic control, health care- available sensors, pipeline monitoring, precision agriculture, active volcano, underground mining.

Textbooks:
1. Fundamental of wireless sensor networks: theory and practice- WaltenegusDargie, Christian Poellabauer, John Wiley and Sons
2. Smart Sensors, Measurement & Instrumentation, Subhas Chandra Mukhopadhyay, Springer, 2013.

References:
1. Wireless Sensors and Instruments: Networks, Design and Applications, HalitEren, CRC Press, Taylor and Francis, 2006
2. Uvais Qidwai, Smart Instrumentation: “A data flow approach to Interfacing”, Chapman & Hall, 1st edition December 2013.
3. Wireless Sensor Networks: Architectures and protocols, Edgar H. Callaway Jr.and Edgar H. Callaway.

Smart and Wireless Instrumentation Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	6	PCE	PCE-2	ICE-324P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Smart and Wireless Instrumentation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the operation of digital humidity sensor.
2. Write a program to connect WIFI to bus.
3. Write a program to connect Wireless Sensor Network (WSN) to a Zigbee communication device.
4. Implementing a Wireless Sensor Network (WSN)
5. FPGA verification using Matlab/Simulink.
6. To measure the open circuit voltage and short circuit current of solar cell.
7. To study Energy management concept principles benefits and its significance.
8. To study energy efficiency in thermal utilities and systems.
9. Implementing a transport control protocol in sensor Network.
10. To study harvesting of Solar Energy.

Smart Antennas	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
ECE	7	PCE	PCE-5	ECE-427T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce about the smart antenna technology and various linked parameters.
2.	To discuss about the different antenna parameters.
3.	To explain the CDMA and its applications.
4.	To study the Optimal Spatial Filtering and Adaptive Algorithms in smart antenna:

Course Outcomes (CO)

CO 1	Understand the basic of smart antenna systems and applications
CO 2	Describe the various types of smart antenna systems.
CO 3	Analyze the smart antenna techniques for CDMA.
CO 4	Analyze the various filtering and adaptive algorithms for smart antennas.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	3	3	3	2	3	3	3	2	1	2
CO 2	2	2	3	2	2	2	2	2	2	3	3	3
CO 3	3	3	3	2	2	3	3	2	3	3	2	1
CO 4	3	2	3	3	3	2	2	2	3	3	2	2

UNIT-I

Introduction to Smart Antennas: Spatial Processing for Wireless Systems, Key Benefits of Smart Antenna Technology, Introduction to Smart Antenna Technology, the Vector Channel Impulse Response and the, Spatial Signature, Spatial Processing Receivers, Fixed Beam forming Networks, Switched Beam Systems.

UNIT-II

Smart Antenna Systems : The Vector Channel Impulse Response and the Spatial Signature, Spatial Processing Receivers, Fixed Beam forming Networks, Switched Beam Systems, Adaptive Antenna Systems, Wideband Smart Antennas, Spatial Diversity, Diversity Combining, and Sectoring, Digital Radio Receiver Techniques and Software Radios for Smart Antennas, Transmission Beam forming.

Unit III

Smart Antennas Techniques for CDMA: Non-Coherent CDMA Spatial Processors, Coherent CDMA Spatial

Processors and the Spatial, Processing Rake Receiver, Multi-User Spatial Processing, Dynamic Re-sectoring Using Smart Antennas, Downlink Beamforming for CDMA. Range Extension in CDMA, Single Cell Systems with Spatial Filtering at the IS-95 Base Station, Reverse Channel Performance of Multi-cell Systems with Spatial Filtering at the Base Station.

Unit IV

Optimal Spatial Filtering and Adaptive Algorithms: Impact of Multipath on Optimal Spatial Filtering, Performance of Under loaded and Overloaded Adaptive Arrays , Adaptive Algorithms , Adaptive Algorithms for CDMA, Multi target Decision Directed Algorithm (MT-DD), Least Squares De-spread Re-spread Multi target Array (LSDRMTA) , Least Squares De-spread Re-spread Multi target Constant Modulus Algorithm.

Textbooks:

1. T.S. Rappaport and J.C. Liberti, Smart Antennas for Wireless Communications, PHI, 1999.
2. T.S. Rappaport, Smart Antennas: Adaptive Arrays, Algorithms, & Wireless Position Location, PHI, 1998
3. Tapan K Sarkar, “Smart Antennas”, IEEE Press, John Wiley & Sons Publications,2003.

References:

1. Ahmed El Zoogh by, “Smart Antenna Engineering” Artech House, Inc.2005

Smart Antennas Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	7	PCE	PCE-5	ECE-427P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Smart Antennas) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Simulate the adaptive array and plot its radiation pattern in MATLAB with MMSE approach.
2. Simulate the adaptive array and plot its radiation pattern in MATLAB with Applebaum approach.
3. Simulate switched beam antenna array using Butler matrix on suitable Computational electromagnetic software, fabricate and test.
4. Implement the smart antenna system with various algorithms.
5. MATLAB simulation of smart antenna system and various algorithms
6. MATLAB simulation of the LMS algorithm based on Weiner –hopf equation.
7. Design of rectangular patch antenna and weight tested by ensemble software.
8. Design of patch antenna array and weight tested by ensemble software.
9. Design of circular patch antenna and weight tested by ensemble software.
10. Design of 8 elements circular patch antenna array and weight tested by ensemble software.
11. Design of fractal patch antenna and weight tested by ensemble software.

Note: These experiments may be performed using simulation software like MATLAB, HFSS and ENSEMBLE etc.

Smart Contracts	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-ICB	7	PC	PC	BT-415T
EAE	7	BT-EAE	BT-EAE-4	BT-415T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand Block chain and smart contracts.
2.	Understand virtual machine in terms of blockchain.
3.	Understand solidity in smart contracts.
4.	Understand different smart contract platforms.

Course Outcomes (CO)

CO 1	Ability of students to understand the concepts of blockchain and smart contracts.
CO 2	Ability of students to analyze basics of blockchain technology and virtual machine.
CO 3	Ability of students to understand the solidity of smart contracts.
CO 4	Ability of students to understand the concepts of object-oriented constructs, debugging contracts and other smart contract platforms.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	2	2	2	2	1
CO 2	3	3	3	2	3	2	3	1	-	-	1	1
CO 3	3	3	2	2	2	3	3	2	2	2	-	-
CO 4	3	3	2	3	2	3	2	1	1	-	-	1

UNIT-I

Introduction to Blockchain and Ethereum: What is a Blockchain, Blockchain Architectural Overview, The Web of Trust, Ethereum's main components, Ethereum's sub-protocols, The new generation of the Web (i.e., Web3.0), Smart Contracts and Decentralized Applications (dApps), Web apps vs. dApps
Introduction to Smart Contracts: An overview of the history of smart contracts, An intro to the life-cycle of a smart contract, Ethereum's smart contract languages, Interfacing with Ethereum Networks (overview of Ethereum Networks, Clients, Wallets, Transactions etc.), The Solidity Programming Language, Development Environments.

UNIT-II

Blockchain technology Supporting Turing-Complete Languages: A comparison of Ethereum and Bitcoin, Overview of Ethereum's tech stack, architecture, The Ethereum reward scheme, Mist, EVM, Swarm, Whisper, Eth, Gas, A simple Solidity Contract (Contract Walk-through), The Solidity compiler, Ethereum Contract ABI, Deployment with the Web3.js or Web3J library.

Virtual Machines and Beyond: History of Virtual Machines, State replication, consensus and the Ethereum Architecture, Introduction to the Ethereum Virtual Machine and EVM Byte Code interpretation, Incentivisation structures, rewards schemes, and gas pricing.

Intro to the dApp Development Pipeline: Introduction to development with Solidity, Development environments (Truffle) Intro to Solidity, Smart contract layout, The structure of .sol source file.

UNIT-III

Deep-dive into Solidity: Understanding the different compiler versions and pragmas, Authoring smart contracts, Contract definitions, Basic data types, Local and State Variables.

Global Variables and Functions: Predefined Global Variables, Structs and Enums, Mapping and Arrays, Build-in Functions (e.g., addmod, keccak256), User Functions.

Expressions and Control Structures: Valid expressions of the language, Exception Handling (e.g., assert, require, revert, throw), Events and Logging, Conditional logic, Implementation of loops.

UNIT - IV

Object Oriented Constructs: Contract constructor and self-destruct, Function Modifiers and Fallback functions, Calling other contracts, Inheritance and Multiple Inheritance, Declaring Abstract Classes and Interfaces, Implementation of Abstract interfaces, Function Overloading

Experimenting with Front-end Libraries: Intro to front-end web interfaces, Decentralized Data Storage, The Ethereum Name Services (ENS)

Unit Testing and Debugging Contracts: Estimating Gas Costs, Basics of using Truffle for testing, Troubleshooting and Debugging, Common design patterns, Smart Contract Security – overview of attacks on Ethereum smart contracts.

Deployment Considerations and Other Smart Contract Platforms: Smart Contacts Quality Assurance, Beyond Ethereum, Blockchain-as-a-Service (BaaS) and the Dark Market, Secure smart contracts with OpenZeppelin, Experimenting with Hyperledger Besu, Future Outlook and the Road Ahead (e.g., graph-based blockchain protocols,distributed autonomous organizations, quantum secured blockchains etc)

Textbook(s):

1. Mastering ethereum: building smart contracts and dapps Antonopoulos, Andreas M., and Gavin Wood, O'Reilly Media, 2018
2. Hands-On Smart Contract Development with Hyperledger Fabric V2, Building Enterprise Blockchain Applications, Matt Zand, Xun (Brian) Wu, Mark Anthony Morris, 2021

Reference books:

1. Patrick Ejeke, “Smart Contracts”
2. Matt Zand, Xun Wu, Mark Morris, “Hands-On Smart Contract Development with Hyperledger Fabric V2: Building Enterprise Blockchain Applications”, 1st Edition

Smart Contracts Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-ICB	7	PC	PC	BT-415P
EAE	7	BT-EAE	BT-EAE-4	BT-415P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Smart Contracts) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Blockchain Platform (e.g., Ethereum, Binance Smart Chain)
Development Environment (e.g., Remix, Truffle, or Hardhat)

1. Setting up the Development Environment: Install and configure the required development tools (Remix, Truffle, or Hardhat) and Connect to a blockchain network (local or testnet) for deployment and testing.
2. Writing and compiling a simple smart contract between a retail shop owner and customer.
3. Write a smart contract using a solidity program to perform the balance transfer from contract to other accounts
4. Write solidity program to perfume the exception handling.
5. Deploy a Smart Contract for Marks Management System in Remix environment, interact with the contract using a web interface or command-line interface and test the functionality of the deployed contract.
6. Deploy a Smart Contract on Ethereum with Python, Truffle and web3py in Remix environment.

Smart Grid and Distributed Generation	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	7	PCE	PCE-5	EEE-431

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the features of Smart Grid
2.	To ssess the role of automation and digitization in Transmission and Distribution
3.	To nalyse Smart grids and Distributed energy resources(DER) with evolutionary algorithms
4.	To nderstand operation and importance of data acquisition devices and their location in Voltage and Frequency control

Course Outcomes (CO)

CO 1	Understand the features of Smart Grid
CO 2	Assess the role of automation and digitization in Transmission and Distribution
CO 3	Analyse Smart grids and Distributed energy resources(DER) with evolutionary algorithms
CO 4	Understand operation and importance of data acquisition devices and their location in Voltage and Frequency control

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT I

Basics of power systems, definition of smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas, regulatory challenges, smart-grid activities in India. Smart grid architecture, standards-policies, smart-grid control layer and elements, network architectures, IP-based systems, power line communications, supervisory control and data acquisition system, advanced metering infrastructure.

UNIT II

The fundamental components of Smart Grid designs, Transmission Automation distribution Automation, Renewable Integration Computational Techniques – Static and Dynamic Optimization Techniques for power applications such as Economic load dispatch – Computational Intelligence Techniques – Evolutionary Algorithms in power system – Artificial Intelligence techniques and applications in power system.

UNIT III

Introduction to Distribution Energy Sources, Renewable Energy Technologies – Microgrids – Storage Technologies –Electric Vehicles and plug – in hybrids – Environmental impact and Climate Change – Economic Issues.

UNIT IV

Smart city pilot projects, essential elements of smart cities, active distribution networks, microgrids, distribution system automation, Reliability and resiliency studies, decentralized operation of power network.

Textbooks:
1. S. Borlase, "Smart Grids, Infrastructure, Technology and Solutions", CRC Press, 1st Edition, 2013.
2. G. Masters, "Renewable and Efficient Electric Power System", Wiley–IEEE Press, 2nd Edition, 2013

References:
1. A.G. Phadke and J.S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2nd Edition, 2017
2. T. Ackermann, "Wind Power in Power Systems", Hoboken, N J, USA, John Wiley, 2nd Edition, 2012

Social Network Analysis and Sentiment Analysis	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	7	PCE	PCE-4	CIE-409T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand various types of graphs networks
2.	To understand the concept of centrality measures in graph and various applications
3.	To understand the underlying structure of the problem and the language constructs commonly used to express opinions and sentiments
4.	To understand the concepts of sentiment classification

Course Outcomes (CO)

CO 1	Ability to identify and describe the type of complex network
CO 2	Ability to visualize a social network to mine meaningful pattern.
CO 3	To understand the underlying structure of the problem and the language constructs commonly used to express opinions, sentiments, and emotions
CO 4	To understand core areas of sentiment analysis

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	-	-	2	2	2	2-	2	2	2
CO 2	2	2	1	-	3	-	-	-	-	-	-	2
CO 3	2	3	1	-	2	3	2	2	-	2	2	2-
CO 4	2	2	1	-	2	-	2	2	-	2	-	3

UNIT-I

Graph Preliminaries and Networks: Overview of graphs and types of graphs including Bipartite and Planar networks, Introduction to Social Networks, Types of Networks: General Random Networks, Small World Networks, Scale-Free Networks; Examples of Information Networks

UNIT-II

Centrality Measures: Network Centrality Measures; Strong and Weak ties; Homophily, Random walk-based proximity measures, Other graph-based proximity measures. Clustering with random-walk based measures. Applications based on the analysis of centrality measures.

UNIT-III

Introduction, Sentiment analysis applications, Sentiment analysis research, Sentiment analysis as mini-NLP,The Problem of Sentiment Analysis, Definition of opinion, Definition of opinion summary, different types of opinions, Document Sentiment Classification, Supervised sentiment classification, Unsupervised sentiment classification, Sentiment rating prediction

UNIT-IV

Sentence Subjectivity and Sentiment Classification: Sentence Subjectivity and Sentiment Classification, Subjectivity & Objectivity, Sentence Subjectivity Classification, Sentence Sentiment Classification, Aspect Sentiment Classification, Document level sentiment classification, Rules of Sentiment composition, Negation and Sentiment, Aspect and Entity Extraction, Feature Extraction methods, Frequency based aspect extraction, Exploring syntactic relations, Using supervised learning

Textbook(s):

1. M.E.J. Newman, “Networks: An Introduction”, Oxford University Press, 2012
2. Sentiment Analysis: Mining Opinions, Sentiments, and Emotions, by Bing Liu

References:

1. John Scott, “Social Network Analysis”, Sage Publication, 2012
2. Filippo Menczer, “A First Course in Network Science”, Cambridge University Press, 201
3. Sentiment Analysis in Social Networks By Federico Pozzi, Elisabetta Fersini, Enza Messina, Bing Liu · 2016
4. Sentiment Analysis for Social Media, Antonio Moreno, Carlos A. Iglesias, MDPI 2020

Social Network Analysis and Sentiment Analysis Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	7	PCE	PCE-4	CIE-409P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Social Network Analysis and Sentiment Analysis) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Implement word similarity.
2. Implementing simple problems related to word disambiguation.
3. Simple demonstration of part of speech tagging.
4. Demonstrate Lexical Analyzer.
5. Demonstrate Semantic Analyzer.
6. Perform Sentiment Analysis.
7. Demonstate Natural Language Generation.
8. Demonstrate Information retrieval and question answering.
9. Demonstrate Grammar formalisms.
10. Perform Aspect level sentiment analysis

Soft Computing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-4	ICE-405T
CSE-AIML	7	PC	PC	SC-401T
EAE	7	AI-EAE	AI-EAE-3	SC-401T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn the basic concepts of Soft Computing
2.	To introduce the concepts of fuzzy sets and fuzzy logic
3.	To make students familiar with genetic algorithms, its applications and advances
4.	To make students familiar with neural networks that can learn from available examples

Course Outcomes (CO)

CO 1	Comprehend soft computing techniques and its applications.
CO 2	Understand the artificial neural networks and its applications
CO 3	Analyse the single-objective optimization problems using GAs
CO 4	Develop the fuzzy logic sets and membership function and defuzzification techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	2	3	3	-	-	2	-	-	-	-
CO 2	-	-	-	-	3	2	3	-	-	-	3	2
CO 3	-	3	-	-	3	-	-	-	2	-	-	2
CO 4	-	-	2	3	3	-	-	-	2	-	-	-

UNIT-I

Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques

UNIT-II

Fuzzy logic: Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Some applications of Fuzzy logic.

UNIT-III

Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc. Solving single-objective optimization problems using GAs.

UNIT - IV

Artificial Neural Networks: Biological neurons and its working, Simulation of biological neurons to problem solving, Different ANNs architectures, Training techniques for ANNs, Applications of ANNs to solve some real-life problems. Fuzzy Neural systems, Genetic Fuzzy systems, Genetic Neural system

Textbook(s):

1. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI, 2004
2. S.N.Sivanandam & S.N.Deepa “Principles of Soft Computing” Wiley India Pvt. Ltd., 2007

References:

1. S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2003.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, 1997

Soft Computing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-4	ICE-405P
CSE-AIML	7	PC	PC	SC-401P
EAE	7	AI-EAE	AI-EAE-3	SC-401P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Soft Computing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Create a perceptron with appropriate no. of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights.
2. Create a simple ADALINE network with appropriate no. of input and output nodes. Train it using delta learning rule until no change in weights is required. Output the final weights
3. Train the autocorrelator by given patterns: A1=(-1,1,-1,1), A2=(1,1,1,-1), A3=(-1, -1, - 1, 1). Test it using patterns: Ax=(-1,1,-1,1), Ay=(1,1,1,1), Az=(-1,-1,-1,-1).
4. Train the hetrocorrelator using multiple training encoding strategy for given patterns: A1=(000111001) B1=(010000111), A2=(111001110) B2=(100000001), A3=(110110101) B3(101001010). Test it using pattern A2.
5. Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform maxmin composition on any two fuzzy relations. 6. To determine the specific rotation of cane sugar solution with the help of half shade polarimeter.
6. Solve Greg Viot's fuzzy cruise controller using MATLAB Fuzzy logic toolbox.
7. Solve Air Conditioner Controller using MATLAB Fuzzy logic toolbox.
8. Implement TSP using GA.

Soft Computing and Expert Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	SC-EAE	SC-EAE-5	SC-481T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the fundamental concepts of soft computing:
2.	Understand the concepts of fuzzy sets, fuzzy membership functions, and linguistic variables.
3.	Learn about representation schemes, selection operators, crossover, and mutation in genetic algorithms.
4.	Gain hands-on experience in solving optimization problems using evolutionary computing techniques.

Course Outcomes (CO)

CO 1	Understand the components and functioning of expert systems, including knowledge representation, inference mechanisms, and rule-based programming.
CO 2	Design and develop rule-based expert systems for real-world applications, considering knowledge acquisition and representation techniques.
CO 3	Apply evolutionary computing techniques, such as genetic algorithms, to solve optimization and search problems effectively.
CO 4	Demonstrate ethical and responsible use of soft computing techniques and expert systems, considering legal and privacy aspects related to data handling and decision-making.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

Unit I

Introduction to Soft Computing: Definition and characteristics of soft computing,Comparison with conventional computing techniques,Fuzzy logic, neural networks, evolutionary computing, and probabilistic reasoning,Expert Systems,Components of an expert system,Knowledge representation and inference mechanisms,Rule-based expert systems,Fuzzy Logic:Fuzzy membership functions and linguistic variables,Fuzzy logic operations: union, intersection, complement,Fuzzy rules and reasoning ,Fuzzy inference systems and Mamdani model

Unit II

Neural Networks and Learning Algorithms: Basics of neural networks and their applications,Biological inspiration and artificial neurons,Activation functions and network architectures,Feedforward and feedback neural networks,Single-layer Neural Networks,Perceptron model and learning algorithm,Linear separability and convergence properties,Multilayer Neural Networks ,Backpropagation algorithm and gradient descent,Training and learning strategies,Overfitting and regularization techniques,Radial basis function networks,Self-Organizing Maps.

Unit III

Evolutionary Computing and Optimization :.Genetic algorithms and genetic programming,Evolutionary strategies and evolutionary programming,Evolutionary optimization and search techniques,Genetic Algorithms,Representation schemes: binary and real-valued,Selection, crossover, and mutation operators,Fitness evaluation and selection mechanisms,Convergence and parameter tuning Evolutionary programming and genetic programming, Particle swarm optimization (PSO), Ant colony optimization (ACO), Bee algorithms and other swarm intelligence techniques

Unit IV

Hybrid Systems and Applications: Integration of soft computing techniques,Fuzzy-neural systems and neuro-fuzzy systems,Genetic-fuzzy systems and genetic-neural systems,Expert System Development: Knowledge acquisition and knowledge engineering,Rule-based system development tools,Expert system shells and inference engines,Soft computing in pattern recognition,Soft computing in data mining and decision support,Soft computing in control systems and optimization.

Textbooks:

1. “Soft Computing: Techniques and Applications" by S. Sivanandam, S. N. Deepa
2. "Expert Systems: Principles and Programming" by Joseph C. Giarratano, Gary D. Riley

References:

1. Soft Computing and Intelligent Systems: Theory and Applications" by Madan M. Gupta, Naresh K. Sinha, and Sanjay Ranka
2. "Introduction to Artificial Intelligence" by Philip C. Jackson
3. Genetic Algorithms in Search, Optimization, and Machine Learning" by David E. Goldberg

Soft Computing and Expert Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	SC-EAE	SC-EAE-5	SC-481P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Soft Computing and Expert Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Fuzzy Inference System for Air Quality Prediction
2. Neural Network-based Handwritten Digit Recognition
3. Genetic Algorithm Optimization of Function Parameters
4. Expert System for Medical Diagnosis
5. Fuzzy Logic Control System for Autonomous Robot Navigation
6. Neural Network-based Stock Market Prediction
7. Genetic Algorithm-based Feature Selection for Classification
8. Expert System for Fault Diagnosis in Industrial Systems
9. Fuzzy Logic-based Traffic Light Control System
10. Hybrid Soft Computing System for Credit Risk Assessment

Software Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-309

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the basic concepts of the software development processes, Software requirements and specifications
2.	To impart knowledge of Software Project Planning and various Software design techniques for developing large software systems.
3.	To understand Software Metrics, Software Reliability, and Quality assurance using ISO 9001 and SEI-CMM.
4.	To impart the knowledge and use of software engineering processes and tools in analysis, design, implementation, software testing, documentation, and maintenance for software systems.

Course Outcomes (CO)

CO 1	Ability to have an understanding of SDLC Models, Techniques for Requirement Elicitation, and SRS Document.
CO 2	To be able to explain Software Project Planning and various methods for software design
CO 3	To Understand Software Metrics, Software Reliability, and Quality assurance
CO 4	Ability to have an understanding of Software testing, documentation and maintenance.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT-I

Introduction: Introduction to Software Engineering, Importance of software engineering as a discipline, Software applications, Software Crisis, Software Processes & Characteristics, Software life cycle models, Waterfall, Prototype, Evolutionary and Spiral Models.

Software Requirements Analysis & Specifications: Requirement engineering, Functional and non-functional requirements, User requirements, System requirements, requirement elicitation techniques like FAST, QFD & Use case approach, requirements analysis using DFD, Data dictionaries & ER Diagrams, Requirements documentation, Nature of SRS, Characteristics & organization of SRS, Requirement Management, IEEE Std. for SRS.

UNIT-II

Software Project Planning: Size Estimation like lines of Code & Function Count, Cost Estimation Models, COCOMO, Putnam resource allocation model, Validating Software Estimates, Risk Management.
Software Design: Cohesion & Coupling, Classification of Cohesiveness & Coupling, Function Oriented Design, Object Oriented Design, User Interface Design.

UNIT-III

Software Metrics: Software measurements: What & Why, Token Count, Halstead Software Science Measures, Data Structure Metrics, Information Flow Metrics.
Software Reliability: Importance, Hardware Reliability & Software Reliability, Failure and Faults, Reliability Models- Basic Model, Logarithmic Poisson Model, Software Quality Models, CMM & ISO 9001.

UNIT – IV

Software Testing: Testing process, Functional testing: Boundary value analysis, Equivalence class testing, Decision table testing, Cause effect graphing, Structural testing: Path testing, Data flow and mutation testing, unit testing, integration and system testing, Debugging, Testing Tools & Standards.
Software Maintenance: Management of Maintenance, Maintenance Process, Maintenance Models, Regression Testing, Reverse Engineering, Software Re-engineering, Configuration Management, Documentation.

Textbook(s):
1. K. K. Aggarwal and Yogesh Singh, “Software Engineering”, New Age International, 3rd Ed., 2005.
2. R. S. Pressman, “Software Engineering – A Practitioner's Approach”, McGraw Hill Int. , 5th Ed., 2001.
3. Pankaj Jalote, “An Integrated Approach to Software Engineering”, Narosa, 3rd Ed., 2005.

References:
1. Stephen R. Schach, “Classical & Object Oriented Software Engineering”, IRWIN, 1996.
2. James Peter, W. Pedrycz, “Software Engineering: An Engineering Approach”, John Wiley & Sons.
3. I. Sommerville, “Software Engineering”, Addison Wesley,8th Ed., 2009.
4. Frank Tsui and Orlando Karan, “Essentials of Software Engineering”, Joes and Bartlett, 2nd Ed., 2010.
5. Kassem A. Saleh, “Software Engineering”, Cengage Learning, 2009.
6. Rajib Mall, “Fundamrntal of Software Engineering”, PHI, 3rd Ed., 2009.
7. Carlo Ghizzi, Mehdi Jazayeri and Dino Mandrioli, “Fundamental of Software Engineering”, PHI, 2nd Ed., 2003.
8. Carol L. Hoover, Mel Rosso-Llopart and Gil Taran, “Evaluating Project Decision Case Studies in Software Engineering”, Pearson, 2010.

Software Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-357

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Software Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write down the problem statement for a suggested system of relevance.
2. Do requirement analysis and develop Software Requirement Specification Sheet (SRS) for suggested system.
3. To perform the function oriented diagram: Data Flow Diagram (DFD) and Structured chart.
4. Draw the entity relationship diagram for the suggested system.
5. To perform the user's view analysis for the suggested system: Use case diagram.
6. To draw the structural view diagram for the system: Class diagram, object diagram.
7. To draw the behavioral view diagram: State-chart diagram, Activity diagram
8. To perform the behavioral view diagram for the suggested system: Sequence diagram, Collaboration diagram
9. To perform the implementation view diagram: Component diagram for the system.
10. To perform the environmental view diagram: Deployment diagram for the system.
11. To perform various testing using the testing tool unit testing, integration testing for a sample code of the suggested system.
12. Perform Estimation of effort using FP Estimation for chosen system.
13. To prepare time Line Chart / Gantt Chart / PERT Chart for selected software project.

Software Engineering Standards	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	SE-EAE	SE-EAE-5	SE-489

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To study fundamental concepts in software Engineering Standards.
2.	To introduce the activities involved in Software Engineering Standards.
3.	To understand International Electrotechnical Commission and International Organization of standard.
4.	To understand Quality System Standards and Project Management.

Course Outcomes (CO)

CO 1	Ability to analyze the importance of Software Engineering Standards while designing a product.
CO 2	Ability to analyze various organizational Goals for Using Software Engineering Standards.
CO 3	Ability to do comparative study for various software Engineering Standards.
CO 4	Ability to understand Quality System Standards and Project Management.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	3	3	2	3	-	-	2	3	2	2	3
CO 2	3	2	2	2	3	2	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT-I

Software Engineering Standards: Scope of Software Engineering Standards, Importance of Software Engineering Standards, Improving the Product, Protecting the Buyer, Protecting the Business, Increasing Professional Discipline, Introducing Technology.
History: Makers of Software Engineering Standards, Roles of Software Engineering Standards, Organizational Goals for Using Software Engineering Standards.

UNIT-II

International Electrotechnical Commission (IEC): IEC TC56—Dependability, Current Collection of IEC TC56, Planned Collection of IEC TC56, Organization of IEC TC56 Collection, Strategic Plans, IEC SC45A—Nuclear Reactor Instrumentation, Current Collection of IEC SC45A , Planned Collection of IEC SC45A, Organization of IEC SC45A Collection, IEC SC65A—Industrial Process Control, Current Collection of IEC SC65A, Planned Collection of IEC SC65A, Organization of IEC SC65A Collection,

UNIT-III

International Organization for Standardization (ISO): ISO TC176—Quality Management, Current Collection of ISO TC176, Planned Collection of ISO TC176, Organization of ISO TC 176 Collection, Strategic Plans ISO/IEC JTC1, ISO/IEC JTC1/SC7—Software Engineering, Current Collection of JTC1/SC7, Planned Collection of JTC1/SC7, Organization of JTC1/SC7 Collection, Strategic Plans.

UNIT – IV

Quality Systems Standards: ISO 9000-3 and IEEE Std 730, The Proposed Revision of ISO 9000-3, An Alternative: AS 3563.1/IEEE Std 1298, An Alternative: CAN/CSA-Q396 ,
Project Management: Project Management Standards for Software, PMI Guide to the PMBOK, IEEE 1058.1—Software Project Management Plans, Configuration Management Standards.

Textbook(s):
1. The Road Map to Software Engineering: A Standards-Based Guide by James W. Moore

References:
1. Guide to Software Engineering Standards and Specifications by Stan Magee , Leonard Tripp.

Software Measurements, Metrics and Modelling	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	SE-350T
EAE	6	SE-EAE	SE-EAE-1	SE-350T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Measurement theory (overview of software metrics, basics of measurement theory, goal-based framework for software measurement, empirical investigation in software engineering).
2.	Software product and process measurements (measuring internal product attributes: size and structure, measuring external product attributes: quality, measuring cost and effort, measuring software reliability, software test metrics, object-oriented metrics)
3.	Measurement management
4.	Software Reliability

Course Outcomes (CO)

CO 1	Understand various fundamentals of measurement and software metrics
CO 2	Apply frame work and analysis techniques for software measurement.
CO 3	Apply internal and external attributes of software product for effort estimation.
CO 4	Apply reliability models for predicting software quality

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	3			3			3	2
CO 2	3		3		2		3	3			2	3
CO 3	3	2		3	3			2	3	3		
CO 4	3	2	3			3		2			2	

UNIT-I

Fundamentals of Measurement: Measurement: what is it and why do it?: Measurement in Software Engineering, Scope of Software Metrics, The Basics of measurement: The representational theory of measurement, Measurement and models, Measurement scales and scale types, meaningfulness in measurement.

UNIT-II

A Goal-Based Framework For Software Measurement: Classifying software measures, Determining what to Measure, Applying the framework, Software measurement validation, Performing Software Measurement validation Empirical investigation: Principles of Empirical Studies, Planning Experiments, Planning case studies as quasi-experiments ,Relevant and Meaningful Studies.

UNIT-III

Software Metrics Data Collection: Defining good data, Data collection for incident reports, How to collect data, Reliability of data collection Procedures Analyzing software measurement data: Statistical distributions and hypothesis testing, Classical data analysis techniques, Examples of simple analysis techniques.
Measuring internal product attributes: Size Properties of Software Size, Code size, Design size, Requirements analysis and Specification size, Functional size measures and estimators, Applications of size measures.

UNIT – IV

Measuring internal product attributes: Structure: Aspects of Structural Measures, Control flow structure of program units, Design-level Attributes, Object-oriented Structural attributes and measures.
Measuring External Product Attributes: Modelling software quality, Measuring aspects of quality, Usability Measures, Maintainability measures, Security Measures Software Reliability: Measurement and Prediction: Basics of reliability theory, The software reliability problem, Parametric reliability growth models, Predictive accuracy.

Textbook(s):
1.Software Metrics A Rigorous and PracticalApproach, Norman Fenton, James Bieman , Third Edition, 2014

References:
1. Software metrics, Norman E, Fenton and Shari Lawrence Pfleeger, International Thomson Computer Press, 1997
2. Metric and models in software quality engineering, Stephen H.Kan, 2nd Edition, 2002, Addison Wesley.
3. Measuring the Software Process, William A. Florac and Areitor D. Carletow, 1995, Addison Wesley.
4. Practical Software Metrics for Project Management and Process Improvement, Robert B.Grady, 1992, PHI

Software Measurements, Metrics and Modelling Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	SE-350P
EAE	6	SE-EAE	SE-EAE-1	SE-350P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Software Measurements, Metrics and Modelling) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write down the problem statement for a suggested system of relevance.
2. To evaluate size metrics for the suggested system.
3. To evaluate design metrics for the suggested system.
4. To evaluate Control flow metrics for the suggested system.
5. To evaluate Information metrics for the suggested system.
6. To evaluate weighted metrics for the suggested system.
7. To evaluate Data Structure metrics for the suggested system.
8. To evaluate Software Cost Estimation using Static, Single Variable Model for the suggested system.
9. To evaluate Software Cost Estimation using Static, Multiple Variable Model for the suggested system.
10. To evaluate Object-oriented Structural attributes and measures for the suggested system.
11. To evaluate Software Maintenance Cost for the suggested system.
12. To evaluate Software Reliability metrics for the suggested system.

Software Project Management	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	6	PCE	PCE-2	CIE-348T
CSE-in-EA	6	OAE-CSE-EA	OAE-1	SE-354T
EAE	6	SE-EAE	SE-EAE-2B	SE-354T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To introduce the concepts of project management and managing software development projects.
2.	To get familiar with the different activities involved in Software Project Management.
3.	To successfully plan and implement a software project management activity.
4.	To complete a specific project in time with the available budget.

Course Outcomes (CO)

CO 1	Develop the model from the conventional software product to the modern
CO 2	Analyze and design the software architecture.
CO 3	Design various estimation levels of cost and effort.
CO 4	Sketch various artifacts sets for better understanding of software development.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	3	2	2	3	-	-	3	-	-	3	2
CO 2	3	-	3	-	2	-	3	3	-	-	2	3
CO 3	3	2	-	3	3	-	-	2	3	2	-	-
CO 4	-	2	3	-	-	3	-	2	-	-	2	-

UNIT-I

Introduction to Software Project Management: The Nature of Software Production, Key Objectives of Effective Management, Quality, Productivity, Risk Reduction, The Role of the Software Project Manager, Technology, Human factors and usability, Tools and environments, Transition of the Product to the user.

UNIT-II

Technical Planning: Life-cycle models, Types of Plans, Plan documentation methods, Work breakdown structures, PERT and CPM, Gantt Charts, Standards, Planning for Risk Management and Control, Entry and Exit criteria, Intermediate checkpoints, Performance prediction and analysis People, Prototyping and modelling, Inspections and reviews, Process and process assessment, Development Methods, Metrics

UNIT-III

Planning the Project: Business Planning, Determining Objectives, Forecasting demand for the Product, Proposal Writing, Requirements analysis, Legal issues (patent, copyright, liability, warranty), Configuration management, Testing and quality assurance, Capacity Planning, Estimating – what it takes to do the job, Cost (direct and indirect), Resources, Time, Size and complexity of the product, Risk determination, Role of requirements and design in estimating, Financial planning – budgeting, Resource Allocation, Organizational considerations, (teams, hierarchies, etc.).

UNIT – IV

Managing the Project: Managing the Task, Project Control, Managing to the Plan, Reviews, Feedback and Reporting Mechanisms, Configuration Management, Quality Control and Quality Assurance, Managing Change, Readjusting Goals and Milestones, Risk Management, Testing Phases, Formalized Support Activities, Managing the Team, Team Organizations, Recruiting and Staffing – picking the right people, Technical leadership, Avoiding obsolescence – training, etc.) Managing the Context, Communication Skill, Decision Theory, Business Management, Assessing the Organization's ability to perform the process, Probability and Statistics, Managing Product Support and Maintenance.

Textbook(s):

1. Tom Gilb, Finzi Susannah, "Principles of Software Engineering Management", Addison-Wesley, England, 1988.
2. Philip Metzger, "Managing A Programming Project", Prentice Hall, New Jersey, 1981.

References:

1. Dennis Lock, "Handbook of Project Management", Jaico Publishing House, 1994.
2. Neal Whitten, "Managing Software Development Projects", John Wiley, 1995.
3. Sanjiv Purba, David Sawh & Bharat Shah, "How to Management a Successful Software Project Methodologies, Techniques, Tools", John Wiley, 1995.

Software Project Management Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE	6	PCE	PCE-2	CIE-348P
CSE-in-EA	6	OAE-CSE-EA	OAE-1	SE-354P
EAE	6	SE-EAE	SE-EAE-2B	SE-354P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Software Project Management) as this is the practical component of the corresponding theory paper.
2. The allotment and guidelines for the project work shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered.

Create a mini project on any topic and create a report consisting of all the phases of software project management. Some suggested topics, but not limited to, are as follows:

1. Inventory Management System
2. Event Management System
3. University Admission Management System
4. Hotel Management System
5. Airline Reserversation System
6. Railway Reserversation System
7. E-commerce

The students shall be asked to write a complete documentation consisting of Requirements Analysis, WBS, Scheuduling Charts, Metrics, Financial Planning, Resource Allocation, Team Organisation, etc.

Software Requirements and Estimation	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CST	6	PCE	PCE-3	CIE-372T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the good practices for Requirements Engineering, Requirements Elicitation & Elicitation Techniques
2.	Understand analysis models & Software quality attributes
3.	Understand Software Estimation & Size Estimation
4.	Understand Effort, Schedule and Cost Estimation

Course Outcomes (CO)

CO 1	Discuss requirements elicitation techniques.
CO 2	Identify the software requirements for a given project.
CO 3	Estimate the software in terms of effort, schedule and cost.
CO 4	Describe the tools for requirements management and estimation.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	1	1	1	3	2	2	3
CO 2	3	2	3	2	2	1	1	1	2	2	2	2
CO 3	3	2	3	2	2	1	1	1	2	2	2	2
CO 4	3	2	3	2	2	1	1	1	2	2	2	2

UNIT-I

Software Requirements: What and Why: Essential Software requirement, Good practices for requirements engineering, Improving requirements processes, Software requirements and risk management. Software Requirements Engineering: Requirements elicitation, requirements analysis documentation, review, elicitation techniques, analysis models, Software quality attributes, risk reduction through prototyping, setting requirements priorities, verifying requirements quality.

UNIT-II

Software Requirements Management: Requirements management Principles and practices, Requirements attributes, Change Management Process, Requirements Traceability Matrix, Links in requirements chain. Software Requirements Modeling: Use Case Modeling, Analysis Models, Dataflow diagram, state transition diagram, class diagrams, Object analysis, Problem Frames.

UNIT- III

Software Estimation: Components of Software Estimations, Estimation methods, Problems associated with estimation, Key project factors that influence estimation. Size Estimation: Two views of sizing, Function Point Analysis, Mark II FPA, Full Function Points, LOC Estimation, Conversion between size measures.

UNIT-IV

Effort, Schedule and Cost Estimation: What is Productivity? Estimation Factors, Approaches to Effort and Schedule Estimation, COCOMO II, Putnam Estimation Model, Algorithmic models, Cost Estimation. UNIT-V (10-Lectures) Tools for Requirements Management and Estimation Requirements Management Tools: Benefits of using a requirements management tool, commercial requirements management tool, Rational Requisite pro, Caliber – RM, implementing requirements management automation. Software Estimation Tools: Desirable features in software estimation tools, IFPUG, USC‟s COCOMO II, SLIM (Software Life Cycle Management) Tools.

Textbooks:

1. Swapna Kishore, Rajesh Naik, Software Requirements and Estimation, 1st Edition, Tata Mc Graw Hill, 2001.
2. Karl E. Weigers, "Software Requirements," 2 nd Edition, Microsoft Press, 2013.
3. Rajesh Naik and Swapna Kishore, "Software Requirements and Estimation," Tata McGraw Hill, 2001.

REFERENCE BOOKS:

1. Dean Leffing well and Don Widrig, "Managing Software Requirements," Pearson Education, 2003.
2. Suzanne Robertson and James Robertson, "Mastering the Requirements Process," 2nd Edition, Pearson Education, 2006.
3. Capers Jones, "Estimating Software Costs," 2 nd Edition, Tata McGraw-Hill, 2007.
4. M.A. Parthasarathy, "Practical Software Estimation," 1 st Edition, Pearson Education, 2007

Software Requirements and Estimation Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CST	6	PCE	PCE-3	CIE-372P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Software Requirements and Estimation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Prepare SRS for Banking or Online bookstore domain problem / Library Management System.
2. Draw an E-R diagram and DFD for the project (Banking or Online book store / ATM System).
3. Using COCOMO Model, estimate effort for Banking or Online bookstore domain problem.
4. Calculate effort-using FP oriented estimation model.
5. Analyze the risk related to the project (Banking or Online book store) and prepare RMMM plan.
6. Develop Time-line chart and project table using PERT or CPM scheduling methods.
7. Suppose that you need to develop an Employee Information System (EIS) for an organization whose employee strength is 100000. Now, perform the following activities for EIS. Make assumptions, wherever necessary.
   a) Which SDLC model will you choose? Justify your answer.
   b) List the functional and non-functional requirements.
   c) Propose a schedule for the project completion. Draw Gantt and Pert charts.
   d) Estimate cost of the project.
   e) Develop complete SRS.
   f) Draw DFDs of level 0 and level 1.
   g) Draw an E - R diagram and its related tables into integrity constraints.
   h) Develop test plan document.
8. Consider a university registration system. The system is to handle student registration for various courses offered by the university as well as for examinations. Identify the risks associated with such a software system.
9. List all the functional and non-functional requirements and also produce a project-scheduling chart using Gantt chart technique for hospital management system.

10. Consider developing a system for Inventory Management for a super market that has a number of branches all over a city. Perform the following activities:

    Suggest the most appropriate software engineering model for developing this project with appropriate justification.

a) Derive the requirement specifications.

b) List all the functional and non-functional requirements.

c) Produce a project-scheduling chart using Gantt chart technique.

d) Give the scope of the solution.

e) Suggest the tools/platform, hardware and requirements.

f) Suggest the security mechanisms to be implemented.

g) Develop a test plan for the system. You can make necessary assumptions and specify them.

h) Write the risk management plans for the system.

i) Estimate the efforts of software project. Make necessary assumptions.

j) Suppose it was revealed that the poor knowledge of the tool is responsible for the problems that are being encountered for timely completion of the project. What type of remedies do you suggest for such type of problem? Justify your answer.

k) Suppose there exists some old systems and wants to replace it, suggest the changes with respect to the software and hardware requirements.

l) Describe the user-training plan, which can be followed.

m) Develop a design review plan for the system. Also, list the deficiencies, if any, in the SRS for the same.

Software Security	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	SE-EAE	SE-EAE-4A	SE-485

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Comprehend the basic terminologies in computer security including Confidentiality, Integrity and Availability (CIA).
2.	Identify and describe different types of widely used encryption algorithms such as DES, AES and RSA and their applications in the real life.
3.	Differentiate between the various types of malwares and implement the proper techniques to proect against them.
4.	Understands the causes and consequences of the attack and the various ways to prevent, detect, and mitigate the system from this attack.

Course Outcomes (CO)

CO 1	Explain computer security problem and identify why broken software lies at its heart and continuous risk management and how to put it into practice to ensure software security.
CO 2	Summarise and contrast security properties and link them into the software development lifecycle. Develop and apply software validation and verification techniques to test security vulnerabilities.
CO 3	Relate security testing and verification to risk analysis to address continued resilience when a cyber-attack takes place.
CO 4	Develop case studies to think like an attacker in order to expose security vulnerabilities in software systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	3			3			3	2
CO 2	3		3		2		3	3			2	3
CO 3	3	2		3	3			2	3	3		
CO 4	3	2	3			3		2			3	3

UNIT-I

Software Security Fundamentals: Defining a Discipline, A Risk Management Framework, Vulnerability Assessment and Management, Overview on Traffic, Vulnerability and Malware Analysis.

UNIT-II

Software Security: Code Inspection for Finding Security Vulnerabilities and Exposures (ref: Mitre's CVE), Architectural Risk Analysis,

UNIT-III

Software Security Testing: Penetration Testing, Concolic Testing, Fuzzing, Automated Test Generation Model Checking, Abstract Interpretation, Symbolic Execution, Risk-Based Security Testing and Verification, Software Security Meets Security Operations.

UNIT – IV

Software Security Grows Up: Withstanding adversarial tactics and techniques defined in Mitre's ATT&CK™ knowledge base, An Enterprise Software Security Program.

Textbook(s):

1. Rashid et al.: The Cyber Security Body of Knowledge, CyBOK, v1.0, 2019.
2. McGraw, Gary: Software Security: Building Security In, Addison-Wesley, 2006.
3. Hoglund, Greg: Exploiting Software: How to Break Code, Addison-Wesley, 2004.

References:

1. Ransome, James and Misra, Anmol: Core Software Security: Security at the Source, CRC Press, 2014.
2. Edmund M. Clark Jr., Orna Grumberg, Daniel Kroening, Doron Peled, Helmut Veith: Model Checking, The MIT Press, 2018.
3. Mark Dowd , John McDonald, et al.: The Art of Software Security Assessment: Identifying and Preventing Software Vulnerabilities, Addison-Wesley, 2006.
4. SEI CERT C Coding Standard: Rules for Developing Safe, Reliable, and Secure Systems, SEI - Carnegie Mellon University, 2016.

Software Testing	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CST	6	PCE	PCE-1	CIE-324

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To study fundamental concepts in software testing
2.	To identify the needs of software test automation, define and develop a test tool to support test automation
3.	To discuss various software testing issues and solutions in unit test, integration and system testing
4.	To expose the advanced software testing topics

Course Outcomes (CO)

CO 1	Ability to apply software testing knowledge and engineering methods.
CO 2	Ability to design and conduct a software test process for a software testing project
CO 3	Ability to understand and identify various software testing problems, and solve these problems by designing and selecting software test models, criteria, strategies, and methods.
CO 4	Ability to understand contemporary issues in software testing, such as component-based software testing problems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	3	2	2	3	-	-	3	-	-	3	2
CO 2	3	-	3	-	2	-	3	3	-	-	2	3
CO 3	3	2	-	3	3	-	-	2	3	2	-	-
CO 4	-	2	3	-	-	3	-	2	-	-	2	-

UNIT-I

Review of Software Engineering: Overview of Software Evolution, SDLC, Testing Process, Terminologies in Testing: Error, Fault, Failure, Verification, Validation, Difference Between Verification and Validation, Test Cases, Testing Suite, Test, Oracles, Impracticality of Testing All Data; Impracticality of Testing All Paths. Verification: Verification Methods, SRS Verification, Source Code Reviews, User Documentation Verification, Software, Project Audit, Tailoring Software Quality Assurance Program by Reviews, Walkthrough, Inspection and Configuration Audits.

UNIT-II

Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique. Structural Testing: Control Flow Testing, Path Testing, Independent Paths, Generation of Graph from Program, Identification of Independent Paths, Cyclomatic Complexity, Data Flow Testing, Mutation Testing

Regression Testing: What is Regression Testing? Regression Test cases selection, Reducing the number of test cases, Code coverage prioritization technique. Reducing the number of test cases: Prioritization guidelines, Priority category, Scheme, Risk Analysis

UNIT-III

Software Testing Activities: Levels of Testing, Debugging, Testing techniques and their applicability, Exploratory Testing Automated Test Data Generation: Test Data, Approaches to test data generation, test data generation using genetic algorithm, Test Data Generation Tools, Software Testing Tools, and Software test Plan.

UNIT - IV

Object Oriented Testing: Definition, Issues, Class Testing, Object Oriented Integration and System Testing. Testing Web Applications: Web Testing, User Interface Testing, Usability Testing, Security Testing, Performance Testing, Database testing, Post Deployment Testing

Textbook(s):

1. Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2. K.K. Aggarwal & Yogesh Singh, “Software Engineering”, New Age International Publishers, 2003.
3. Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, Fifth Edition, McGraw-Hill, 2001.

References:

1. Marc Roper, “Software Testing”, McGraw-Hill, 1994.
2. M.C. Trivedi, Software Testing & Audit, Khanna Publishing House 6. Boris Beizer, “Software System Testing and Quality Assurance”, Van Nostrand Reinhold, 1984

Software Verification, Validation and Testing	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	SE-487T
EAE	7	SE-EAE	SE-EAE-4B	SE-487T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To study fundamental concepts in software testing
2.	To identify the needs of software test automation, and define and develop a test tool to support test automation
3.	To discuss various software testing issues and solutions in software unit test, integration and system testing
4.	To expose the advanced software testing topics

Course Outcomes (CO)

CO 1	Ability to apply software testing knowledge and engineering methods.
CO 2	Ability to design and conduct a software test process for a software testing project
CO 3	Ability to understand and identify various software testing problems, and solve these problems by designing and selecting software test models, criteria, strategies, and methods.
CO 4	Ability to understand contemporary issues in software testing, such as component-based software testing problems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	3	2	2	3	-	-	3	-	-	3	2
CO 2	3	-	3	-	2	-	3	3	-	-	2	3
CO 3	3	2	-	3	3	-	-	2	3	2	-	-
CO 4	-	2	3	-	-	3	-	2	-	-	2	-

UNIT-I

Review of Software Engineering: Overview of Software Evolution, Error, Fault, Failure, Incident, Test Cases, Testing Process, Limitations of Testing, SDLC, Testing Process, Terminologies in Testing: Error, Fault, Failure, Verification, Validation, Difference Between Verification and Validation, Test Cases, Testing Suite, Test, Oracles, Impracticality of Testing All Data; Impracticality of Testing All Paths. Verification: Verification Methods, SRS Verification, Source Code Reviews, User Documentation Verification

UNIT-II

Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause

Effect Graphing Technique. Structural Testing: Control Flow Testing, Path Testing, Independent Paths, Generation of Graph from Program, Identification of Independent Paths, Cyclomatic Complexity, Data Flow Testing, Mutation Testing
Regression Testing: What is Regression Testing? Regression Test cases selection, Reducing the number of test cases, Code coverage prioritization technique. Reducing the number of test cases: Prioritization guidelines, Priority category, Scheme, Risk Analysis.

UNIT-III

Object Oriented Testing: Definition, Issues, Class Testing, Object Oriented Integration and System Testing. Testing Web Applications: Web Testing, User Interface Testing, Usability Testing, Security Testing, Performance Testing.

UNIT - IV

Software Testing Activities: Levels of Testing, Debugging, Testing techniques and their applicability, Exploratory Testing Automated Test Data Generation: Test Data, Approaches to test data generation, test data generation using genetic algorithm, Test Data Generation Tools, Software Testing Tools, and Software test Plan.

Textbook(s):

1. Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2. K.K. Aggarwal & Yogesh Singh, “Software Engineering”, New Age International Publishers, 2003.
3. Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, Fifth Edition, McGraw-Hill, 2001.

References:

1. Marc Roper, “Software Testing”, McGraw-Hill, 1994.
2. M.C. Trivedi, Software Testing & Audit, Khanna Publishing House 6. Boris Beizer, “Software System Testing and Quality Assurance”, Van Nostrand Reinhold, 1984

Software Verification, Validation and Testing Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	7	OAE-CSE-EA	OAE-2	SE-487P
EAE	7	SE-EAE	SE-EAE-4B	SE-487P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Software Verification, Validation and Testing) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Identify system specification and design test cases for Inventory Management.
2. Design test cases for railway Reservation.
3. To determine the nature of roots of a quadratic equations, its input is triple of +ve integers (say x,y,z) and values may be from interval [1,100] the program output may have one of the following:- [Not a Quadratic equations, Real roots, Imaginary roots, Equal roots] Perform 3-2 Functional Testing.
4. To determine the type of triangle. Its input is triple of +ve integers (say x,y,z) and the values may be from interval[1,100]. The program output may be one of the following [Scalene, Isosceles, Equilateral, Not a Triangle]. Perform 3-2 Non Functional Testing.
5. To determine the nature of roots of a quadratic equations, its input is triple of +ve integers (say x,y,z) and values may be from interval [1,100] the program output may have one of the following:- [Not a Quadratic equations, Real roots, Imaginary roots, Equal roots] Perform Regression Testing.
6. Prepare defect report after executing test cases for any login form.
7. Study of Any Testing Tool. (Ex. Win Runner)
8. Study of Any Test Management Tool. (Ex. QA Complete)
9. Automate the Test cases using Test Automation tool.(Ex. using QA Complete)
10. Learn how to raise and report Bugs using Bug tracking tool. (Ex. Bugzilla,Jira using QA Complete)
11. Study of any Test Management Tool. (Ex. Test Director)

Solar Photovoltaic Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	PED-EAE	PED-EAE-5	PED-429T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To gain knowledge about the significance of Renewable Energy.
2.	To understand PV system's characteristics and behaviour under varying parameters
3.	To understand MPP and methods to evaluate MPP.
4.	Application of power electronics in PV technology.

Course Outcomes (CO)

CO 1	Ability to understand the basics and role of renewable energy.
CO 2	Analyse the PV characteristics of solar PV.
CO 3	Ability to understand the concepts of Maximum Power Point and learn methods to implement MPP.
CO 4	Application of Power Electronics in solar PV systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	1	2	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	2	2	1	1	3	3
CO 3	3	3	3	3	3	3	2	2	1	1	3	3
CO 4	3	2	2	1	3	3	3	2	1	3	3	3

UNIT-I

PV Cells and Modules: Renewable Energy sources, Emergence of renewable sector and its significance, Impact of Global warming, Introduction to PV cells and modules, Designing of PV cells to form PV modules/arrays, Types of solar panels, Potential of solar electrical energy systems in India, Contribution of Solar PV systems in economic growth of a country, Future of solar in India.

UNIT-II

PV Characteristics: Introduction to PV characteristics in terms of VI and PV plots, Modeling of solar cells, Effect of temperature and irradiance on performance of PV module, Partial shading and its effects, Role of bypass and blocking diodes, Losses and Efficiency calculation of PV module, Parameters affecting module performance.

UNIT-III

Maximum Power Point: Introduction to MPP, Various methods to find out MPP, Application of AI and hybrid methods to find MPP, Solar Emulators and their basics, PV integration system, Government schemes and policies to promote PV in India.

UNIT-IV

Role of Power Electronics Components in PV Systems: Designing of PV Emulators using Power electronic components, Introduction to types of batteries used in PV systems, Limitations and challenges of PV systems, Agencies involved in promotion of PV in India, Reliability Analysis of solar PV systems, Introduction to availability.

Textbook(s):

1. N.D. Kaushika, Anuradha Mishra, Anil K. Rai: Solar Photovoltaics - Technology, System Design, Reliability and Viability. Springer Cham, 2018.
2. Maurice Hebert: Maximum Power Point Tracking: Background, Implementation and Classification. Nova Science Publishers Inc., 2020.

Reference(s):

1. Garg HP, Solar Energy: Fundamentals & Applications, Tata McGraw Hill, 2000.
2. Solanki: Solar Photovoltaics: Fundamentals, Technologies and Applications. PHI Learning Pvt Ltd, 2009.
3. Ali M. Eltamaly, Almoataz Y. Abdelaziz: Modern Maximum Power Point Tracking Techniques for Photovoltaic Energy Systems, Springer, 2020.
4. Neeraj Priyadarshi, Akash Kumar Bhoi, Ramesh C. Bansal, Akhtar Kalam: DC—D Converters for Future Renewable Energy Systems. Springer, 2022.

Solar Photovoltaic Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	PED-EAE	PED-EAE-5	PED-429P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Solar Photovoltaic Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To design a solar PV module.
2. To simulate effect of temperature change on output of solar PV.
3. To determine the effect of irradiance on PV characteristics.
4. To design a solar Emulator using buck converter.
5. To design a solar Emulator using boost converter.
6. Write a MATLAB program to obtain MPP OF A PANEL.
7. Write a MATLAB program for obtaining behaviour of a solar cell
8. Simulate dynamic loading on a PV Emulator.
9. To design MPPT system for any solar panel.
10. To design an overall PV system with load.

Note: The above practical list can be based on hardware kits. However, hands on MATLAB/Sim Power System Toolbox simulation-based models related to the course contents can be carried out.

Solid State Drives	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	7	PCE	PCE-4	EEE-409T
EAE	7	PED-EAE	PED-EAE-4	PED-427T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Introduction of solid state drive, characteristic and control.
2.	Study of operation and control of DC drives.
3.	To understand the induction motor drives
4.	Introduction to controllers of drives

Course Outcomes (CO)

CO 1	Ability to understand the motor- load dynamics, closed loop control of speed.
CO 2	Ability of analysis of DC motor drive for multi-quadrant operation and various control structure.
CO 3	Ability to understand the speed control methods of Induction motor
CO 4	Ability to understand the BLDC motors and feedback control techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	2	2	1	2	1	1	2
CO 2	3	3	2	2	2	2	2	1	2	1	1	2
CO 3	3	3	2	2	2	2	2	1	2	1	1	2
CO 4	3	3	3	2	3	2	2	1	2	1	1	2

UNIT-I

Electric drive dynamics**:** Drive Characteristic: Types of loads, Motor load dynamics, Steady state stability, multi quadrant operation, load torque characteristics, closed loop control, class of duty, thermal considerations.

UNIT-II

Chopper fed dc motor drive**:** DC motor speed control: Methods of armature control, field weakening; Steady state analysis of the single and three phase converter fed separately excited DC motor drive– continuous conduction, Time ratio and current limit control, 4 quadrant operation of converter / chopper fed drive-applications.

UNIT-III

Induction motor drives: Three phase induction motor starting, braking, transient analysis, stator voltage control–V/f control, rotor resistance control-qualitative treatment of slip power recovery drives-closed loop control– vector control- Applications.

UNIT – IV

Design of controllers for drives**:** Concept of BLDC motor, 120^0 and 180^0 operation, load and converter – Closed loop control with current and speed feedback - Armature voltage control and field weakening mode control - Design of controllers: Current controller and speed controller.

Textbook(s):
1. G K Dubey, Principle of Electrical Drives, Narosa Publishing House
2. Bimal K. Bose. 'Modern Power Electronics and AC Drives', Pearson Education, 2002.

References:
1. R Krishnan, Electrical Motor Drives, PHI Publications.
2. Bimal K Bose, Power Electronics and Variable Frequency Drives, Wiley India Publication.
3. De, Sen , Electric Drives, PHI Publications
4. Ned Mohan, Electrical Machines And Drives, Wiley India Publication

Solid State Drives Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
EE/EEE	7	PCE	PCE-4	EEE-409P
EAE	7	PED-EAE	PED-EAE-4	PED-427P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Solid State Drives) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study of load equalization by flywheel for intermittent duty loads.
2. To study of single phase bridge configurations cyclo- converter using micro controller.
3. To conduct the study of open loop AC voltage Control of single phase capacitor run induction motor.
4. To conduct the speed control of DC motor below/above base speed using micro controller.
5. To control the speed of DC Motor using MOSFET based chopper and to plot voltage v/s speed graph.
6. To study single phase half controlled converter and speed control of DC Motor..
7. To conduct the speed control of Induction Motor using V/F drive.
8. To study the performance of three phase fully controlled bridge converter.
9. To study the comparison of various braking methods and their range of braking for induction motor.
10. To conduct the close loop speed control of BLDC motor Drive.
11. To conduct the closed Loop speed control of SRM (Switched reluctance Motor) drive.
12. To study of load supply chopping by using the step down chopper.

Solid State Microwave Device and their Application	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-346

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn the basics principles of various microwave solid state devices.
2.	To study the operation and device characteristics of RF Active components.
3.	To design and analyse various other Solid State Devices and measurements.
4.	To design and analyse various applications of the solid state microwave devices and their scope.

Course Outcomes (CO)

CO 1	Explain different types of waveguides and their respective modes of propagation along with impedance, admittance, transmission and scattering matrix representations of typical microwave devices and design microwave matching networks using L section, single and double stub and quarter wave transformer.
CO 2	Describe and explain working of microwave tubes and solid state devices.
CO 3	Perform measurements on microwave devices and networks using power meter and VNA.
CO 4	Explain the various application perspectives of the solid state microwave or RF based devices.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	1	2	1	1	1	1	1	3
CO 2	3	3	3	3	2	2	1	1	1	1	1	3
CO 3	3	3	3	3	2	3	1	1	1	1	1	3
CO 4	3	3	3	3	2	3	1	1	1	1	1	3

UNIT I

Introduction to Solid State Concepts: Semiconductors, Energy Bands, Electrical behaviour of Silicon, Germanium, Gallium Arsenide, Gallium Phosphide, Indium Phosphide, ZnO etc. Need for Microwave Solid State Devices, Evolution, Advantages and Applications.
Introduction to Microwave Solid State Devices: **Microwave Diodes**: Crystal Diodes, Schottcky Diodes, PIN Diodes, Varactor Diodes and Tunnel diodes, MOS Diode. **Microwave Transistors**: Characteristics of Microwave BJT, Hetero Junction Bipolar Transistor (HBT).

UNIT II

Microwave Solid-State Devices: Microwave Field Effect Transistors: Characteristics of Junction Field Effect Transistors (JFET), MESFET, HEMT, Charged Couple Devices.

Transferred Electron Devices: RWH Theory, Two-Valley Modes of operations, Gunn Diode, Limited Space Charge Accumulation Diode (LSA Diode), InP Diodes, Cadmium Telluride Diodes.

UNIT III

Advanced Microwave Solid State Devices: Avalanche Transit Time Devices: Read diode, IMPATT (Impact Ionisation Avalanche Transit Time) Diode, TRAPATT (Trapped Plasma Avalanche Triggered Transit Time) Diode, BARITT (Barrier Injected Transit Time) Diodes.

UNIT IV

Applications: Detectors, Modulators, Amplifiers, Oscillators, Switching Circuits, Phase Shifters, Phase Limiters, Attenuators and Mixers.

Textbooks:
1. Watson, “Microwave Semiconductor Devices and their applications”, McGraw Hill, 1969.
2. Sze. S.M, and Kwok K. Ng, “Physics of Semiconductor Devices”, John Wiley, 3rd Edition 2007.
3. Kai Chang, Microwave Solid-state Circuits And Applications, Wiley Series.
4. S. Y. Liao, Microwave Devices and Circuits, Pearson.

References:
1. Thomas S. Laverghetta, Solid State Microwave Devices.
2. K. C. Gupta et. al., CAD of Microwave Circuits, Artech House, 1981.
3. R. E. Collins, Foundation of Microwave Engineering, McGraw Hill, 1993.

Statistical Quality Control	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	QM-EAE	QM-EAE-4	QM-443T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand and utilize the tools of quality systems.
2.	To collect, analyse and plot variable and attribute data. Create and react to control charts.
3.	To understand and monitor sources of variation.
4.	Determine and use capability indices to describe a process.

Course Outcomes (CO)

CO 1	Evaluate the usage of Statistical analysis tools as an essential tool for quality improvement.
CO 2	Collect, analyse and chart attribute data parameters.
CO 3	Measure and describe process capability.
CO 4	Setup and use various chart types for problem solving.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	2	-	-	-	-	-	-	2	-	-
CO 2	3	2	2	2	2	2	-	2	2	2	-	-
CO 3	3	3	3	3	3	-	-	-	-	-	-	2
CO 4	3	-	2	-	2	3	2	-	2	-	-	2

UNIT-I

The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement).

Mean, Median, Mode, Standard deviation, calculating area, The Deming funnel experiment, Normal distribution tables, Finding the Z score, Central limit theorem.

UNIT-II

Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL).

UNIT-III

Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error. Simple Numerical Problems.
Statistical Process Control and Process Capability, Zero defect programme; Six – Sigma approach.

UNIT – IV

The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, Military Standard 105E, the Dodge-Romig sampling plans. Numerical problems

Textbook(s):

1. M. Mahajan, Statistical Quality Control, Dhanpant Rai and Co.
2. Grant and Leavenworth-Statistical Quality Control, 7th Edition, Tata Mcgraw Hill.

References:

1. D.C. Montgomery, Introduction to Statistical Quality Control, John Wiley, 2019.
2. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.
3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
4. Juran’s Quality Control Handbook –McGraw Hill Book Company.

Statistical Quality Control Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	QM-EAE	QM-EAE-4	QM-443P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Statistical Quality Control) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To verify given statistical relationships.
2. To plot and determine the given unknown distribution.
3. To plot control charts for X-Bar and R- Charts.
4. To perform use of control charts and process engineering techniques for implementing thequality plan.
5. To state and prove central limit theorem.
6. To perform statistical tolerance analysis of case study.
7. To perform sampling problem of a given data.
8. To design a sequential sampling plan.
9. To study Six sigma quality tools and its application.
10. To study quality function and concept of quality cycle.

Statistics, Statistical Modelling & Data Analytics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI/CSE-AIML/CSE-DS	6	PC	PC	DA-304T
EAE	6	AI-EAE	AI-EAE-2	DA-304T
EAE	6	AIML-EAE	AIML-EAE-2	DA-304T
EAE	6	DS-EAE	DS-EAE-1	DA-304T
EAE	6	SC-EAE	SC-EAE-1	DA-304T
EAE	6	MLDA-EAE	MLDA-EAE-1	DA-304T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart basic knowledge about Statistics, visualisation and probability.
2.	To impart basic knowledge about how to implement regression analysis and interpret the results.
3.	To impart basic knowledge about how to describe classes of open and closed sets of R, concept of compactness Describe Metric space - Metric in Rn.
4.	To impart basic knowledge about how to apply Eigen values, Eigen vectors.

Course Outcomes (CO)

CO 1	Ability to learn and understand the basic concepts about Statistics, visualisation and probability.
CO 2	Ability to implement regression analysis and interpret the results. Be able to fit a model to data and comment on the adequacy of the model
CO 3	Ability to describe classes of open and closed sets of R, concept of compactness Describe Metric space - Metric in Rn.
CO 4	Ability to impart basic knowledge about how to apply Eigen values, Eigen vectors.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	3	-	-	1	2	-	-	3
CO 2	3	3	3	3	3	-	-	1	2	-	-	3
CO 3	3	3	3	3	3	-	-	1	2	-	-	3
CO 4	3	3	3	3	3	-	-	1	2	-	-	3

UNIT-I

Statistics: Introduction & Descriptive Statistics- mean, median, mode, variance, and standard deviation. Data Visualization, Introduction to Probability Distributions.

Hypothesis testing, Linear Algebra and Population Statistics, Mathematical Methods and Probability Theory, Sampling Distributions and Statistical Inference, Quantitative analysis.

UNIT-II

Statistical Modelling: Linear models, regression analysis, analysis of variance, applications in various fields. Gauss-Markov theorem; geometry of least squares, subspace formulation of linear models, orthogonal projections; regression models, factorial experiments, analysis of covariance and model formulae; regression diagnostics, residuals, influence diagnostics, transformations, Box-Cox models, model selection and model building strategies, logistic regression models; Poisson regression models.

UNIT-III

Data Analytics: Describe classes of open and closed set. Apply the concept of compactness. Describe Metric space - Metric in Rn. Use the concept of Cauchy sequence, completeness, compactness and connectedness to solve the problems.

UNIT – IV

Advanced concepts in Data Analytics: Describe vector space, subspaces, independence of vectors, basis and dimension. Describe Eigen values, Eigen vectors and related results.

Textbook(s):

1. Apostol T. M. (1974): Mathematical Analysis, Narosa Publishing House, New Delhi.
2. Malik, S.C., Arora, S. (2012): Mathematical Analysis, New Age International, New Delhi

References:

1. Pringle, R.M. and Rayner, A.(1971): Generalized Inverse of Matrices with Application to Statistics, Griffin, London
2. Peter Bruce, Andrew Bruce (2017), Practical Statistics for Data Scientists Paperback

Statistics, Statistical Modelling & Data Analytics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI/CSE-AIML/CSE-DS	6	PC	PC	DA-304P
EAE	6	AI-EAE	AI-EAE-2	DA-304P
EAE	6	AIML-EAE	AIML-EAE-2	DA-304P
EAE	6	DS-EAE	DS-EAE-1	DA-304P
EAE	6	SC-EAE	SC-EAE-1	DA-304P
EAE	6	MLDA-EAE	MLDA-EAE-1	DA-304P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Statistics, Statistical Modelling & Data Analytics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Exercises to implement the basic matrix operations in Scilab.
2. Exercises to find the Eigenvalues and eigenvectors in Scilab.
3. Exercises to solve equations by Gauss elimination, Gauss Jordan Method and Gauss Siedel in Scilab.
4. Exercises to implement the associative, commutative and distributive property in a matrix in Scilab.
5. Exercises to find the reduced row echelon form of a matrix in Scilab.
6. Exercises to plot the functions and to find its first and second derivatives in Scilab.
7. Exercises to present the data as a frequency table in SPSS.
8. Exercises to find the outliers in a dataset in SPSS.
9. Exercises to find the most risky project out of two mutually exclusive projects in SPSS
10. Exercises to draw a scatter diagram, residual plots, outliers leverage and influential data points in R
11. Exercises to calculate correlation using R
12. Exercises to implement Time series Analysis using R.
13. Exercises to implement linear regression using R.
14. Exercises to implement concepts of probability and distributions in R

Stochastic Processes and Systems	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	6	PCE	PCE-1	EEE-318

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the probability
2.	To understand the density function
3.	To understand the temporal characteristics of stochastic process
4.	To understand the spectral characteristics of stochastic process

Course Outcomes (CO)

CO 1	Ability to understand the probability
CO 2	Ability to understand the density function
CO 3	Ability to understand the temporal characteristics of stochastic process
CO 4	Ability to understand the spectral characteristics of stochastic process

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	2	1	1	1	2	2	3	1
CO 2	3	2	3	3	2	1	1	1	2	2	3	1
CO 3	3	2	3	3	2	1	1	1	2	2	3	1
CO 4	3	2	3	3	2	1	1	1	2	2	3	1

UNIT I

Probability and Random Variable: Introduction to probability through sets and probability: Relative frequency; Experiments and sample spaces, discrete and continuous sample spaces; Events; Probability definitions and axioms; Mathematical model of experiments; Probability as a relative frequency; Joint probability; Conditional probability, total probability; Baye’s theorem and independent events. Random variable: Definition of random variable, conditions for a function to be a random variable, discrete, continuous and mixed random variable.

UNIT II

Distribution and Density Functions: Distribution and density functions: distribution and density functions definitions and properties; binomial, poisson, Uniform, gaussian, exponential, rayleigh, conditional distribution, methods of defining conditioning on an event, Conditional density, properties. Operation on one random variable expectations: introduction, expected value of a Random variable, function of a random variable, moments about the origin, central moments, variance and skew; Chebyche’s inequality; characteristic function; moment generating function; transformations of a random variable: Monotonic transformations for a continuous random variable; non monotonic transformations of continuous random Variable; transformation of a discrete random variable

UNIT III

Stochastic Processes - Temporal Characteristics: The random process concept, classification of processes, deterministic and non deterministic processes, distribution and density functions, concept of stationary and statistical independence; First order stationary processes; Second order and wide sense stationary, N Order and strict sense stationary, time averages and periodicity, mean Ergodic processes, correlation Ergodic processes; Autocorrelation function and its properties; Cross correlation function and its properties; Covariance functions; Gaussian random processes; Poisson random process.

UNIT IV

Stochastic Processes - Spectral Characteristics: Power spectrum: Properties, relationship between power spectrum and autocorrelation function; The cross power density spectrum, properties, relationship between cross power spectrum and cross correlation function. Spectral characteristics of system response: Power density spectrum of response; cross-power density spectrums of input and output of a linear system. Introduction to white Gaussian noise process and its properties.

Textbooks:
1. Peyton Z. Peebles, “Probability, Random Variables & Random Signal Principles”, TMH, 4th Ed, 2001.
2. Scott Miller, Donald Childers, “Probability and random process”, Elsevier, 2nd Edition, 2012.
3. S.P. Eugene Xavier, “Statistical Theory of Communication”, New Age Publications, 1st Edition, 2003

References:
1. Athanasius Papoulis, S. Unnikrishna Pillai, “Probability, Random Variables and Stochastic Processes”, PHI, 4th Ed., 2002.
2. Henry Stark, John W. Woods, “Probability and Random Processes with Application to Signal Processing”, Pearson Education, 3rd Edition, 2014.
3. George R. Cooper, Clave D. MC Gillem, “Probability Methods of Signal and System Analysis”, Oxford, 3rd Ed, 1999.

Strength of Materials-II	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-5	MEE-413T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about the concept of 3-dimensional state of stress, theories of failure and strain energy.
2.	To develop the understanding of various stresses acting in thick pressure vessels and rotating discs/cylinders.
3.	To facilitate students to understand the bucking phenomena and concept of the curved beams.
4.	To study about the shear stresses in beams and the concept of unsymmetrical bending.

Course Outcomes (CO)

CO 1	Understood the concept of 3D state of stress at a point, theories of failure and strain energy.
CO 2	Determine the stresses induced in thick pressure vessels and rotating disc/cylinders.
CO 3	Analyse the Euler’s buckling phenomena and bending of curved beams.
CO 4	Compute the shear stresses for different sections of beam and understand the concept of unsymmetrical bending.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	3	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	3	-	3	-	-	--	-	-	2

UNIT-I

3D Stress: Three dimensional stress and strain, Stress tensor, stress invariants, Strain Tensor, Equilibrium Equations, St. Venant’s principle, generalized hooks law, Theories of elastic failure and their applications.
Strain Energy: Strain Energy Due to Axial Force, Shear Stress, Bending; Maxwell’s reciprocal theorem, Castigliano’s theorem for statically determinate structures.

UNIT-II

Thick Cylinders: Stresses in thick cylinders, sphere subjected to internal pressure, Lame’s equations, compound cylinders, spherical vessels, hub shrunk on solid shafts.
Rotating Disc and Cylinders: Rotational stresses in discs and rims of uniform thickness; discs of uniform Strength, long cylinder.

UNIT-III

Columns: Combined direct and bending stresses in columns, Euler's and Rankine Gordon equations, applications of Johnson's empirical formula for axially loaded columns.
Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks.

UNIT – IV

Shear Stresses in Beams: Shear stress at a section, shear stress distribution for different sections: square, rectangular, Triangular, Circular section, I-section, T-section.
Unsymmetrical Bending and Shear Centre: Properties of beam cross-section, Principal Axes, Determination of Principal Axes, stress and deflection in unsymmetrical bending, shear centre.

Textbook(s):

1. Dr. Sadhu Singh, "Strength of Materials", Khanna Publishers.
2. R.K. Bansal, "A Textbook of Strength of Materials", Laxmi Publications; 4th ed. (2010).

References:

1. S.P. Timoshenko and J. Gere, "Elements of Strength of Materials", East-West affiliated, New Delhi.
2. R.C. Hibbler, "Mechanics of Materials", Prentice Hall, New Delhi;(1994).
3. L.S. Sri Nath et.al., "Strength of Materials", McMillan, New Delhi;(2001).
4. Eger P. Popov, "Engg. Mechanics of solids", Prentice Hall, New Delhi;(1998).
5. Roger T. Fenner, "Mechanics of Solids", U.K. B.C. Publication, New Delhi;(1990).
6. S. Ramamrutham et.al., "Strength of Materials", Dhanpat Rai Publishing Company.

Strength of Materials-II Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	7	PCE	PCE-5	MEE-413P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Strength of Materials-II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To inspect the property of creep in metals
2. To determine the endurance limit of the given specimen under fatigue or cyclic loading.
3. To study and verify the Maxwell’s Reciprocal theorem on beams.
4. To perform bending test on beam (wooden or any other material) and to determine the Young's modulus and Modulus of rupture.
5. To find the Shear Modulus of Elasticity of two different materials; Aluminum and Steel using two twist and bent test rigs are used.
6. To determine the Modulus of Elasticity and Poison’s ratio of Aluminum, the specimen being a cantilever beam, and compare them with theoretical value.
7. To determine principal stresses and strains in a beam made of aluminum and loaded as a cantilever, and compare them with theoretical values.
8. To determine flexural strength (modulus of rupture) of concrete using simple beam with third-point loading.
9. To study behaviour of different types of columns and find Euler’s buckling load for different end conditions.

Structural Analysis - II	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	5	PC	PC	CEC-303

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To know the concept of combined direct and bending stresses, stresses developed in thin cylinders.
2.	To construct influence lines and be able to use the same.
3.	To explain method of consistent deformation and slope deflection method.
4.	To discuss moment distribution method and unit load method.

Course Outcomes (CO)

CO 1	Determine stresses in structures and thin cylinders.
CO 2	Utilise the concept of influence line diagrams for support reaction, shear force and bending moment.
CO 3	Interpret unknown forces and displacements in indeterminate structures by method of consistent deformation and slope deflection method.
CO 4	Analyse indeterminate structures by moment distribution, Kani's and unit load method.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	-	-	-	-	-	-	-	-	-	-
CO 2	1	2	-	-	-	-	-	-	-	-	-	-
CO 3	1	3	-	-	-	-	-	-	-	-	-	-
CO 4	1	3	-	-	-	-	-	-	-	-	-	-

UNIT-I

Combined direct and bending stresses: Middle third rule, core of a section, stresses due to water and earth pressure in structures like retaining walls, dams etc.

Thin cylinders: Thin cylinders subjected to internal fluid pressure, wire wound thin cylinders. Thin cylindrical shells, circumferential and hoop stresses, longitudinal stresses, Maximum shear stress.

UNIT-II

Moving loads and Influence lines: Introduction to moving loads, absolute maximum bending moment and shear force, concept of influence lines, influence lines for reaction, shear force, bending of determinate beams, analysis for different types of moving loads, single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than span, Application of Muller Breslau Principle for determinate structures.

UNIT-III

Method of consistent deformation: Analysis of indeterminate beams and frames upto two degree of indeterminacy, Analysis of pin jointed plane frame with external indeterminacy, effects due to error in length of a member.

Slope Deflection Method: Analysis of continuous beams, Analysis of rigid frames, frames with sloping legs, frames without sway and with sway, settlement effects.

UNIT – IV

Moment distribution method and Kani's Method: Analysis of continuous beams and plane frames.

Deflections of pin jointed plane frame: Unit Load Method, Deflections due to Lack of Fit and Temperature Changes.

Textbook(s):

1. Dr. B. C. Punamia, Er. Ashok Kumar Jain, Dr. Arun Kumar Jain, "Mechanics of Materials", Laxmi Publications (P) Ltd. Revised edition (2017)
2. Dr. R. K Bansal, "A Textbook of Strength of Materials", Laxmi Publications (P) Ltd. (2018)
3. S S Bhavikatti, "Structural Analysis (Vol.I and II)", Vikas Publication, Fourth Edition (2011)

References:

1. C.S. Reddy, "Basic Structural Analysis", Tata McGraw Hill (2017)
2. 2.R. Agor, "Structural Analysis", Khanna Publishing, Third Edition (2021)
3. S. Ramamrutham, R. Narayan, "Theory of Structures", Dhanpat Rai Publishing Company, (2017)
4. Dr. R. Vaidyanathan, Dr. P. Perumal, "Structural Analysis Volume II", Laxmi Publications (P) Ltd. (2016)
5. R.C. Hibbler, "Structural Analysis", Pearson Education

Structural Analysis and Design	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	CE-OAE	CE-OAE-1	OCE-302

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand concept of shear force and bending moment in different structures.
2.	To analyse indeterminate structures.
3.	To develop understanding of various design philosophies and their differences.
4.	To develop basic understanding of steel as a construction material

Course Outcomes (CO)

CO 1	Illustrate shear force and bending moment diagrams for determinate structures.
CO 2	Analyze indeterminate structures using slope deflection and moment distribution method.
CO 3	Identify codal provision for concrete design by working stress and limit state method.
CO 4	Summarize structural steel properties, type of members and connections.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	2	3	-	-	-	-	-	-	-	-	-
CO 2	1	2	3	-	-	-	-	-	-	-	-	-
CO 3	-	2	3	1	-	-	-	-	-	-	1	-
CO 4	1	3	2	-	-	-	-	-	-	-	1	-

UNIT-I

Classification of Structures, Degree of Freedom per node, Static and Kinematic degrees of indeterminacy, Shear force and bending moment: Different types of beams and loads, shear force and bending moment diagrams for cantilever and simply supported beams with and without overhangs subjected to different kinds of loads, relation between loading, shear force and bending moments.

UNIT-II

Slope Deflection Method: Slope-deflection equations, equilibrium equation of slope-deflection method, Analysis of beams with and without joint translation and rotation.
Moment distribution method: Basic concept, Stiffness factor, carry over factor, distribution factor, distribution theorem, analysis of beams with and without joint translation.

UNIT-III

Concrete: Mechanical properties of concrete: elastic modules, poisson's ratio, creep, shrinkage and durability of concrete. Working stress and Limit state design concepts. Introduction to Various Design Philosophies including characteristic strength, Partial Safety Factor, Factored Load, Design stress strain curve. Assumptions in Limit State Design Method. Constituents, mix design, shortterm and long-term properties. (IS 456, IS 800, IS 10262)

UNIT – IV

Structural Steel: Composition and its type, material properties and behaviour; stress strain curve, relaxation of steel, Structural steel designation as per IS: 800:2007, Basics of types of members (Tension member, Compression member and flexural member) Connections – Types of connections. Rivet Connections, Bolted Connections and Welded Connections.

Textbook(s):

1. S S Bhavikatti, "Structural Analysis (Vol.I and II)", Vikas Publication, Fourth Edition (2011).
2. Jain A.K., "Limit State Design of Reinforced Concrete Structures", Nem Chand Publishers, Roorkee.

References:

1. Ramamrutham, R. Narayan, "Theory of Structures", Dhanpat Rai Publishing Company, (2017).
2. R. Agor, "Structural Analysis", Khanna Publishing, Third Edition (2021).
3. S.K. Duggal, "Limit State Design of steel structures", Tata Mc Graw Hill, 3rd Edition (2019).
4. L.S Negi, "Design of Steel Structure", Tata McGraw-Hill.

Structural Design - II	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	5	PC	PC	CEC-305

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	The course aims at designing of basic elements of structures such as beam and slab
2.	The course aims at designing of basic elements of structures such as column and foundation.
3.	To provide a basic understanding of use of steels in civil engineering
4.	To develop technical competence in the design of simple bolted and welded connections, tension and compression members

Course Outcomes (CO)

CO 1	Analyze singly and doubly reinforced beams, one way and two way slabs, short and slender columns and footings.
CO 2	Understand the behavior of concrete structures under flexure, shear, bond and torsion and compression.
CO 3	Design of different types of joint system for complex engineering problems considering safety and economic factors.
CO 4	Identify tension, compression and flexural members in a structure which can meet the specified needs with appropriate considerations.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	1	2	2	1	-	1	1	3	2	3
CO 2	3	3	1	2	1	1	1	1	2	3	2	3
CO 3	2	2	3	2	2	2	-	1	-	3	2	2
CO 4	2	2	3	1	1	2	2	1	1	3	2	2

UNIT-I

Analysis and design of singly and doubly reinforced simply supported cantilever and continuous beams and flanged beam section, lintels, Design principles of retaining walls. Design of simply supported, cantilever slabs, one way and two way slabs
Limit state of Collapse: Flexure, Shear, bond and torsion, Compression, Limit state of Serviceability

UNIT-II

Design of short and slender columns under axial load, under uniaxial and biaxial bending and shear force. Design of isolated footing for vertical load and Moment, Design of combined footings.

UNIT-III

Riveted connections: Analysis and design of various types of riveted connections, permissible stresses in rivets, Design criteria, Code requirements, Tacking rivets, rivet joints subject to moment, Stresses in rivets.
Welded connections: Advantage and disadvantages of welding, Design criteria, Code requirements, Analysis and design of Fillet and Butt weld, Fillet weld subjected to moment.

UNIT – IV

Design of Tension members: Analysis of trusses and design of axially loaded tension member, Lug angle, tension splice.
Design of compression members: Modes of failure in column, Design of compression member, Lacing and battening for built up compression member. Compression member composed of two components back-to-back, column base and foundation, Roof trusses [including Purlins, bracings and connections].

Textbook(s):
1. Sinha S.N., "Handbook of Reinforced Concrete Design", McGraw Hill Publishing Company., New Delhi.
2. Gambhir M.L., "Fundamentals of Reinforced Concrete Design"., PHI Learning (P) Ltd., New Delhi
3. S.K. Duggal, "Limit State Design of steel structures", Tata Mc Graw Hill
4. L.S. Negi, "Design of steel structures", Tata Mc Graw Hill

References
1. Jain A.K., "Limit State Design of Reniforced Concrete Structures"., Nem Chand Publishers, Roorkee.
2. Shetty M.S., "Concrete Technology, Theory and Practice", S.Chand and Co., New Delhi.
3. Raju K., "Reinforced Concrete", New Age International (P) Ltd., New Delhi.
4. N. Subramanian, "Design of steel structures", Oxford University Press.
5. Krishnamurthy, "Elementary Structural Design"-Vol-III, CBS Publishers

Structural Design Lab	L	P	C
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	5	PC	PC	CEC-351

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Structural Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of SP34/IS13920/IS456:2000 for detailing of structural elements
2. Preparation of bar bending schedule of Simply supported and Cantilever RCC Beam using MS Excel.
3. Preparation of bar bending schedule of RCC Slabs (One way and two way) by using MS Excel.
4. Preparation of bar bending schedule of RCC Columns –(Tied columns and Spirally reinforced columns) by using MS Excel
5. Preparation of bar bending schedule of Isolated and combined footings for RC Columns by using MS Excel.
6. Preparation of working hand sketches and Auto CAD drawings for RCC Beam
7. Preparation of working hand sketches and Auto CAD drawings for Slabs - One way and two way slabs.
8. Preparation of working hand sketches and Auto CAD drawings for RCC Column.
9. Preparation of working hand sketches and Auto CAD drawings for Combined rectangular and trapezoidal footing.

Structural Dynamics	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	7	PCE	PCE-5	CEE-409

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the basics of dynamics of structures using various analysis methods.
2.	To analyze the theory of vibrations and their impact on structures using earthquake analysis.
3.	To know the multi-degree of freedom system to evaluate and analyse dynamics responses.
4.	To implement Practical vibration analysis.

Course Outcomes (CO)

CO 1	To understand structural dynamics and their types.
CO 2	To know the theory of vibrations and earthquakes analysis using IS 1893:2016
CO 3	To evaluate various degrees of freedom on various structural systems.
CO 4	To analyze practical vibration analysis.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	1	2	3	-	-	-	-	-	-	-	-
CO 2	-	-	-	1	2	-	-	-	-	-	-	3
CO 3	-	-	-	3	1	-	-	-	-	-	-	2
CO 4	-	-	-	1	2	3	-	-	-	-	-	-

UNIT-I

Introduction to Structural Dynamics : Fundamental objectives of dynamic analysis - Types of prescribed loading - Methods of discretization - Formulation of equations of motion by different methods – Direct equilibration using Newton's law of motion / D'Alembert's principle, Principle of virtual work and Hamilton principle.

Single Degree of Freedom Systems: Formulation and solution of the equation of motion - Free vibration response - Response to Harmonic, Periodic, Impulsive and general dynamic loadings - Duhamel integral.

UNIT-II

Theory of Vibrations: Introduction - Elements of vibratory system - Degrees of Freedom - Continuous System - Lumped mass idealization - Oscillatory motion - Simple Harmonic motion - Vectorial representation of S.H.M. - Free vibrations of single degree of freedom system - undamped and damped vibrations - critical damping - Logarithmic decrement - Forced vibration of SDOF systems - Harmonic excitation -Dynamic magnification factor – Phase angle – Bandwidth

Introduction to Earthquake Analysis: Introduction - Excitation by rigid base translation - Lumped mass approach - SDOF and MDOF systems - I. S. Code methods of analysis for obtaining the response of multi-storeyed buildings

UNIT-III

Multi Degree of Freedom Systems: Selection of the degrees of Freedom - Evaluation of structural property matrices - Formulation of the MDOF equations of motion - Undamped free vibrations - Solutions of Eigen value problem for natural frequencies and mode shapes - Analysis of Dynamic response – Normal co-ordinates - Uncoupled equations of motion - Orthogonal properties of normal modes - Mode superposition

UNIT – IV

Practical Vibration Analysis: Introduction - Stodola method - Fundamental mode analysis - Analysis of second and higher modes - Holzer method - Basic procedure. Continuous Systems: Introduction - Flexural vibrations of beams - Elementary case – Derivation of governing differential equation of motion - Analysis of undamped free vibrations of beams in flexure - Natural frequencies and mode shapes of simple beams with different end conditions - Principles of application to continuous beams.

Textbook(s):
1. Basics of Structural Dynamics and Aseismic Design by Damodarasamy S.R, Publisher: PHI.
2. Dynamics of Structures by Anil K Chopra, Pearson Education India Publications.

References:
1. Dynamics of Structures by Clough & Penzien, McGraw Hill, New York
2. Structural Dynamics by Mario Paz, C.B.S Publishers, New Delhi.
3. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi.
4. I.S: 1893 - 1984, “Code of practice for Earthquake resistant design of Structures” and latest , I.S: 1893 - 2002 (version) Part-1

Supervised and Deep Learning	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	**Semester**	**Group**	**Sub-group**	**Paper Code**
EAE	7	MLDA-EAE	MLDA-EAE-3	ML-463T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce students to the fundamentals of Supervised Learning and Deep Learning techniques and algorithms.
2.	To enable students to develop skills in implementing supervised and deep learning algorithms using Python programming language and popular machine learning libraries.
3.	To equip students with the ability to evaluate the performance of supervised and deep learning models and select the appropriate models for specific problems.
4.	To provide students with hands-on experience in working with real-world supervised and deep learning projects.

Course Outcomes (CO)

CO 1	Develop a deep understanding of the concepts and applications of Supervised Learning and Deep Learning techniques and algorithms.
CO 2	Develop proficiency in using Python programming language and popular machine learning libraries to implement supervised and deep learning models.
CO 3	Demonstrate the ability to evaluate the performance of supervised and deep learning models and select the appropriate models for specific problems.
CO 4	Gain hands-on experience in working with real-world supervised and deep learning projects, including image recognition, text analysis, and time-series analysis.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT-I

Introduction to Machine Learning, Types of Machine Learning, Supervised Learning Basics, Regression and Classification, Linear Regression, Logistic Regression, Model Evaluation Metrics

UNIT-II

Introduction to Deep Learning, Artificial Neural Networks, Activation Functions, Loss Functions, Optimization

Algorithms, Backpropagation Algorithm, Regularization Techniques

UNIT-III

Introduction to CNNs, CNN Architecture, Convolution and Pooling Layers, Object Detection, Image Segmentation, Transfer Learning, Introduction to RNNs, RNN Architecture, Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), Text Generation, Language Translation

UNIT – IV

Generative Adversarial Networks (GANs), Autoencoders, Reinforcement Learning, Natural Language Processing (NLP), Sentiment Analysis, Time Series Analysis

Textbooks:

1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 2nd Edition, O'Reilly Media, 2019. ISBN: 978-1492032649
2. Francois Chollet, "Deep Learning with Python", 1st Edition, Manning Publications, 2017. ISBN: 978-1617294433

Reference Books:

1. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron.
2. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
3. "Pattern Recognition and Machine Learning" by Christopher M. Bishop.
4. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", 1st Edition, MIT Press, 2016. ISBN: 978-0262035613
5. Andrew Ng, "Machine Learning Yearning", eBook, 2018.
6. Sebastian Raschka and Vahid Mirjalili, "Python Machine Learning", 3rd Edition, Packt Publishing, 2019. ISBN: 978-1789955750

Supervised and Deep Learning Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	MLDA-EAE	MLDA-EAE-3	ML-463P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Supervised and Deep Learning) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Linear regression: Implement linear regression on a dataset and evaluate the model's performance.
2. Logistic regression: Implement logistic regression on a binary classification dataset and evaluate the model's performance.
3. k-Nearest Neighbors (k-NN): Implement k-NN algorithm on a dataset and evaluate the model's performance.
4. Decision Trees: Implement decision trees on a dataset and evaluate the model's performance.
5. Random Forest: Implement random forest algorithm on a dataset and evaluate the model's performance.
6. Support Vector Machines (SVM): Implement SVM on a dataset and evaluate the model's performance.
7. Naive Bayes: Implement Naive Bayes algorithm on a dataset and evaluate the model's performance.
8. Gradient Boosting: Implement gradient boosting algorithm on a dataset and evaluate the model's performance.
9. Convolutional Neural Networks (CNN): Implement CNN on an image classification dataset and evaluate the model's performance.
10. Recurrent Neural Networks (RNN): Implement RNN on a text classification dataset and evaluate the model's performance.
11. Long Short-Term Memory Networks (LSTM): Implement LSTM on a time-series dataset and evaluate the model's performance.
12. Autoencoders: Implement autoencoders on an image dataset and evaluate the model's performance.
13. Generative Adversarial Networks (GANs): Implement GANs on an image dataset and evaluate the model's performance.
14. Transfer Learning: Implement transfer learning on an image dataset and evaluate the model's performance.
15. Reinforcement Learning: Implement reinforcement learning on a game environment and evaluate the model's performance.

Supervised and Unsupervised Learning	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AIML	6	PC	PC	ML-352T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn about supervised learning and its algorithms
2.	To learn about supervised learning networks
3.	To learn about unsupervised learning
4.	To learn about Unsupervised learning network,Autoencoder,Generative Adversarial Network

Course Outcomes (CO)

CO 1	Applying classification and regression algorithm to real world examples
CO 2	Learn about supervised learning network
CO 3	Applying clustering algorithms to real world examples
CO 4	Learn about Unsupervised learning network,Autoencoder,Generative Adversarial Network

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	3	2	2	-	-	-	-	2
CO 2	3	2	3	3	3	2	2	-	-	-	-	2
CO 3	3	2	3	3	3	2	2	-	-	-	-	2
CO 4	3	2	3	3	3	2	2	-	-	-	-	2

UNIT-I

Supervised Learning: Classification, Ensemble Learning Classification-Introduction, Example of Supervised Learning, Classification Model, Classification Learning Steps, Common Classification Algorithms - k-Nearest Neighbour (kNN), Decision tree, Random forest model, Support vector machines. Ensemble Learning- Boosting, Bagging

Regression: Introduction, Regression Algorithms - Simple linear regression, Multiple linear regression, Polynomial Regression Model, Logistic Regression

Bayesian Concept Learning - Introduction, Bayes’ Theorem, Bayesian Belief Network.

UNIT-II

Supervised Learning Networks:

Perceptron: Representational power of Perceptron, The Perceptron Training Rule, Gradient Descent and Delta Rule

Multilayer Networks: A differentiable Threshold Unit, Representational Power of Feedforward Networks

Backpropagation Algorithm: Convergence and local minima, Hypothesis space search and Inductive Bias, Generalization, overfitting and stopping criteria.
Regularization for Deep Learning: Parameter Norm Penalties, Dataset Augmentation, Noise Robustness, Early Stooping, Sparse Representation, Dropout.
Optimization for Training Deep Models: Challenges in Neural network Optimization, Basic Algorithms, Parameter Initialization Strategies.

UNIT-III

Unsupervised Learning: Introduction, Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering –Clustering as a Machine Learning task, Different types of clustering techniques, Partitioning methods, Hierarchical clustering, Density-based methods: DBSCAN.
Finding Pattern using Association Rule: Definition of common terms, Association rule, Apriori algorithm.

UNIT – IV

Unsupervised Learning Networks: Kohonen Self-Organizing Feature Maps – architecture, training algorithm, Kohonen Self Organizing Motor Map,Restricted Boltzmann machine
Autoencoders: Linear Factor Methods such as Probabilistic PCA and Factor Analysis, Independent Component Analysis, Sparse Coding; Undercomplete Autoencoders, Regularized Autoencoders, Stochastic Encoders and Decoders, Denoising Autoencoders, Contractive Autoencoders, Applications of Autoencoders.
Generative Adversarial Networks: Generative Vs Discriminative Modeling, Probabilistic Generative Model, Generative Adversarial Networks (GAN), GAN challenges: Oscillation Loss, Mode Collapse, Uninformative Loss, Hyperparameters, Tackling GAN challenges, Wasserstein GAN, Cycle GAN, Neural Style Transfer

Textbook(s):
1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (India) Private Limited, 2013
2. Jennifer Grange ,” Machine Learning for Absolute Beginners: A Simple, Concise & Complete Introduction to Supervised and Unsupervised Learning Algorithms”,Kindle
3. Kamal Kant Hiran, Ritesh Kumar Jain, Dr. Kamlesh Lakhwani, Dr Ruchi Doshi,” Master Supervised and Unsupervised Learning Algorithms with Real Examples”, BPB Publications

References:
1. C. M. BISHOP (2006), “Pattern Recognition and Machine Learning”, Springer-Verlag New York, 1st Edition
2. Michael W. Berry, Azlinah Mohamed,Bee Wah Yap,”Supervised and Unsupervised Learning for Data Science”

Supervised and Unsupervised Learning Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AIML	6	PC	PC	ML-352P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Supervised and Unsupervised Learning) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to JUPYTER IDE and its libraries Pandas and NumPy
2. Program to demonstrate Multiple Linear Regression
3. Program to demonstrate SVM based classification
4. Implement Boolean gates using perceptron
5. Program to demonstrate Back-Propagation Algorithm
6. Program to demonstrate k-means clustering algorithm
7. Program to demonstrate Agglomerative Hierarchical clustering
8. Program to demonstrate PCA on face recognition
9. Compare the performance of PCA and Autoencoders on a given dataset
10. Build Generative adversarial model for fake (news/image/audio/video) prediction.

Supply Chain Management	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	QM-EAE	QM-EAE-1	QM-326T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about different types of building blocks of a supply chain network.
2.	To understand the supply chain strategy and performance measures and supply chain integration.
3.	To understand network designing and operation in supply chain and forecasting techniques.
4.	To understand about supply chain restructuring.

Course Outcomes (CO)

CO 1	Develop a sound understanding of the important role of supply chain management in today's business environment.
CO 2	Apply foundational business skills needed in SCM settings.
CO 3	Analyse the analytical business skills to address SCM challenges.
CO 4	Understand and apply the current supply chain theories, practices and concepts utilizing case problems and problem-based learning situations.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	3
CO 2	3	3	3	3	-	3	-	-	-	2	-	3
CO 3	3	3	3	3	-	3	-	-	-	2	-	2
CO 4	3	3	3	2	-	3	-	-	2	2	-	2

UNIT-I

Introduction: Evolution of SCM, Building blocks of a supply chain network. Decision in a Supply Chain; Strategic, tactical, and operational decisions, SCM in Indian Context.
Supply chain Strategy and performance measures: Customer service and cost trade- off; order delivery lead time; supply chain responsiveness; delivery reliability, product variety; Benchmarking supply chain performance using financial data. Supply chain optimization, integration and restructuring.

UNIT-II

Supply chain inventory management: Types of Inventory, inventory related costs, managing cycle stock, managing safety stock, managing seasonal stock, Supply chain redesign on the inventory, Inventory of short life cycle products. Newsboy, Base-stock, and (Q,r) models, multi-echelon supply chains, Performance modelling of supply chains using Markov chains and queuing networks.

Modes of transportation: choice and their performance measure, Vehicle Scheduling, Transportation costs in E retailing.
Network designing and operation: planning for network operations, design of networks, Data for network design, location of Service outlets.

UNIT-III

Demand forecasting: Qualitative forecasting methods, Quantitative Forecasting methods, Time series forecasting models.
Web based SCM: Internet-enabled supply chains: e-marketplaces, e-procurement, elogistics, customer relationship management, web services, supply chain automation, and supply chain integration.
Supply chain Integration: Internal and External, Building relationship and trust; Vendor management, customer response.

UNIT - IV

Supply chain Restructuring: Value addition curve, Entry point of customer, Supply chain mapping, point of differentiation, Postponing for cost reduction, Change in the value addition curve.
Agile Supply chain, Pricing and revenue management.

Textbook(s):
1. Janat Shah, “Supply Chain Management: Text and Cases”, Pearson Education India, 2009.
2. Sunil Chopra, “Supply Chain Management, 3rd Ed”, Pearson Education India, 2009.

References:
1. Khanna O. P., “Industrial Engineering Management”.

Supply Chain Management Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	QM-EAE	QM-EAE-1	QM-326P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Supply Chain Management) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To conduct experiment regarding building blocks of a supply chain network.
2. To perform decision in a Supply Chain; Strategic, tactical, and operational decisions using case study.
3. To conduct benchmarking supply chain performance using financial data.
4. To conduct supply chain inventory management with case study.
5. To calculate Performance modelling of supply chains using Markov chains and queuing networks.
6. To perform network designing and operation with data for network design.
7. To prepare demand forecasting with any given data and using appropriate method.
8. To perform Web based SCM.
9. To determine Supply Chain Restructuring.
10. To determine Pricing and revenue management with any given data.

Sustainable Engineering Technologies	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	GTSE-EAE	GTSE-EAE-5	GTSE-433

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To increase awareness on issues in areas of sustainability.
2.	To understand the role of engineering and technology within sustainable development.
3.	To know the methods and tools for sustainable development.
4.	To develop the understanding of the role and impact of various aspects of engineering on environmental, societal and economic problems.

Course Outcomes (CO)

CO 1	Define the different types of environmental problems and their sustainable solutions.
CO 2	Make use of various standards for development of sustainable solutions.
CO 3	Apply the knowledge of renewable energy in sustainable urbanization.
CO 4	Explain new technology and advanced materials for Social and technological change.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	1	2	-	-	2	3	-	-	-	-	-
CO 2	-	1	2	1	1	2	3	-	-	-	-	-
CO 3	1	1	2	-	-	1	3	-	-	-	-	-
CO 4	-	1	-	-	2	3	1	-	-	-	-	2

UNIT-I

Sustainable Engineering: Introduction, Need and Applications, Social-environmental and economic sustainability concepts, Sustainable development, connection between Technology and Sustainable development, Challenges for sustainable development, Multilateral environmental agreements and protocols-Clean Development Mechanism (CDM).

Sustainable wastewater treatment, Zero waste concept, 3 R concept. Global environmental issues- Resource degradation, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print, carbon capture and storage technology, LEED building and construction methods.

UNIT-II

Basic concepts of sustainable habitat, material selection for sustainable design, Methods for increasing energy efficiency of buildings.Tall Buildings and Elevators-New Sustainable Design: Introduction, Recent Technological Developments, Case Studies, Other Technologies, Future Developments, chilled beam system

Engineering innovations and sustainable development goals: Engineering innovations to improve health sector, water engineering for sustainable development, engineering technologies to reduce disaster risks, developing sustainable and resilient energy system.

UNIT-III

Energy Sources of the Future: Introduction, Biomass Energy Field, Energy from Water, Ensuring Sustainability of Bioenergy in Practice, Geothermal Energy, Renewability of Energy Resources, Energy Vectors, and Energy Technologies for Mobility, Solar Energy: Harvesting the Sun's Energy for Sustainable Future, A Comparative Energy-Efficiency Analysis for Renewable Energy Technologies.

Sustainable Urbanization: Introduction, Why Urban Design Matters, Low-Carbon Urbanization Strategies, Innovation and New Technologies, public and electric transport, LED light technology.

UNIT – IV

Sustainable Materials and Technology: Recycling of waste into useful material and their energy applications, Sustainable technologies for plastic transformation, Bifunctional nanoparticles for sustainable water splitting applications, sustainable nanostructured materials for energy storage device, Sustainable development of heavy metal detoxification from water, Sustainable remediation of industrial contaminated water towards potential industrial applications

Alternative Materials Development Utilizing Advanced Nanotechnology, Biopolymers for Environmental Applications: Highly Functional Polylactic Acid Composites Used for Durable Products, Computational Materials Science and Computer-aided Materials Design and Processing, Mechanisms of Organisms as Environment-Friendly Materials Design Tools.

Textbook(s):

1. David S-K. Ting & Jacqueline A. Stagner, "Sustainable Engineering Technologies and Architectures", AIP Publishing LLC (2021).
2. David Allen (Author), David R. Shonnard (Author), "Sustainable Engineering: Concepts, Design and Case Studies" Prentice Hall, 1st Edition (2011).

References:

1. Joanne Kauffman & Kun-Mo Lee, "Handbook of Sustainable Engineering", SpringerReference.
2. Bradley Striebig, Adebayo A. Ogundipe, Maria Papadakis , "Engineering Applications in Sustainable Design and Development", Cengage Learning, (2016).
3. John Twidell, "Renewable Energy Resources", 4th Edition (2021).

Sustainable Materials and Practices	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	GTSE-EAE	GTSE-EAE-2	GTSE-320

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Demonstrate concepts of life-cycle analysis including economic and sustainability aspects and apply these concepts to sustainable construction
2.	Evaluate the environmental impacts of different materials throughout their life cycle.
3.	Analyze the energy consumption, carbon emissions, and resource depletion associated with materials.
4.	Explore the applications of sustainable materials in various civil engineering disciplines, such as structural engineering, transportation engineering, and geotechnical engineering.

Course Outcomes (CO)

CO 1	Understand the concept of life cycle analysis in sustainability and economical aspects.
CO 2	Quantify the environmental impact of buildings in terms of energy consumption.
CO 3	Determine the carbon emission and resource depletion during construction..
CO 4	Examine the applications of sustainable asphalt and pavement material in transportation engineering

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	-	2	-	-	1	3	-	-	-	-	2
CO 2	-	-	3	2	-	3	3	-	-	-	-	2
CO 3	-	-	-	-	-	-	1	-	-	-	-	2
CO 4	2	-	-	-	-	-	3	-	-	-	-	3

UNIT-I

Introduction: Embodied energy, Operational energy in Building and Life cycle energy. Ecological foot print, Bio-capacity and calculation of planet equivalent.
Sustainable Timber: Sourcing of certified and responsibly harvested timber. Wood preservation techniques and treatments. Engineered wood products and their sustainability advantages. Timber in sustainable building systems and construction methods

UNIT-II

Sustainable Concrete: Role of quality, minimization of natural resource utilisation, High volume fly ash concrete, geo-polymer concrete etc. concrete with alternative material for sustainability. Use of supplementary cementitious materials (SCMs) such as fly ash, slag, and silica fume. Low-carbon concrete and carbon footprint reduction strategies. Concrete recycling and reuse, Self-healing and self-cleaning concrete.

Reduction in water consumption in concrete, Recycled aggregate, Energy for grinding crushing of cement aggregate etc. and reduction. Operational energy in building role of materials and thermal conductivity

UNIT-III

Sustainable Masonry: Alternative masonry materials such as rammed earth, cob, and straw bale, Clay Bricks Comparative energy performance emission performance and financial performance, Indoor air quality, Paints, Adhesive and sealants for use in building, Volatile organic content (VOC) emission issues and indoor air quality for Sustainability and Health hazard.

Sustainable Steel and Metal Alloys: Recycling and reuse of steel and metal alloys. High-performance and low-impact steel production methods. Corrosion protection and durability enhancements. Lightweight and high-strength alloys for structural applications.

UNIT – IV

Sustainable Asphalt and Pavement Materials: Use of recycled asphalt pavement (RAP) and reclaimed asphalt shingles (RAS). Warm mix asphalt and energy-efficient asphalt production techniques. Porous pavement systems for stormwater management. Alternative pavement materials like rubberized asphalt and pervious concrete.

Material Selection and Design Guidelines: Strategies for sustainable material selection in civil engineering projects. Integrating sustainable materials into design and specifications. Cost and performance considerations for sustainable materials. Case studies of successful projects utilising sustainable materials.

Textbook(s):

1 The Philosophy of Sustainable Design by Jason F. McLennan, Ecotone Publishing Co., 2004.
2. Sustainable Construction - Green Building Design and Delivery by Charles J. Kibert, John Wiley & Sons, 2nd edition, 2008.

References:

1. Sustainable Construction: Green Building Design and Delivery, Charles Kibert, John Wiley & Sons, 2005.
2. Sustainable Construction and Design by Regina Leffers, Prentice Hall, 2009.
3. Green Building Fundamentals by Mike Montoya, Pearson, 2nd edition, 2010

Switch Mode Power Conversion	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	PED-EAE	PED-EAE-3	PED-425T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understanding the function of semiconductor switches, inductor and capacitors in DC-DC converters. Modes of operation of converters.
2.	To make aware about isolation in switch mode power conversion.
3.	Controller basics, design and implementation.
4.	Performance analysis of different control schemes

Course Outcomes (CO)

CO 1	Understanding the function of semiconductor switches, inductor and capacitors in DC-DC converters. Modes of operation of converters.
CO 2	To make aware about isolation in switch mode power conversion.
CO 3	Controller basics, design and implementation.
CO 4	Performance analysis of different control schemes

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	1	2	2	1	1	1	1	1
CO 2	3	3	2	2	1	1	2	1	1	1	1	1
CO 3	3	3	3	3	2	2	1	1	1	1	1	1
CO 4	3	2	2	2	1	1	1	1	1	1	1	1

UNIT-I

Switched Mode DC-to-DC Converter: Introduction to buck, boost, buck-boost DC-DC converters; power semiconductor switches diode, controlled switch; reactive components capacitor and inductor as energy storage; Continuous and discontinuous operation converters, Modelling of DC-DC converters.

UNIT-II

Isolated and non-isolated: Single-switch and multi-switch transformer-isolated DC-DC converters; Flyback and forward converters, isolated half-bridge, full-bridge converters; Voltage-fed and current-fed converters.

UNIT-III

DC-DC Controller: DC-DC converter controller, Controller structure, Positional-integral (PI) controller, Positional-integral-Differential (PID) controller, Implementation of controllers, Control Design and parameters, Pulse width modulation.

UNIT – IV

Switching Regulator Control: Small-signal models for switching regulators, Performance analysis and design of closed-loop system under different control methods, and operating modes. Measurement of small signal transfer functions, Soft-switched and resonant DC-DC Power converters.

Textbook(s):

1. N Mohan, T M Undeland and W P Robbins, "Power Electronics: Converters, Applications and Design", Wiley
2. Erickson, Robert W., Fundamentals of Power Electronics, Chapman & Hall, 1997

References:

1. A I Pressman, "Switching Power Supply Design", McGraw-Hill
2. Application Notes from International Rectifiers and other Power Devices and ICs manufacturers
3. Middlebrook, R. D.(Robert David), and Slobodan Cuk, Advances in Switched-Mode Power Conversion, Volumes I and II, 2nd Edition, TESLAco, 1983.
4. V. Ramanarayanan Course Material on Switched Mode Power Conversion, Deptt of Electrical Engineering, Indian Institute of Science, Bangalore 560012

Switch Mode Power Conversion Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	PED-EAE	PED-EAE-3	PED-425P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Switch Mode Power Conversion) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Simulate the Buck and Boost converter for the resistive load
2. Study of buck-boost converter and show its continuous and discontinuous mode of operation.
3. Comparative performance analysis of linear and switch mode power supply.
4. Study of flyback DC-DC converter with basic topology and ideal switch.
5. Study of full bridge converter application of battery charging.
6. Study of voltage and current fed converter topologies for high power applications.
7. Study of commonly used pulse width techniques.
8. Study of Buck converter closed loop voltage control.
9. Study of closed loop control of DC-DC converter by using the PI controller.
10. Study of switching regulator as a voltage regulator.
11. Study of switching regulator selection and sizing.
12. Implementation of feedback control by using the proportional-integral (PI) controller in a DC-DC converter with resistive load.

Switchgear and Protection	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	7	PCE	PCE-4	EEE-411T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand components of protection system
2.	To understand protection of feeders, generator and transformer
3.	To understand working and applications of circuit breaker
4.	To understand working of static relay

Course Outcomes (CO)

CO 1	Ability to understand components of protection system
CO 2	Ability to understand protection of feeders, generator and transformer
CO 3	Ability to understand working and applications of circuit breaker
CO 4	Ability to understand working of static relay

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	2	1	1	1	2	2	3	1
CO 2	3	2	3	3	2	1	1	1	2	2	3	1
CO 3	3	2	3	3	2	1	1	1	2	2	3	1
CO 4	3	2	3	3	2	1	1	1	2	2	3	1

UNIT- I

Protective Devices: Philosophy of protection, Nature, Causes and consequences of faults, Zone of protection, Requirements of a protective scheme, Basic terminology components of protection scheme. Relay classification, Principle of different types of electromagnetic relay. General equation of phase and magnitude comparators, Duality of comparators, Electromagnetic relays, over current relays Directional relays, Distance relay- impedance, Reactance and Mho type, Differential relays.

UNIT- II

Feeder: Protection: Over current and earth fault protection, Distance protection, Pilot wire protection, Carrier current protection.
Generator Protection: Biased differential protection, restricted earth fault protection, Field suppression, Negative sequence protection, Earth fault detection in rotor circuit
Power transformer Protection: Biased differential protections, restricted earth fault protection, Buchholz relay Protection of combined transformer and alternator.

Bus Zone Protection: frame leakage and circulating current scheme-use of Translay relay.

UNIT- III

Circuit Breakers: Formation of arc during circuit breaking. Characteristics of electric arc. Theories of arc Interruption. Recovery and restriking voltage, interruption of capacitive and inductive currents. Current chopping. Principle of A.C. and D.C. circuit breaking requirements of good circuit breaker circuit breaker rating.
Different types of circuit breakers. Air break and Air blast circuit breaker. Plain break and controlled break all circuit breakers. Minimum oil circuit breakers. Vacuum circuit breaker, SF6 circuit breaker. D.C. Circuit breaker.
H.R.C. Fuse: Construction and characteristics

UNIT-IV

Static Relays : Development and classification of static relays, Different types of phase and amplitude capacitors, Basic static relays used in protective scheme, Elementary idea about digital & numerical protection. Testing and maintenance of protective gear, Protection against surge-surge absorber, Surgediverter. Arrangement of Bus bar, Circuit breaker and isolator. Current limiting reactors in power system and their arrangement calculation of fault MVA for symmetrical short circuits. Circuit breaker capacity.

Textbooks:
1. Paithanker, Bhide ,"Fundamentals of Power System Protection " PHI 2014
2. BadriRam"Power System Protection and Switchgear" TMH Publications 2nd Edition

References:
1. Van C Warrington, "Protective Relays" Vol.-I & II
2. Ravindranath, M.Chander, "Power System Protection and SwitchGear", Wiley Eastern Ltd. New Delhi
3. T S Madhav Rao, "Power System Protection", TMH Pulication
4. Sunil S.Rao, "Switch Gear and Protection", Khanna Publication

Switchgear and Protection Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	7	PCE	PCE-4	EEE-411P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Switchgear and Protection) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the numerical IDMT over current relay. Obtain & plot its current-time characteristics for various plugs setting time multiplier & measure pickup / reset ratio.
2. To plot operating Characteristics of percentage numerical differential relay.
3. To plot operating Characteristics of numerical under voltage / over voltage relay.
4. To plot operating Characteristics of numericalNegative sequence relay.
5. To study C.T./ PT testing by comparison method.
6. Instantaneous over current protection Relay based on Mann and Morrison algorithm.
7. Implementation of over current protection of transformer in LabVIEW.
8. MATLAB Program for Simulating Three Sample Algorithms.
9. Implementation Methods of Motor Protection in LabVIEW.
10. Ground Fault Protection of Three Phase Line Using Phase Quantities.

System Modeling, Simulation and Analysis	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-3	MEE-336T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about the fundamental concepts, the necessary knowledge and the basic skills related to system modeling.
2.	To develop simulation model using heuristic methods.
3.	To analyse Simulation models using input analyzer, and output analyzer.
4.	To explain Verification and Validation of simulation model.

Course Outcomes (CO)

CO 1	Describe the role of important elements of discrete event simulation and modeling paradigm.
CO 2	Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.
CO 3	Develop skills to apply simulation software to construct and execute goal-driven system models.
CO 4	Interpret the model and apply the results to resolve critical issues in a real world environment.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	2	-	2
CO 3	3	3	3	3	-	2	-	-	2	2	-	3
CO 4	3	3	3	2	-	3	-	-	2	2	-	3

UNIT-I

Introduction of system modelling: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Integrated Product Design, Modelling, Analysis and Simulation, Man-Machine Interface; Product design, process route modelling, Optimization techniques, Case studies & industrial applications

UNIT-II

Introduction to Simulation: Simulation, Advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study. Simulation Examples: Simulation of Queuing systems, Simulation of Inventory System, Other simulation examples.

UNIT-III

General Principles: Concepts in discrete - event simulation, event scheduling/ Time advance algorithm, simulation using event scheduling. Random Numbers: Properties, Generations methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test

UNIT – IV

Analysis of Simulation Data Input Modelling: Data collection, Identification and distribution with data, parameter estimation, Goodness of fit tests, Selection of input models without data, Multivariate and time series analysis. Verification and Validation of Model – Model Building, Verification, Calibration and Validation of Models.

Output Analysis – Types of Simulations with Respect to Output Analysis, Stochastic Nature of output data, Measures of Performance and their estimation, Output analysis of terminating simulation, Output analysis of steady state simulations. Simulation Softwares: Selection of Simulation Software, Simulation packages, Trend in Simulation Software.

Textbook(s):

1. Averill M Law, W David Kelton, Simulation Modelling & Analysis, McGraw Hill International Editions – Industrial Engineering series, 4th Edition, ISBN: 0-07-100803-9.
2. Jerry Banks, John S Carson, II, Berry L Nelson, David M Nicol, Discrete Event System Simulation, Pearson Education, Asia, 4th Edition, 2007, ISBN: 81-203-2832-9.

References:

1. Geoffrey Gordon, System Simulation, Prentice Hall publication, 2nd Edition, 1978, ISBN: 81-203-0140-4
2. Narsingh Deo, Systems Simulation with Digital Computer, PHI Publication (EEE), 3rd Edition, 2004, ISBN: 0-87692-028-8

System Modeling, Simulation and Analysis Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-3	MEE-336P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (System Modeling, Simulation and Analysis) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study features of Arena Package and Input Modeling
2. Simulation of Manufacturing System I
3. Simulation of Manufacturing System II
4. Simulation of Service Operations I
5. Simulation of Service Operations II
6. Simulation of JIT Kanban Multi Product Assembly Line System
7. Modelling a Live Problem
8. Analyse the output of a system with different input variables using simulation.

Note: Suggested Simulation Packages; Promodel, Arena, Quest, Witness, Extend, Simio

Systems Design and Simulation	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	6	PCE	PCE-3	EEE-364T
EEE	7	PCE	PCE-4	EEE-435T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To create admittance matrix for systems
2.	To evaluate load flow in systems
3.	To develop load forecasting methods
4.	To create state estimation of systems

Course Outcomes (CO)

CO 1	Ability to create admittance matrix for systems
CO 2	Ability to evaluate load flow in systems
CO 3	Ability to develop load forecasting methods
CO 4	Ability to create state estimation of systems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	2	1	1	1	2	2	3	1
CO 2	3	2	3	3	2	1	1	1	2	2	3	1
CO 3	3	2	3	3	2	1	1	1	2	2	3	1
CO 4	3	2	3	3	2	1	1	1	2	2	3	1

UNIT- I

Network Formulation and Graph Theory: Introduction, Network Equations,Graph Theory, Development of Network Matrices from Graph Theoretic Approach, Building Algorithm for the Bus Impedance Matrix, Modification of ZBUS matrix due to changes in the primitive network, Transformer modeling for YBUS

UNIT- II

Load Flow Studies: Introduction, Static Load Flow Equations and solution methods: Gauss Seidal method, Newton Raphson method, DeCoupled method, Fast Decoupled method, Modified Fast Decoupled, Concept of Optimal Power Flow, Solution of Optimal power flow by Gradient method, Solution of Optimal power flow by Newton's Raphson linear Programming Methods.

UNIT- III

Load Forecasting: Objectives of forecasting - Load growth patterns and their importance in planning Load forecasting Based on discounted multiple regression technique-Weather sensitive load forecasting-Determination of annual forecasting-Use of AI in load forecasting.

Modelling of Power System Components: The need for modelling of power system, different areas of power system analysis. Simplified models of non-electrical components like boiler, steam & hydro-turbine &governor system. Transformer modelling such as auto-transformer, tapchanging & phase-shifting transformer

UNIT-IV

Introduction to State Estimation in Power Systems: Introduction, Power system state estimation, Maximum Likelihood Weighted Least Squares Estimation, Introduction, , Maximum Likelihood Concepts, Matrix Formulation, State Estimation of an AC network, Development of Method, An Introduction to Advanced topics in state estimation, Detection andIdentification of Bad measurements, Estimation of quantities not being measured, Network Observability and Pseudo measurements, Applicationof Power Systems State Estimation

Textbooks:

1. Power Generation Operation & Control, John Wiley & Sons, Inc, 1996- A. J.Wood and B. F. Wollenberg
2. Computational Methods for Electric Power Systems, Second Edition, Mariesa Crow, CRC Press, 2009

References:

1. AC-DC Power System Analysis, IEE London UK, 1998- Jos Arrillaga and Bruce Smith
2. Advanced Power System Analysis and Dynamics, New Age International Ltd,New Delhi, 1992- L. P. Singh
3. Power System Analysis, Tata Mcgraw Hill, New Delhi, 1999- Hadi Sadat
4. Elements of Power System Analysis, W.D. Stevenson Jr., 4th Edition, Mcgraw hill,
5. Power System Analysis, A.R. Bergen, Vijay Vittal, 2nd edition, Pearson Publication.
6. Modern Power System Analysis, I.J. Nagarath, D.P.Kothari, 3rd edition, Tata Mcgraw Hill, New Delhi

Systems Design and Simulation Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	6	PCE	PCE-3	EEE-364P
EEE	7	PCE	PCE-4	EEE-435P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Systems Design and Simulation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Understanding various Commands of MATLAB and solving simple DC circuit through MATLAB.
2. Develop program in MATLAB using Gauss-Seidel Method and solve a given P. S. Network problem.
3. Develop program in MATLAB using Fast-Decoupled Method and solve a given P. S. Network problem.
4. Develop program in MATLAB for formation of Z-bus by modification method. Form the Z-bus for a given network manually as well as through Progam and match the results.
5. Develop program in MATLAB for Fault current, bus voltages and line currents for (i) 3- phase symmetrical Fault (ii) Single Line to ground fault (iii) Line to Line fault (iv) Double line to ground fault.
6. Develop program in MATLAB for calculation of optimal dispatch, Fuel Cost by (i) analytical method (ii) graphical demonstration method, neglecting linelosses.
7. Develop program in MATLAB for calculating state Estimation and solve a given network manually and using the program and match theresults.
8. Develop program in MATLAB for calculation of generator shift distribution factors.
9. Develop program in MATLAB for calculation of line outage distribution factors.
10. Write a program for plotting Power – Delta curve for fault occurs in network (solving of swing equation).

Systems Restructuring for Optimization	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	7	PCE	PCE-5	EEE-433T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the restructuring of power sector
2.	To understand the economics of power sector
3.	To understand the Transmission Open Access and Pricing Issues
4.	To understand the Transmission Congestion Management and Pricing

Course Outcomes (CO)

CO 1	Ability to understand the restructuring of power sector
CO 2	Ability to understand the economics of power sector
CO 3	Ability to understand the Transmission Open Access and Pricing Issues
CO 4	Ability to understand the Transmission Congestion Management and Pricing

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	2	1	1	1	2	2	3	1
CO 2	3	2	3	3	2	1	1	1	2	2	3	1
CO 3	3	2	3	3	2	1	1	1	2	2	3	1
CO 4	3	2	3	3	2	1	1	1	2	2	3	1

UNIT- I

Introduction to Restructuring of Power Industry: Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process, Introduction to issues involved in deregulation, Reasons and objectives of deregulation of various power systems across the world . Indian power sector-past and present status, overview of growth of power sector in India. Players in the Indian power sector.

UNIT- II

Fundamentals of Economics: Introduction, Consumer behavior, Supplier behavior, Market equilibrium, Short-run and Long-run costs, Various costs of production, Relationship between short-run and long-run average costs, Perfectly competitive market.

Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service - ancillary service –Co-optimization of energy and reserve services.

UNIT- III

Deregulation of power industry, restructuring process, issues involved in deregulation, competitive market structure of deregulated power system, operation and control aspects of deregulated power system.
Transmission Open Access and Pricing Issues: Introduction, power wheeling, transmission open access, cost components in transmission, pricing of power transactions, transmission open access and pricing mechanisms in various countries.

UNIT-IV

Transmission Congestion Management and Pricing- transmission cost allocation methods, LMP, FTR and Congestion Management. Role of FACTS devices in competitive power market, Available Transfer Capability, Distributed Generation in restructured markets.

Textbooks:

1. Steven Stoft, “Power system economics: designing markets for electricity”, John Wiley & Sons, 2002.
2. Mohammad Shahidehpour, MuwaffaqAlomoush, Marcel Dekker, “Restructured electrical power systems: operation, trading and volatility” Pub., 2001.
3. W. H. J. R. Dunn, M. A. Rossi, B. Avaramovic: Impact of market restructuring on power systems operation, IEEE computer Applications on Power Engineering, vol. 8, January 1995, pp 42–47.
4. Understanding electric utilities and de-regulation, Lorrin Philipson, H. Lee Willis, Marcel Dekker Pub., 1998.

References:

1. Making competition work in electricity Sally Hunt, John Wiley & Sons, Inc., 2002.
2. Operation of restructured power systems Kankar Bhattacharya, Jaap E. Daadler, Math H.J Bollen, Kluwer Academic Pub., 2001.

Systems Restructuring for Optimization Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	7	PCE	PCE-5	EEE-433P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Systems Restructuring for Optimization) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Use MATLAB's power flow toolbox or build your own load flow algorithm to calculate voltage magnitudes, angles, active power, and reactive power flows.
2. Use MATLAB to analyze the connectivity and power flow between different buses or areas in the network.
3. Implement an OPF algorithm in MATLAB to optimize the operation of the power system after restructuring.
4. Determine the optimal commitment of generation units in the restructured power system.
5. Optimize the expansion of the transmission network after restructuring to accommodate changes in power flow patterns.
6. Investigate the provision of ancillary services, such as frequency regulation or reactive power support, in the restructured power system.
7. Explore the integration of renewable energy sources into the restructured power system.
8. Perform reliability assessment of the restructured power system using MATLAB.
9. Analyze the impact of different market mechanisms on the restructured power system.

Theory of Machines	L	P	C
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	ME-OAE	ME-OAE-1	OME-324T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge of various types of mechanisms and perform their synthesis by analytical and graphical method.
2.	To develop the understanding of Gears, Gear trains and Gyroscope.
3.	To facilitate students to understand the function and working of flywheels and governor.
4.	To learn and study the phenomena of balancing and mechanical vibrations.

Course Outcomes (CO)

CO 1	Examine various types of mechanisms and execute their kinematic analysis.
CO 2	Explain the concept of Gears, Gear Trains and Gyroscope.
CO 3	Describe the working principle of flywheel and governor.
CO 4	Understand the concept of balancing and mechanical vibration system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	2	-	-	-	-	-	2
CO 3	3	3	3	3	-	2	-	-	-	-	-	2
CO 4	3	3	3	3	-	2	-	-	-	-	-	2

UNIT-I

Mechanisms and Machines: Introduction of Simple mechanism, Different types of Kinematics pair, Grubler's rule for degree of freedom, Grashof's Criterion for mobility determination, Inversions of 4R, 3R-P, and 2R-2P chains. Kinematic Analysis of Planar Mechanisms: Velocity and acceleration diagrams, Application of relative velocity method in Slider crank and four bar mechanism, Instantaneous centre method, Kennedy-Arnold theorem, Acceleration diagrams for simple mechanism.
Cams: Classification, Construction of Cam profile, Analysis of Cams with uniform acceleration, and retardation, SHM, Cycloidal motion.

UNIT-II

Gears and Gear Trains: Classification of gears, Terminology, Geometry of tooth profiles, Law of gearing, Cycloidal and Involute profile, Undercutting and interference, Methods to avoid interference, Condition for minimum number of teeth to avoid interference, Contact ratio, Interference, Simple, Compound and Epicyclic

gear trains, Tabular column method for Epicyclic gear trains, Fixing torque.
Gyroscopes: Principles of Gyroscope, Effect of Gyroscopic couple on automobiles, ships and aircrafts.

UNIT-III

Dynamic Analysis: Analysis of single slider crank mechanism for displacement, velocity and acceleration using analytical method, Klein's Construction, Turning moment diagrams, Flywheel.
Mechanical governors:Function of a governor, types of governors: weight and spring loaded, Hunting and Sensitivity, efforts and power of a governor, controlling diagrams.

UNIT - IV

Balancing: Static and Dynamic balancing, balancing of rotating and reciprocating masses, single and multicylinder engines.
Vibrations: Free vibration of a body, single degree of freedom system, Rayleigh method, free vibrations with viscous damping, Logarithmic decrement, Response of damped spring mass system to harmonic forces, Whirling of shafts, Vibration isolation, Transmissibility Ratio.

Textbook(s):
1. S.S. Rattan, "Theory of Machines", Tata McGraw Hill.
2. V.P. Singh, "Theory of Machines", Dhanpat Rai & Co.(P)Ltd.

References:
1. J E Shigley "Theory of Machines", Pearson.
2. Thomas Beven, "The Theory of Machines", CBS Publishers.
3. R.L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill.
4. 4. P.L. Ballaney, "Theory of Machines & Mechanism", Khanna Publishers.

Theory of Machines Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
OAE	6	ME-OAE	ME-OAE-1	OME-324P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Theory of Machines) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study and verify the inversions of four bar (4R), single slider (3R-1P) crank and double slider (2R-2P) crank mechanism and also prove Grashof's Law.
2. To find out experimentally the Coriolis component of acceleration and compare with theoretical values
3. To study various types of CAM and follower mechanisms. Also, draw the CAM profile for the given CAM apparatus and determine jumping speed.
4. Draw velocity and acceleration diagram of engine mechanism using Klien's construction
5. To study various types of gear and gear trains and to determine gear ratio of simple, compound and epicyclic gear trains.
6. To calculate the torque on a Planet Carrier and torque on internal gear using epicyclic gear train and holding torque apparatus.
7. To determine the radius of gyration and moment of Inertia of a given rod.
8. To study and verify the motion of any one Governor.
9. To study and verify the gyroscopic law of motion.
10. To study and verify the dynamic balancing of rotating masses.
11. To determine the natural frequency of undamped free vibration of the given spring mass system.
12. To find the moment of inertia of a fly wheel.
13. To determine whirling speed of shaft theoretically and experimentally.

Total Quality Management	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	QM-EAE	QM-EAE-3	QM-441T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concept of Quality.
2.	To understand the Implication of Quality on Business.
3.	To Implement Quality Implementation Programs.
4.	To have exposure to challenges in Quality Improvement Programs.

Course Outcomes (CO)

CO 1	Evaluate the usage of TQM as an essential tool for quality improvement.
CO 2	Review therole of leadership, performance appraisal and supplier partnership as the important strategies in the field of TQM.
CO 3	Examine seven traditional tools used for enhancing the quality of a system.
CO 4	Estimate and compare the various ISO 9000- ISO 9000-2000, ISO 14000 Quality Systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	2	-	-	-	-	-	-	2	-	-
CO 2	3	2	2	2	2	2	-	2	2	-	-	-
CO 3	3	3	3	3	3	-	-	-	-	-	-	2
CO 4	3	-	2	-	2	3	2	-	--	-	-	-

UNIT-I

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

UNIT-II

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT-III

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.
TQM tools and techniques, control charts, process capability, concepts of six sigmas, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

UNIT - IV

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Textbook(s):

1. Bester field D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
2. Janaki Raman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.

References:

1. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
2. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

Total Quality Management Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	QM-EAE	QM-EAE-3	QM-441P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Total Quality Management) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To perform Quality considerations in design.
2. To understand difference between product quality and service quality with case study.
3. To calculate costs to quality of a given specimen.
4. To perform PDCE cycle of a case study.
5. To study Six sigma- concepts, methodology.
6. To apply TQM tools and techniques on case study.
7. To construct control charts on given data.
8. To calculate Taguchi quality loss function.
9. To study seven traditional tools of quality and their application.
10. To study TQM implementation in manufacturing and service sectors with case study.

Traffic Engineering and Pavement Design	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	5	PC	PC	CEC-311

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To design the various geometric parameters of road.
2.	To study the traffic characteristics and design of road intersections & signals.
3.	To design and construct the pavement by selecting appropriate materials and design approach.
4.	To learn methods to construct various types of roads and propose the maintenance strategies.

Course Outcomes (CO)

CO 1	Design the various geometric parameters of road.
CO 2	Study the traffic characteristics and design of road intersections & signals.
CO 3	Design and construct the pavement by selecting appropriate materials and design approach.
CO 4	Learn methods to construct various types of roads and propose the maintenance strategies.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	1	1	-	-	2	-	1	1	1	-
CO 2	1	2	3	1	2	2	1	-	2	1	2	2
CO 3	3	2	3	2	3	-	-	-	3	1	3	1
CO 4	2	3	3	2	3	2	2	-	2	-	-	1

UNIT-I

Geometric Design of Highways (IRC:73- Latest revision): Cross section elements–pavement surface characteristics, camber, kerbs, shoulder, Sight distance, Horizontal curves, Superelevation, Extra widening, Transition curves, Gradient, Vertical curves–Summit and valley curves.
Traffic Engineering: Traffic characteristics–road user characteristics, vehicular characteristics; Traffic studies and analysis: Traffic volume studies–methods of counting volume, presentation of volume data; Traffic speed studies– Types of speeds, methods of measuring spot speeds, presentation of spot speed data; Speed & delay studies–floating car method; Origin & destination studies–objective, methods of conducting O & D study, presentation of O-D data; Parking studies; Accident studies.

UNIT-II

Traffic Flow and Roadway Capacity: Traffic flow characteristics–space headways, time headways; Speed-Flow-Density relations; Passenger car units, recommended PCU values, peak hour factor; Capacity and level of service of rural highways and urban roads as per latest IRC recommendation.

Traffic Regulation and Control: Traffic signs and their classification; Traffic signal–classification, general principles of two-phase signal design, Design of traffic signal by webster method and IRC; Intersection at grade, Grade separated intersection, Design of roundabouts as per IRC:65-2017.

UNIT-III

Design of Highway Pavement: Types of Pavements, Difference between flexible and rigid pavement, Design factors–Standard axle load, ESWL, Rigidity factor; Design of flexible pavement– group index method, CBR method, California resistance value method, Design of flexible pavement by IRC:37 (Latest revision); Design of rigid pavement, Westergaard theory, load and temperature stresses, joints, IRC method of rigid pavement design (IRC:58-2015), Design of Dowel bars, Design of Tie bars.

UNIT – IV

Highway Construction and Maintenance: Construction of Subgrade, Water Bound Macadam (WBM), Wet mix macadam (WMM), Granular Sub Base (GSB), Tack Coat, Prime Coat, Seal Coat, Surface Dressing, Bituminous Macadam (BM), Bituminous concrete, Dry lean concrete (DLC), Cement Concrete (CC) road construction; Maintenance of bituminous and concrete roads, Concepts of overlay design.

Note: All designs and procedure are to be done with reference to latest revision of IRC as given below in reference section.

Textbook(s):

1. S.K. Khanna, C.E.G. Justo, A. Veeraragavan, "Highway Engineering", Nem Chand & Bros., 10th Edition (2021).
2. S.K. Khanna, C.E.G. Justo, A. Veeraragavan, "Highway Materials and Pavement Testing", Nem Chand and Bros.

Referencs:

1. L.R. Kadiyali, "Traffic Engineering and Transport Planning", Khanna Publishers.
2. Rangwala, "Highway Engineering",Charotar Publishing House, 12th Edition (2022).
3. IRC: 37- Latest revision, "Tentative Guidelines for the design of Flexible Pavements" Indian Roads Congress, New Delhi.
4. IRC:58-2015 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (4th Revision).
5. IRC:65-2017 Guidelines for Planning and Design of Roundabouts (1st Revision)
6. IRC:73-1980 Geometric Design Standards for Rural (Non-Urban) Highways
7. IRC:106-1990 Guidelines for Capacity of Urban Roads in Plain Areas
8. IRC:93-1985 Guidelines on Design and Installation of Road Traffic Signals.
9. IRC:92-2017 Guidelines for Design of Interchanges in Urban Areas (1st Revision)
10. IRC:SP:68-2005, "Guidelines for Construction of Roller Compacted Concrete Pavements", Indian Roads Congress, New Delhi.
11. IRC:15-2002, "Standard Specifications and Code of Practice for construction of Concrete Roads" Indian Roads Congress, New Delhi.
12. MORTH, "Specifications for Road and Bridge Works", Ministry of Shipping, Road Transport & Highways, Published by Indian Roads Congress, New Delhi.

Transmission Lines, Waveguides and Antenna Design	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	5	PC	PC	ECC-309

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To familiarise the various types of transmission lines and to deliberate the losses associated.
2.	To communicate information about waveguide concepts
3.	To impart the understanding of characteristics of different types of high frequency resonators.
4.	To impart the knowledge to define different terminologies of antenna parameters.

Course Outcomes (CO)

CO 1	To Understand the primary model of wave propagation in Transmission Lines and Analyze the various line parameters and Apply smith chart for line parameter and impedance calculations.
CO 2	Discuss the fundamental concepts of wave propagation in rectangular and circular waveguides and evaluate their characteristics.
CO 3	Understand the characteristics of resonance frequency of different types of resonator and its modes configuration.
CO 4	To describe the basic parameters of antenna and interpret to solve the radiation components

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Microwave Transmission Lines: Transmission-Line Equations, Solutions of Transmission-Line Equations. Reflection Coefficient, Transmission Coefficient. Standing Wave, Standing-Wave Ratio, Line Impedance, Line Admittance, Open and short circuited lines. Smith Chart Impedance Matching: Single-Stub Matching, Double-Stub Matching. Losses in transmission lines. Lines of different lengths – λ/2, λ/4, λ/8 lines.
Introduction to Microstrip transmission line.

UNIT II

Microwave Waveguides and Components:
Introduction Rectangular Waveguides: Solutions of Wave Equations in Rectangular Coordinates, TE Modes in Rectangular Waveguides, TM Modes in Rectangular Waveguides, Power Transmission in Rectangular

Waveguides, Losses in Rectangular Waveguides, Excitations of Modes in Rectangular Waveguides.
Circular Waveguides: Solutions of Wave Equations in Cylindrical Coordinates, TE Modes in Circular Waveguides, TM Modes in Circular Waveguides, Excitations of Modes in Circular Waveguides.

UNIT III

Microwave Resonators: Series and Parallel Resonant Circuits: Series Resonant Circuit, Parallel Resonant Circuit, Loaded and Unloaded *Q*.
Transmission Line Resonators: Short-Circuited λ/2 line, Open-Circuited λ/2, Short-Circuited λ/4 Line; Rectangular Waveguide Cavities: Resonant Frequencies, *Q* of the TE_{10l} Mode; Circular Waveguide Cavities: Resonant Frequencies, Q of the TE_{nml} Mode. Dielectric Resonators: Resonant Frequencies, *Q* of the $TE_{01\delta}$ Mode. Excitation of Resonators: Critical Coupling, A Gap-Coupled Microstrip Resonator.

UNIT IV

Antennas: Introduction, Types of Antennas, Radiation Mechanism. Introduction monopole and dipole antenna.
Fundamental Parameters: Introduction, Radiation Pattern, Radiation Power Density, Radiation Intensity, Beamwidth, Directivity, Antenna Efficiency, Gain, Realized Gain, Beam Efficiency, Antenna Radiation Efficiency, Friis Transmission Equation and Radar Range Equation
Radiation Integrals and Auxiliary Potential Functions: The Vector Potential A for an Electric Current Source J, The Vector Potential F for A Magnetic Current Source M, Electric and Magnetic Fields for Electric (J) and Magnetic (M) Current Sources, Solution of the Inhomogeneous Vector Potential Wave Equation, Far-Field Radiation, Duality Theorem, Reciprocity Theorems

Textbook(s):
1. M. N. O. Sadiku , “Elements of Electromagnetics”, Oxford University Press 2007
2. S.Y Liao, “Microwave devices and Circuits” Pearson publications
3. D.M Pozar, “Microwave Engineering”, Wiley Publications.
4. Antenna for all Application-John D Kraus, third edition-TMH publication
5. Antenna Theory-Constantine A. Balanis -Third edition-Wiley Publication

References:
1. E. C. Jordon, K. G. Balman, “Electromagnetic Waves & Radiation System” Prentice Hall, India
2. Antennas and Wave Propagation–G. S. N. Raju (Pearson)
3. Foundations of Antenna Theory and Techniques – Vincent F. Fusco(Pearson)

Transmission Lines, Waveguides and Antenna Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	5	PC	PC	ECC-357

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Transmission Lines, Waveguides and Antenna Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To design and simulate a coaxial transmission line and obtain the propagation constant.
2. To design and simulate strip line and microstrip line and coplanar line and obtain the propagation constants.
3. To design and simulate a rectangular waveguide.
4. To design and simulate a circular waveguide.
5. To design and simulate a dipole antenna.
6. To design and simulate a slotted a rectangular waveguide antenna.
7. To design and simulate a leaky wave antenna using the rectangular waveguide.
8. To design and simulate a rectangular microstrip patch antenna.
9. To design and simulate a circular patch antenna.
10. To design and simulate a rectangular microstrip patch antenna array.
11. To design and simulate a circular microstrip patch antenna array.

Note: These experiments may be performed using simulation software like HFSS, CST and IE3D.

Transport Planning and Intelligent Transportation System	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	7	PCE	PCE-4	CEE-407T
EAE	7	IE-EAE	IE-EAE-4	IE-437T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand system approach to traffic planning process based on travel demand and traffic management.
2.	To develop traffic management for accident prevention, smooth highway traffic flow.
3.	To study Application of queuing approach to traffic flow, trip generation, trip distribution models for traffic analysis.
4.	To develop intelligent transport systems.

Course Outcomes (CO)

CO 1	Examine essential characteristics of the traffic stream using manual and automatic methods.
CO 2	Illustrate traffic signal timings and traffic flow curves.
CO 3	Make use of queuing approach, trip generation and trip distribution models.
CO 4	Explain the role of ITS and its applications for improving the performance of the transportation system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	1	3	-	-	-	-	-	-	-	-	-
CO 2	2	1	3	-	-	-	-	-	-	-	-	-
CO 3	3	1	2	1	1	-	-	-	-	-	-	-
CO 4	2	-	1	-	3	-	-	-	-	-	-	-

UNIT-I

Urban travel characteristics, Evolution of Planning Process, Supply and Demand – Systems approach, Overall Planning process, Long term Vs. Short-term planning, Methods of Measuring Spot Speeds, Radar Speed Meters, Video Camera Method, Moving Observer Method, Presentation of Travel Time and Journey Speed Data, Vehicle Volume Classification and Occupancy Counts, Origin-Destination Survey, Parking Surveys, Use of photographic Techniques in Traffic Survey, Analysis and Interpretation of Traffic Study, fitting a Normal Distribution Curve to Observed Speed Data, Time Mean Speed and Space Mean Speed.

UNIT-II

Traffic and Parking Problems, Parking Space requirement standards, Design standards for on-street and off-street parking facilities. Public transport systems, planning for pedestrians and bicycles. Requirement of traffic Signals and traffic signs, Fixed Time Signals and Vehicle Actuated signals, Optimum Cycle Length, Co-Coordinated Control of Signals, Delay at Signalized Intersections.

Introduction to Travel Demand and Traffic Management, Traffic Management measures and their influence on accident prevention, Road Safety Audit. Theory of Traffic Flow, Basic Diagram of Traffic flow, Speed Flow Curves, Vehicular Stream equations and diagrams, Shock Waves in traffic. Uninterrupted speed flow relationships, Freeway capacity and level of service.

UNIT-III

Queuing system and input parameters, Queuing discipline, Application of Queuing approach to traffic flow, Gap and Headway Distribution, Trip Generation Analysis: Type of trips, Factor affecting trip generation, Trip Generation models: zonal models, Household models, Trip distribution models: Growth factor models, Gravity models. Mode split analysis: Mode choice behaviour, Factor influencing the choice of mode, Mode split curves, Traffic assignment, Development of comprehensive mobility plan, uncontrolled intersections.

UNIT - IV

Basics of Intelligent Transport System, Challenges and opportunities in ITS, Systems engineering in ITS and ITS architecture, ITS applications in Transportation system management, Traffic operations, Public transportation, Freight and commercial vehicle operations, Electronic tolling and pricing, Personal transportation, Rural and regional transportation, Sustainable transportation, Connected and autonomous vehicles (C&AV), Supporting ITS Technologies, ITS standards and specifications, Indian Smart Cities Mission, ITS Case studies

Textbook(s):

1. Papacostas, C.S. and Prevedouros, P.D., “Transportation Engineering and Planning”, PHI, Third Edition, (2012).
2. Dr. L.R.Kadiyali, “Traffic Engineering and Transport Planning”, Khanna Publishers.

References:

1. Ashok Kumar Jain, “Urban Transport: Planning and Management”, APH pub Corporation, ND (2009).
2. Partha Chakroborty, Animesh Das, “Principles of Transportation Engineering”, PHI, New Delhi.
3. Michael J. Bruton, “An Introduction to Transportation Planning”, Routledge Library Editions: Global Transport Planning, (2021).
4. Hutchinson B.G., Allen, Taylor & Francis, Principles of Urban Transportation System Planning, McGraw Hill, (1986)
5. Michael D. Meyer, “Transportation Planning Handbook”, Institute of Transportation Engineers, John Wiley & Sons, Fourth Edition, (2016).

Transport Planning and Intelligent Transportation System Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	7	PCE	PCE-4	CEE-407P
EAE	7	IE-EAE	IE-EAE-4	IE-437P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Transport Planning and Intelligent Transportation System) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To determine traffic stream characteristics by moving observer method.
2. To determine distribution characteristics by plotting frequency and cumulative frequency distribution curves for traffic data.
3. To determine parking space requirement by plotting parking accumulation curve.
4. To determine parking space requirement for data obtained by In-Out parking survey method.
5. To determine parking space requirement for data obtained by License plate methos of parking survey.
6. To plot fundamental diagrams of traffic flow.
7. To design traffic signal system.
8. To calculate peak hour factor and actual flow rate for volumetric data obtained at a traffic intersection.
9. To determine maximum queue length and maximum delay at a toll plaza using queuing analysis.
10. To compute trip matrix using growth factor model.
11. To study the Case Studies of the latest ITS Implementations.
12. To study applications of Intelligent Transport System.

Turbomachines	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-1	MEE-308T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide the knowledge of basic principles, governing equations and applications of turbo machine.
2.	To understand the construction, operation, and analysis of steam turbines.
3.	To understand the construction, operation, and analysis of hydraulic turbines.
4.	To understand the construction, operation, and analysis design of centrifugal pumps and compressors.

Course Outcomes (CO)

CO 1	Explain the fluid and thermodynamics principles relevant to turbo machines.
CO 2	Analyse the performance of the steam turbines based on the principles of fluid mechanics and thermodynamics.
CO 3	Analyse the performance of the hydraulic turbines based on the principles of fluid mechanics.
CO 4	Analyse the performance of the centrifugal pumps and compressors based on the principles of fluid mechanics and thermodynamics.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	2	-	-	-	-	--	-	-	2

UNIT-I

Introduction to Turbomachines, angular momentum principle, velocity diagram, Euler’s energy equation, physical meaning of energy equation Classification of Turbomachines. Comparison with positive displacement machines, general thermodynamic analysis.

Flow through nozzle: nozzle definition, classification, velocity of sound or pressure pulse in fluid, stagnation properties, critical pressure ratio and choke flow, nozzle efficiency.

UNIT-II

Steam Turbines:

Impulse Turbines: classification, single stage impulse turbine, velocity triangle, blade work, blade efficiency, condition for maximum blade efficiency, need of compounding, pressure or Rateau compounding, velocity or

Curtis compounding.
Reaction turbine – Parsons's turbine, velocity triangle, blade work, blade efficiency, condition for maximum blade efficiency, carry over efficiency, losses in steam turbines, reheat factor and condition line, governing of turbine.

UNIT-III

Hydraulic Turbines: Classification, various efficiencies.
Pelton Wheel – Principle of working, velocity triangles, design parameters, maximum efficiency, and numerical problems.
Francis turbine: Principle of working, velocity triangles, design parameters, Kaplan and Propeller turbines - Principle of working, velocity triangles, design parameters and Numerical Problems. Theory and types of Draft tube.

UNIT - IV

Centrifugal Pumps: Parts of centrifugal pump, working of centrifugal pump, different heads and efficiencies of centrifugal pump, Velocity triangles and their analysis, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel.
Centrifugal Compressors: Parts of centrifugal compressor, working of centrifugal compressor, Ideal energy transfer, Slip, Power input parameter, Pressure coefficient, Compressor efficiency, Losses in centrifugal compressor, surging and choking.

Textbook(s):

1. Seppo A. Korpela, "Principles of Turbomachinery", John Wiley& Sons, 2nd ed. (2019).
2. V Ganesan, "Gas Turbines", Mc Graw Hill Education; 3rd ed. (2014).

References:

1. R.K.Turton, Principles of Turbomachinery, Chapman and Hall, 2nd ed. (1995).
2. E. Dick, "Fundamentals of Turbomachines", Springer, 1st ed. (2015).
3. G. Ingram, "Basic concepts in Turbomachinery", BookBoon, 1st ed. (2009).
4. S. M. Yahya, "Turbines, Compressors & Fans",Mc Graw Hill Education, 2nd ed. (2002).
5. P. K. Nag, "Power Plant Engineering", Mc Graw Hill Education; 3rd ed. (2009).

Turbomachines Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ME	6	PCE	PCE-1	MEE-308P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Turbomachines) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of Pelton turbine.
2. To conduct performance test on the given Pelton wheel turbine.
3. Study of Francis turbine.
4. To conduct performance test on the given Francis turbine.
5. Study of centrifugal pump.
6. To conduct performance test on the given centrifugal pump.
7. Study of Kaplan turbine.
8. To conduct performance test on the given Kaplan turbine.
9. Study of centrifugal compressor.
10. To conduct performance test on the given centrifugal compressor.
11. Parametric analysis of the performance of Pelton turbine using any software.
12. Parametric analysis of the performance of Francis turbine using any software.
13. Parametric analysis of the performance of centrifugal pump using any software.
14. Parametric analysis of the performance of centrifugal compressor using any software.

Understanding Human Being, Nature and Existence Comprehensively	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	OUHV-338
OAE	6	UHV-OAE	UHV-OAE-1	OUHV-338

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To help the students develop clarity about human being, human aspirations and their fulfilment through all-encompassing resolution.
2.	To facilitate the competence to understand the harmony in nature/existence and participation of human being in the nature/existence.
3.	To help the students develop the understanding of human tradition and its various components.
4.	To distinguish between self and body, and formulate the role of self in the day-to-day activities of a human being

Course Outcomes (CO)

CO 1	Develop clarity about human aspirations and their fulfillment through all-encompassing resolution
CO 2	Evaluate the significance of right understanding for a happy and prosperous life
CO 3	Examine the participation of human being in ensuring harmony in the family, society, nature and existence
CO 4	Formulate the holistic way of living leading to human tradition with its various components

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	3	1	1	-	1
CO 2	-	-	-	-	-	3	-	3	1	1	-	1
CO 3	-	-	-	-	-	3	-	3	1	1	-	1
CO 4	-	-	-	-	-	3	-	3	1	1	-	1

UNIT-I

Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution: The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution are the activities of the Self, Self is central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution.

UNIT-II

Right Understanding (Knowing)- Knower, Known & the Process: The domain of right understanding starts from understanding the human being (the knower, the experiencer and the doer); and extends up to

understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).
Understanding Human Being: Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Reasons for harmony/contradiction in the self.

UNIT-III

Understanding Existence (including Nature): A comprehensive understanding (knowledge) about the existence, which certainly includes the Nature. The need and the process of inner evolution (through self-exploration, self-awareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).

UNIT - IV

Understanding Human Conduct, All-encompassing Resolution and Holistic Way of Living: Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavor viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence, ultimately, leading to a Humane Society and Human Tradition.

Textbooks:
1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. Professional Ethics and Human Values, Premvir Kapoor, Khanna Book Publishing, New Delhi, 2022.

References:
1. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India
2. Economy of Permanence – (a quest for social order based on non-violence), J. C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India
3. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA
4. IshadiNauUpnishad, Shankaracharya, Geeta press, Gorakhpur,
5. ManavVyavaharDarshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
6. ManaviyaSamvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
7. MahasatipatthanSutta, S N Goenka, Vipassana Research Institute, First Edition, 1996
8. Small Is Beautiful: A Study of Economics as if People Mattered, E. F. Schumacher, 1973, Blond & Briggs, UK
9. Slow is Beautiful, Cecile Andrews http://www.newsociety.com/Books/S/Slow-is-Beautiful)
10. Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur (1990), Commonwealth Publishers, New Delhi
11. Sanchian Sri Guru Granth Sahib Ji, ShiromaniGurdwaraParbhandhak Committee, 2001
12. SamanSuttam, JinendraVarni, 1974.
13. VyavaharvadiSamajshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India
14. VyavahatmakJanvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India.

Universal Human Values	L	P	C
	1		1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
All	6	HS/MS	HS	HS-304

Marking Scheme:

4. Teachers Continuous Evaluation: 25 marks
5. Term end Theory Examinations: 75 marks
6. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives :

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. To analyze the value of harmonious relationship based on trust and respect in their life and profession

Course Outcomes (CO)

CO 1	Evaluate the significance of value inputs in formal education and start applying them in their life and profession
CO 2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO 3	Examine the role of a human being in ensuring harmony in society and nature.
CO 4	Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	3	1	1	-	1
CO 2	-	-	-	-	-	3	-	3	1	1	-	1
CO 3	-	-	-	-	-	3	-	3	1	1	-	1
CO 4	-	-	-	-	-	3	-	3	1	1	-	1

UNIT-I

Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution: The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution as the activities of the Self, Self being central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution

UNIT-II

Understanding Human Being: Understanding the human being comprehensively as the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Basis for harmony/contradiction in the self

UNIT-III

Understanding Nature and Existence: A comprehensive understanding (knowledge) about the existence, Nature being included; the need and process of inner evolution (through self-exploration, self-awareness and self-evaluation), particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).

UNIT - IV

Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living: Understanding Human Conduct, different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavor viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from Self to Nature and entire Existence

Textbook(s):

1. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi.
2. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

References:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986.
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome’s report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
9. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists &Engineers, Oxford University Press
10. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Unsupervised Learning	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	MLDA-EAE	MLDA-EAE-4	ML-465T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn about unsupervised learning and clustering algorithms
2.	To learn about Gaussian mixture models and linear dimensional reduction methods
3.	To learn about autoencoders and generative adversarial network
4.	To learn about outlier detection,density estimation methods and unsupervised learning networks

Course Outcomes (CO)

CO 1	Applying clustering algorithms for the real world data
CO 2	Applying Dimensional reduction techniques for feature extraction and learn,Gaussian mixture models
CO 3	Learn about Autoencoders and Genearative adversarial network
CO 4	Applying outlier and novelity detection,density estimation methods to real world data and learn about unsupervised learning networks

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	3	2	2	-	-	-	-	2
CO 2	3	2	3	3	3	2	2	-	-	-	-	2
CO 3	3	2	3	3	3	2	2	-	-	-	-	2
CO 4	3	2	3	3	3	2	2	-	-	-	-	2

UNIT-I

Unsupervised learning - Introduction, Unsupervised vs Supervised Learning, Application of Unsupervised Learning,
Clustering –Clustering as a Machine Learning task, Different types of clustering techniques, Partitioning methods, Hierarchical clustering, Density-based methods: DBSCAN
Biclustering :Spectral co-clustering,spectral biclustering
Finding Pattern using Association Rule - Definition of common terms, Association rule, Apriori algorithm.

UNIT-II

Gaussain Mixture Models: Gaussian mixture ,Variational Bayesian Gaussian mixture
Manifold learning:Introduction,Isomap,Locally linear embedding,Modified locally linear embedding,Spectral embedding,MDS(Multi dimensional scaling, t-distributed Stochastic Neighbor Embedding (t-SNE)

Decomposing signals in components (matrix factorization problems):PCA(Principal component Anlysis),Factor Analysis, Kernel Principal Component Analysis (kPCA), Truncated singular value decomposition and latent semantic analysis, Independent component analysis (ICA), Non-negative matrix factorization (NMF or NNMF), Latent Dirichlet Allocation (LDA)

UNIT-III

Autoencoders: Architecture,Layers in autoencoder ,training of autoencoder ,Sparse Coding, Undercomplete Autoencoders, Regularized Autoencoders, Stochastic Encoders and Decoders, Denoising Autoencoders, Contractive Autoencoders, Applications of Autoencoders.
Generative Adversarial Networks: Generative Vs Discriminative Modeling, Probabilistic Generative Model, Generative Adversarial Networks (GAN), GAN challenges: Oscillation Loss, Mode Collapse, Uninformative Loss, Hyperparameters, Tackling GAN challenges, Wasserstein GAN, Cycle GAN, Neural Style Transfer

UNIT - IV

Novelty and outlier detection:Overview of outlier detection methods,Novelty detection,outlier detection
Density estimation:Histograms and kernel density estimation
Unsupervised Learning Networks: Kohonen Self-Organizing Feature Maps – architecture, training algorithm, Kohonen Self-Organizing Motor Map,Restricted Boltzmann machine(neural network model)

Textbook(s):
1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (India) Private Limited, 2013.
2. Benyamin Ghojogh, Mark Crowley, Fakhri Karray, ¸ Ali Ghodsi , Elements of Dimensionality Reduction and Manifold Learning,Springer

References:
1. C. M. BISHOP (2006), “Pattern Recognition and Machine Learning”, Springer-Verlag New York, 1st Edition
2. Kevin Murphy, *Machine learning: a probabilistic perspective*.
3. Jennifer Grange ,” Machine Learning for Absolute Beginners: A Simple, Concise & Complete Introduction to Supervised and Unsupervised Learning Algorithms”,Kindle

Unsupervised Learning Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	MLDA-EAE	MLDA-EAE-4	ML-465P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Unsupervised Learning) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Setting up the Jupyter Notebook and Executing a Python Program
2. Installing Keras, Tensorflow and Pytorch,Pandas ,numpy etc libraries and making use of them
3. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
4. Program to demonstrate k-means clustering algorithm
5. Program to demonstrate DBSCAN clustering algorithm
6. Program to demonstrate PCA and LDA on Iris dataset
7. Compare the performance of PCA and Autoencoders on a given dataset
8. Build Generative adversarial model for fake (news/image/audio/video) prediction.
9. Outlier detection in time series dataset using RNN
10. Anomaly detection using Self-Organizing Network

Utilization of Electrical Energy	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-1	EEE-320T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Demonstrate laws of illumination and lightning schemes
2.	Principles and operations of electrical heating and welding
3.	Characteristics and operation of various traction motors
4.	Demonstrate electrolysis and design of batteries

Course Outcomes (CO)

CO 1	Implement laws of illumination
CO 2	Demonstrate electrical heating and welding
CO 3	Implement braking schemes on traction motors
CO 4	Acquire knowledge of construction of energy storage devices

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	3	3	2	2	2	3	2	3
CO 2	3	2	1	2	3	3	3	2	2	2	2	2
CO 3	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	2	3	3	2	2	3	2	2	2

UNIT I

Illumination: Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light, discharge lamps, Mercury Vapour and Sodium Vapour lamps- their characteristic and applications. Performance comparison between tungsten filament lamps, fluorescent tubes, CFL and LED Lights. Basic principles of light control, types and design of lighting schemes and flood lighting.

UNIT II

Electrical Heating : Principle and application of resistance, induction and dielectric heating;,Infrared or radiant heating, High frequency eddy current heating, arc furnaces, induction furnace, electric supply for high frequency heating applications.

Welding: Resistance welding; arc welding, welding generator and welding transformer, properties of arcing electrode, comparison between resistance and arc welding, comparison between A.C. and D.C. welding.

UNIT III

Electric Traction: Advantages of electric traction, requirements of an ideal traction system, different system of electric traction; comparison between D.C. and A.C. systems of railway electrification; speed – time curves, different types of traction motors and their characteristics; parallel operation of traction motors.
Starting and speed control of 3 phase induction motors, braking, advantages and disadvantages of regenerative braking. Calculation of energy returned during regeneration.

UNIT IV

Electroplating: Principles and applications of electrolysis. Faraday’s law of electrolysis, electroplating; calculation of current required for depositing given amount of metal, current efficiency, voltage-energy efficiency, extraction of metals electro deposition, factors governing deposition process.
Energy Storage Devices: Constructional details, principle of operation of Rechargeable Alkaline, Nickel – Cadmium, Nickel-Metal Hydride, Lithium ion and Lead-acid batteries, their comparison and applications. Charging of batteries and rating. Fuel cell and use of electric double layer capacitor (super capacitor) as battery bank.

Textbooks:
1. Pratab. H. “Art and Science of Utilization of Electrical Energy”: Dhanpat Rai & Sons.
2. N.V. Suryanarayana, “Utilization of Electrical Power including Electric Drives and ElectricTraction”,New Age.

References:
1. C.L. Wadhwa, “Generation, Distribution and Utilization of Electrical Energy”, New Age.
2. E. Openshaw Taylor, “Utilization of Electric Energy”, Orient Longman, Universities Press

Utilization of Electrical Energy Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-1	EEE-320P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Utilization of Electrical Energy) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Demonstration and calculation of current for electro plating process used to different metals.
2. Demonstration of large size cut model of different types of batteries.
3. Study of charging methods of batteries and calculation of their life cycle.
4. Charging and discharging of super capacitors.
5. To plot polar curves for various lamps.
6. Verification of illumination laws.
7. Performance comparison of MV lamps, SV lamps, filament lamps, CFL & LED lights.
8. Design of lighting schemes for house / commercial complex / industry / street light / flood light.
9. Demonstration of resistance / inductance / dielectric heatings.
10. Characteristics of welding transformer.
11. Speed control of various traction motors.
12. Braking schemes for traction motors.

VHDL Programming	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	6	PCE	PCE-1	CIE-326T
ECE	6	PCE	PCE-1	ECE-306T
CSE-in-EA	7	OAE-CSE-EA	OAE-2	ES-403T
EAE	7	ES-EAE	ES-EAE-3B	ES-403T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide knowledge of basics of VHDL Programming.
2.	To impart knowledge of Combinational logic circuit simulation and its implementation.
3.	To impart knowledge of simulation and implementation of Synchronous Sequential logic circuit.
4.	To impart knowledge of simulation and implementation of Asynchronous Sequential logic circuit.

Course Outcomes (CO)

CO 1	To understand the basics of VHDL Programming.
CO 2	To understand simulation and implementation of Combinational logic circuit.
CO 3	To understand simulation and implementation of Synchronous Sequential logic circuit.
CO 4	To understand simulation and implementation of Asynchronous Sequential logic circuit.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	3	3	2	2	2	-	1	2	2	3
CO 2	3	2	3	3	3	2	2	-	1	2	2	3
CO 3	3	2	3	3	3	2	2	-	1	2	2	3
CO 4	3	2	3	3	3	2	2	-	1	2	2	3

UNIT-I

Introduction to VHDL, design units, data objects, signal drivers, inertial and transport delays, delta delay, VHDL data types, concurrent and sequential statements, configuration declaration, instantiation.

UNIT-II

Combinational logic circuit design and VHDL implementation of following circuits –full adder, Subtractor, decoder, encoder, multiplexer, ALU, Subprograms – Functions, Procedures, attributes, generic, generate, package, IEEE standard logic library, file I/O, test bench, barrel shifter, 4X4 key board encoder, multiplier, divider, Hamming code encoder and correction circuits.

UNIT-III

Sequential circuit design: flip-flops, registers, counters. **Synchronous Sequential circuit design:** finite state machines, Mealy and Moore, state assignments, design and VHDL implementation of FSMs, Linear feedback shift register (Pseudorandom and CRC).

UNIT – IV

Asynchronous sequential circuit design – primitive flow table, concept of race, critical race and hazards, design issues like metastability, synchronizers, clock skew and timing considerations Introduction to place & route process, Introduction to ROM, PLA, PAL, Architecture of CPLD and FPGA (Xilinx/Altera).

Textbook(s):

1. Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with VHDL design", TMH.
2. Douglas Perry , "VHDL" 4th Edition, TMH.

References:

1. J. Bhasker, "A VHDL Primmer", Prentice Hall 1995.
2. Charles. H.Roth , "Digital System Design using VHDL", PWS (1998)
3. John F. Wakerley , "Digital Design Principles And Practices" , Pearson Education
4. Navabi Z , "VHDL-Analysis & Modelling of Digital Systems", McGraw Hill.
5. William I. Fletcher, "An Engineering Approach To Digital Design", Prentice Hall
6. M. Morris Mano, "Digital Design 3rd Edition", Pearson.

VHDL Programming Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	6	PCE	PCE-1	CIE-326P
ECE	6	PCE	PCE-1	ECE-306P
CSE-in-EA	7	OAE-CSE-EA	OAE-2	ES-403P
EAE	7	ES-EAE	ES-EAE-3B	ES-403P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (VHDL Programming) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Design all gates using VHDL.
2. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
   i) half adder ii) full adder
3. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
   i) multiplexer ii) demultiplexer
4. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
   i) decoder ii) encoder
5. Write a VHDL program for a comparator and check the wave forms and the hardware generated
6. Write a VHDL program for a code converter and check the wave forms and the hardware generated
7. Write a VHDL program for a FLIP-FLOP and check the wave forms and the hardware generated
8. Write a VHDL program for a counter and check the wave forms and the hardware generated
9. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
   i) ALU ii) shift register

Virtual Instrumentation	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-4	ICE-403T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Ability to develop basic understanding of Virtual Instrumentation & Labview.
2.	Ability to design a Virtual Instrumentation model.
3.	Ability to analyze different Arrays
4.	Ability to apply labview for various Applications.

Course Outcomes (CO)

CO 1	Understand basic concepts of Labview
CO 2	Apply PC interfacing principles for data acquisition
CO 3	Appraise the usefulness of LabVIEW for real time data acquisition and analysis
CO 4	Design instrumentation and control applications using LabVIEW

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	-	-	3	-	3	-	-	-	-	3
CO 2	3	2	3	-	3	3	3	3	3	-	-	3
CO 3	3	3	-	-	3	-	3	3	3	-	-	3
CO 4	3	2	-	-	3	3	3	3	3	-	3	3

UNIT I

Introduction: Virtual Instrumentation: Definition & Architecture of virtual instrumentation system, Advantages of Labview, Salient features of labview, Virtual Instrument & Traditional Instrument, Application area of Virtual Instrumentation,

Introduction to LabView: Comparison with conventional programming, popular data flow and VI software packages, building a VI front panel and block diagram

UNIT II

Data Flow Programming Techniques: Graphical programming in data flow, creating sub VI's, For and While loops, case and sequence structure, formula nodes, local and global , string and file I/O, array and clusters, creating one-dimensional, two dimensional and multidimensional arrays, initializing array, deleting, inserting and replacing elements, rows, columns and pages with in arrays, arrays functions, auto indexing, creating two dimensional arrays using loops.

UNIT III

Plotting Data, String and File Input/Output: Plotting data: Types of waveforms, waveform graphs, waveform charts, XY graphs, Digital waveform graphs, 3D graphs, customizing graphs & charts, configuring a graph or chart

String and File Input/Output: File formats, fill I/O functions, path functions, sample VI's to demonstrate file write & read, generating file names automatically, String functions.

UNIT IV

Data Acquisition Basics: A/D and D/A converters, Plug-in Analog Input / Output cards, Digital Input and Output Cards, Selecting and Configuring data acquisition device, Organization of the DAQ VI system, design of digital voltmeter with transducer input, counters and timers, timing, interrupts, DMA.

Common Instrumentation Interfaces: RS232C/ RS485, GPIB, use of library functions to communicate with different instruments

Textbooks:

1. Jeorome Jovitha, " Virtual Instrumentation using Labview", PHI
2. Sanjay Gupta, joseph john, "Virtual Instrumentation Using Labview", TMH

References:

1. Gary johnson, "Labview Graphical programming", Second Edition TMH.
2. Ronald W Larsen, "Labview for Engineers" , prentice Hall Ltd.
3. S Gupta and J P Gupta, "PC Interfacing for Data Acquisition and process control", Instrument Society of America, 1994.
4. Robert H. Bishop "Learning with Lab-View" Prentice Hall 2009.

Virtual Instrumentation Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ICE	7	PCE	PCE-4	ICE-403P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Virtual Instrumentation) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to VI,Basic operations, controls, Indicators and Structures
2. Lab view – Debugging a VI, Sub VI's
3. To perform Boolean operations using VI .
4. Preparing simple VIs (learning front panel and block diagram environment)
5. To apply filtering technique for a given input signal
6. Generate signals such as Sine , Square and Triangular using VI.
7. Simulation of PID controller using VI.
8. Developing VI using control system tool kit.
9. Hardware- Software Interfacing using VI.
10. Developing Web based applications using Vis.

Vision for Humane Society	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	OUHV-340
OAE	6	UHV-OAE	UHV-OAE-2	OUHV-340

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To help the students understand the values ensuring justice in human-human relationship
2.	To develop the competence to think about the conceptual framework of humane society which includes undivided society (relationship based) and universal human order (system based).
3.	To help the students have the exposure for transition from current state to humane society (the undivided society and universal human order).
4.	To formulate a conceptual framework of humane society based on relationship and harmony

Course Outcomes (CO)

CO 1	Analyze the significance of feelings in ensuring justice in human-human relationships
CO 2	Evaluate the fulfillment in relationships in their personal and professional life with the understanding of established and expressed values
CO 3	Develop the competence to work as a team based on relationship in different dimensions of life and society
CO 4	Formulate the steps of transition from current state to humane society (the undivided society and universal human order)

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	3	1	1	-	1
CO 2	-	-	-	-	-	3	-	3	1	1	-	1
CO 3	-	-	-	-	-	3	-	3	1	1	-	1
CO 4	-	-	-	-	-	3	-	3	1	1	-	1

UNIT-I

Introduction to the Course: Basic aspiration of a Human Being and program for its fulfillment, need for family and relationship for a Human Being, Human-human relationship and role of behavior in its fulfillment, Human-rest of Nature relationship and role of work in its fulfillment, Comprehensive Human Goal, Need for Undivided Society, Need for Universal Human Order, an appraisal of the Current State, Appraisal of Efforts in this Direction in Human History.

UNIT-II

Understanding Human-Human Relationship & its Fulfilment: Recognition of Human-Human Relationship, Recognition of feelings in relationship, Established Values and Expressed Values in Relationship, interrelatedness of feelings and their fulfillment, Expression of feelings, Types of relationship and their purpose, mutual evaluation in relationship, meaning of justice in relationship, Justice leading to culture, civilization and Human Conduct.

UNIT-III

Justice from Family to World Family Order: Undivided Society as continuity and expanse of Justice in behaviour – family to world family order, continuity of culture and civilization, Universal Order on the basis of Undivided Society, Conceptual Framework for Universal human order, Universal Human Order as continuity and expanse of order in living: from family order to world family order, a conceptual framework for universal human order.

UNIT - IV

Program for Ensuring Undivided Society and Universal Human Order: Education – Sanskar, Health – Self Regulation, Production-work, Exchange – storage, Justice-preservation.
Human Tradition: Scope and Steps of Universal Human Order, Human Tradition (Ex. Family order to world family order), Steps for transition from the current state, Possibilities of participation of students in this direction, Present efforts in this direction, Sum up.

Textbooks:
1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. Professional Ethics and Human Values, Premvir Kapoor, Khanna Book Publishing, New Delhi, 2022.

References:
1. AvartansheelArthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
2. An Appeal by the Dalai Lama to the World: Ethics Are More Important Than Religion, Dalai Lama XIV, 2015.
3. Economy of Permanence – (a quest for social order based on non-violence), J. C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India.
4. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA.
5. Human Society, Kingsley Davis, 1949.
6. Hind Swaraj or, Indian home rule Mohandas K. Gandhi, 1909.
7. Integral Humanism, Deendayal Upadhyaya, 1965.
8. LohiyaKeVichar, LokBharti, RammanoharLohiya, 2008.
9. ManavVyavaharDarshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
10. ManaviyaSamvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
11. SamadhanatmakBhautikvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India
12. Small Is Beautiful: A Study of Economics as if People Mattered, E. F. Schumacher, 1973, Blond & Briggs, UK.
13. Slow is Beautiful, Cecile Andrews (http://www.newsociety.com/Books/S/Slow-is-Beautiful)
14. Sociology Themes and Perspectives, Harper Collins; EIGHT edition (2014), Martin Holborn and Peter Langley, 1980.
15. Samagrakranti: Jaya Prakash Narayan's philosophy of social change, Siddharth Publications, Renu Sinha, 1996.
16. Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur (1990), Commonwealth Publishers, New Delhi
17. VyavaharvadiSamajshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
18. VyavahatmakJanvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
19. The Communist Manifesto, Karl Marx, 1848.
22. Toward a True Kinship of Faiths: How the World's Religions Can Come Together Dalai Lama XIV, 2011.

Reference Videos

1. Kin school, Tekos, Russia (30 minutes)
2. Technology (Solar City etc.).
3. Natural Farming.
4. Economics of Happiness (1h 8m)

Visual Basic.NET Programming	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-1	CIE-308T

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn about the various data types and control structures in VB.NET
2.	To learn about object-oriented programming concepts and their implementation in VB.NET
3.	To understand how to work with files, directories, and databases using VB.NET
4.	To learn about multi-threading, XML document handling, and web programming with VB.NET

Course Outcomes (CO)

CO 1	Knowledge and understanding of the basic syntax and structure of VB.NET programs.
CO 2	Ability to use control structures and data types effectively to solve programming problems.
CO 3	Understanding of object-oriented programming concepts and their implementation in VB.NET.
CO 4	Understanding and implementation of multi-threading, XML document handling, and web programming with VB.NET.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT-I

Overview of VB.NET and its history, Features and benefits of VB.NET, Introduction to .NET framework architecture and common language runtime (CLR), Setting up the development environment (Visual Studio), Basic syntax and structure of a VB.NET program, use of namespaces

UNIT-II

Variables and data types, Operators and expressions, Control structures: decision making statements and loops, Working with arrays and strings, Exception handling in VB.NET, Working with files and directories, Basic understanding of LINQ

UNIT-III

Understanding the basics of object-oriented programming (OOP), Creating classes and objects in VB.NET, inheritance and polymorphism, encapsulation and abstraction, Working with interfaces and abstract classes, delegates and events

UNIT – IV

Working with databases using ADO.NET, multi-threading concepts and working with threads, Working with XML documents using XML DOM and XML serialization, the basics of web programming with ASP.NET, Understanding the basics of WPF and Windows Forms for desktop application development,Overview of .NET core and its features

Text Books:

1. "Programming Visual Basic .NET" by Dave Grundgeiger
2. "Programming Microsoft Visual Basic .NET" by Francesco Balena
3. "VB.NET and XML" by Rod Stephens
4. "VB.NET Language in a Nutshell" by Steven Roman and Ron Petrusha

References:

1. "Visual Basic .NET and the .NET Platform: An Advanced Guide" by Andrew Troelsen

Visual Basic.NET Programming Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-1	CIE-308P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Visual Basic.NET Programming) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Create a program that calculates the sum of two numbers entered by the user.
2. Develop a program that accepts a string from the user and displays it in reverse order.
3. Build a program that converts a given temperature in Fahrenheit to Celsius.
4. Create a program that generates a random number and asks the user to guess the number.
5. Build a program that determines whether a given year is a leap year or not.
6. Develop a program that accepts a string from the user and displays the number of vowels and consonants in the string.
7. Create a program that reads a file and displays its content on the screen.
8. Build a program that accepts a number from the user and displays its factorial.
9. Develop a program that accepts a number from the user and displays its binary, octal, and hexadecimal equivalents.
10. Create a program that determines whether a given string is a palindrome or not.
11. Build a program that accepts a number from the user and displays its prime factors.
12. Develop a program that accepts two strings from the user and concatenates them.
13. Create a program that sorts an array of integers in ascending order.
14. Build a program that accepts a number from the user and displays its square root.
15. Develop a program that accepts a sentence from the user and displays the number of words and characters in the sentence.

VLSI	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-3	EEE-362T
EAE	6	VLSI-EAE	VLSI-EAE-2	VLSI-330T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide the basic knowledge of VLSI Technology, MOS transistor working principle and scaling effect on device parameters
2.	To impart the knowledge of MOS fabrication, inverter configuration, switching characteristics and interconnection effects.
3.	To give knowledge of combinational and sequential circuit design using NMOS, PMOS, CMOS technology.
4.	To give knowledge of designing of dynamic logic circuit, clocking issues and low power design concept.

Course Outcomes (CO)

CO 1	To understand the basic knowledge of VLSI Technology, MOS transistor working principle and scaling effect on device parameters
CO 2	To understand MOS fabrication, inverter configuration, switching characteristics and interconnection effects.
CO 3	To design combinational and sequential circuit design using NMOS, PMOS, CMOS technology.
CO 4	To understand designing of dynamic logic circuit, clocking issues and low power design concept.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	-	-	2	1	2	1
CO 2	3	3	3	3	2	1	-	-	2	1	2	1
CO 3	3	3	3	3	2	1	-	-	2	1	2	1
CO 4	3	3	3	3	2	1	-	-	2	1	2	1

UNIT-I

Evolution of VLSI, VLSI designing methodology, design flow, design Hierarchy, concept of regularity, modularity & locality, VLSI design style, MOS transistor theory, MOS structure, Energy band diagram of MOS system, MOS under external bias, derivation of threshold voltage equation, enhancement & depletion transistor, MOS device design equations, MOSFET scaling and small geometry effects, MOSFET capacitances.

UNIT-II

CMOS & NMOS process technology – explanation of different stages in fabrication, Body effect, and latch up in

CMOS. NMOS inverter, CMOS inverter, DC characteristics, static load MOS inverter, pull up/pull down ratio, static & dynamic power dissipation. Switching characteristics: rise time, fall time delays, noise margin.

UNIT-III

CMOS logic gate design: NAND, NOR, XOR and XNOR gates, Transistor sizing, combinational MOS logic circuits: pass transistor and transmission gate designs, Pseudo NMOS logic, Complex Logic Circuits. Stick diagram, Layout design rules. Sequential MOS logic circuits: SR latch, clocked latch and flip flop circuits, CMOS D latch and edge triggered flip flop.

UNIT – IV

Dynamic logic circuits: Basic Principles of Pass Transistor Circuits, dynamic CMOS circuits, High performance dynamic CMOS circuits: Domino CMOS logic, NORA CMOS logic, Zipper, TSPC. Low power design concepts using CMOS Technology.

Textbook(s):

1. S. M. Kang, Y. Lebiebici, “CMOS digital integrated circuits analysis & design” Tata McGraw Hill, 3rd Edition.
2. Basic VLSI Design - Pucknell Douglas A., Eshraghian Kamran, PHI Learning Pvt Limited, 2013.
3. Adel S. Sedra, Kenneth C. Smith: Microelectronics Circuits, Oxford University Press.

References:

1. J. M. Rabaey, “Digital Integrated Circuits” PHI Learning Pvt Limited, India
2. J. P. Uyemura, Introduction to VLSI Circuits and Systems‖, John Wiley & Sons, Inc., New York, NY
3. N. Weste and D. Harris, "CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Pearson

VLSI Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-3	EEE-362P
EAE	6	VLSI-EAE	VLSI-EAE-2	VLSI-330P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (VLSI) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the MOS characteristics and introduction to tanner EDA software tools.
2. To design and study the DC characteristics of PMOS and NMOS.
3. To design and study the DC and AC characteristics of resistive load inverter.
4. To design and study the DC and AC characteristics of CMOS inverter.
5. To design and study the characteristics of CMOS NAND and NOR gate.
6. To design any Boolean function using transmission gates.
7. To design and study the characteristics of CMOS multiplexer.
8. To design and study the characteristics of D latch.
9. To design and study the characteristics of Full adder.
10. To design and study the layout of PMOS and NMOS transistors.
11. To design and study the layout of CMOS inverter.

VLSI Testing	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	VLSI-EAE	VLSI-EAE-5C	VLSI-451

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To enhance knowledge of the fault modeling in VLSI circuits.
2.	To create vectors to test a circuit efficiently covering maximum faults.
3.	Learn about application in modern digital design
4.	Use modern CAD tools for VLSI testing and verification.

Course Outcomes (CO)

CO 1	To understand fault modelling in VLSI circuits.
CO 2	To create vectors for test a circuit efficiently covering maximum faults.
CO 3	Understanding the application in modern digital design
CO 4	Using modern CAD tools for VLSI testing and verification.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	3	2	3	2	1	-	2	1	1	1
CO 2	3	2	3	2	3	1	1	-	2	1	-	1
CO 3	3	2	3	2	2	2	1	-	2	1	2	2
CO 4	3	3	3	2	3	2	1	-	2	1	2	2

UNIT I

Physical fault sandtheir modelling. Fault equivalence and dominance, fault collapsing, Fault simulation: parallel, deductive and concurrent techniques; critical path-tracing. Test generation for combinational circuits: Boolean differenced-algorithm, Podem, random etc.

UNIT II

Exhaustive, random and weighted test pattern generation, aliasing and its effect on fault coverage. PLA testing: cross-point fault model, test generation, easily testable designs. Memory testing: permanent, intermittent and pattern-sensitive faults; test generation. Delay faults and hazards; test pattern generation techniques, ATPG and its different types.

UNIT III

Test pattern generation for sequential circuits: ad-hoc and structures techniques scan path and LSSD, boundary scan. Built-in self-test techniques: LBIST and MBIST. Verification: logic level (combinational and sequential circuits), RTL-level (data path and control path).

UNIT IV

Verification of embedded systems. Use of formal techniques: decision diagrams, logic-based approaches. ASIC/IP Verification, direct and random testing, Error detection and correction codes.

Textbook(s):

1. Essentials of Electronic Testing, M. L. Bushnell and V. D. Agrawal,3rd Kluwer Academic Publishers 2002.
2. Delay Fault Testing for VLSI Circuits, A. Krstic and K-T Cheng,3rd Kluwer Academic Publishers. 2003.
3. Testing of Digital Systems, N. K. Jha and S. Gupta, 2nd, Cambridge University Press. 2003.

References:

1. Digital Systems Testing and Testable Design, M. Abramovici, M. A. Breuer and A. D. Friedman, 3rd, Wiley-IEEE Press. 1994
2. B Fault Tolerant and Fault Testable P. K. Lala, 4th, Hardware Design, Prentice-Hall. 1986.

Water Resource Planning	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CE	6	PCE	PCE-2	CEE-314
EAE	6	IE-EAE	IE-EAE-1	IE-322

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge about the planning and management of water resources.
2.	To introduce the concepts of watershed management, integrated water resources management, environmental interaction of water resources and policies/framework related to water resources
3.	To enable the students to understand the different components of water resources and their management
4.	To enable the student to estimate well parameters and yield of well, with the help of mathematics, science, and engineering fundamentals.

Course Outcomes (CO)

CO 1	Identify different problems related to water resources planning, management and development.
CO 2	Describe problems like water balance, water distribution networks, water pollution and other water related concerns.
CO 3	Apply principles and guidelines to solve above mentioned problems
CO 4	Determine appropriate techniques for Ground Water modeling and prediction of flow.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	-	2	2	-	-	-	-	-	-	-
CO 2	2	-	1	-	-	-	2	-	-	-	-	-
CO 3	3	-	1	2	3	-	-	-	-	-	-	-
CO 4	3	2	2	-	-	-	-	-	-	-	-	-

UNIT-I

Introduction of Water Systems engineering-scope and approach Issues and the systems planning approach, Water system dynamics, Water Resource [W.R.] development alternatives, Water systems planning objectives, Constraints and Criteria, Economic and Econometric principles, Cost and Benefit Curves.

UNIT-II

Application of Linear programming [LP] and Dynamic programming [DP] models in Water Resource Engineering, Problem formulation for W.R. systems, Multi-objective Water Resource Planning, Non-inferior Solutions, Plan Formulation, Weighting Method, Constraint Method, Plan Selection. Reservoir Operation, Standard Operating

Policy, Optimal Operating Policy using LP Rules, Curves for Reservoir Operations Reservoir Systems [Deterministic Inflow], Reservoir Sizing, Sequent Peak Analysis Neglecting Evaporation, Sequent Peak Analysis Considering Evaporation Loss, Reservoir Capacity using LP , Storage Yield Function, Mixed Integer LP Formulation for Maximising Yield.

UNIT-III

Multireservoir Operation, Stationary Policy using DP, Simulation of Reservoir Operation for Hydropower Generation, Reservoir Systems [Random Inflow], Lognormal and Exponential Distributions, Chance Constrained LP, Linear Decision Rule, Deterministic Equivalent of a chance constraint Concept of Reliability, Reliability-based Reservoir Sizing, Maximum Reliability, Stochastic Dynamic programming for reservoir operation, State variable discretisation, Inflow as a stochastic process, Steady state operating policy, Steady State Probabilities, Real-time Operation, Case Study.

UNIT - IV

Water quality management planning and associated models, Regional planning models, Policy issues for improvement in utilisation of water resources, Optical Irrigation Water allocation for single and multiple crops, Crop Yield optimization. Applications of Linear Programming in [1] Optimal Irrigation water allocation to multiple crops, [2] Multireservoir system for irrigation planning, [3] Reservoir Operation [Short term] for irrigation, [4] Reservoir operation for Hydropower optimization. Application of dynamic programming in - [1] Steady State Reservoir operating policy for irrigation, [2] Real Time Reservoir Operation for Irrigation, An Example application for inflow forecasting, Fuzzy Sets and Fuzzy logic, Introduction, Fuzzy rule based reservoir operation model.

Textbook(s):

1. Water Resources Systems Planning and Management, Sharad K. Jain, V 2003 ,Elsevier ,Singh . .P
2. Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications, Daniel P. Loucks, Eelco Van Beek, 2005.

References:

1. S.Vedula, P.P.Majumdar-Water Resources Systems, Tata Mcgraw Hill Publishing Company Ltd., ND
2. M.C. Chaturvedi, W.R.Systems-Planning and Management, Tata McGraw Hill Publications, New Delhi
3. Louks D Petal W.R. System Planning and Analysis, Prentice Hall – 1981. [R4] Maass. A. eta:-Design Water Resources Systems-McMillan, 1968.
4. A.S. Goodman, Principals of Water Resources Planning, Prentice Hall, 1984

Wavelets	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-340T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Impart the basics of signal representation and Fourier theory
2.	To Explain the concepts, theory, and algorithms behind wavelets from an interdisciplinary perspective that unifies harmonic analysis, filter bank, and multiresolution analysis.
3.	To Discuss the wavelet, transform in both continuous and discrete domain
4.	To understand the applications of Wavelet transform

Course Outcomes (CO)

CO 1	Understand the terminology that are used in the Wavelets literature
CO 2	To understand Multi Resolution Analysis and Filter banks
CO 3	To Understand the design of Wavelets in both continuous and discrete domain
CO 4	Apply wavelets, filter banks, and multiresolution techniques to solve practical engineering problems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	1	1	-	1	1	-	2
CO 2	3	3	3	3	3	1	1	-	1	1	-	2
CO 3	3	3	3	3	3	1	1	-	1	1	-	2
CO 4	3	3	3	3	3	1	1	-	1	1	-	2

UNIT I

Introduction and Fundamentals: Stationary and non-stationary signals, Signal representation using basis and frames, Orthogonality and Orthonormality, Properties of Norm, Parseval's Theorem, Brief introduction to Fourier transform and Short time Fourier transform, Time-frequency analysis, Heisenberg's uncertainty principle, Filter banks, Multi resolution formulation: Wavelets from filters, Classes of wavelets: Haar, Daubechies, bi-orthogonal.

UNIT II

Continuous Wavelet Transform: Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain.

UNIT III

Discrete Wavelet Transform And Filterbanks: Orthogonal and bi-orthogonal two-channel filter banks, Design of two-channel filter banks, Tree-structured filter banks, Discrete wavelet transform, Non-linear approximation in the Wavelet domain, multi resolution analysis, Construction and Computation of the discrete wavelet transform, the redundant discrete wavelet transform.

UNIT IV

Multi Resolution Analysis: Multirate discrete time systems, Parameterization of discrete wavelets, Bi-orthogonal wavelet bases, two dimensional, wavelet transforms and extensions to higher dimensions, wave packets.

Applications: Signal and Image compression, analysis and classification of audio signals using CWT, Wavelet based signal de-noising and energy compaction.

Textbook(s):

1. A Wavelet Tour of Signal Processing, 2nd edition, S. Mallat, Academic Press, 1999.
2. Wavelet transforms: Introduction, Theory and applications, Raghuveer rao and Ajit S. Bopardikar, Pearson Education Asia, 2000.
3. Wavelets and Sub band Coding, M. Vetterli and J. Kovacevic, Prentice Hall, 1995.

References:

1. Fundamentals of Wavelets: Theory, Algorithms, and Applications, J.C. Goswami and A.K. Chan, 2nd ed., Wiley, 2011.
2. Wavelets and their Applications, Michel Misiti, Yves Misiti, Georges Oppenheim, Jean-Michel Poggi, John Wiley & Sons, 2010.
3. A premier on Wavelets and their scientific applications, J S Walker, CRC press, 2002.
4. Wavelets and signal processing: An application-based introduction, Stark, Springer, 2005.
5. A friendly guide to Wavelets, Gerald Keiser, Springer, 2011.
6. Multirate Systems and Filter Banks, P. P. Vaidyanathan, Pearson Education, 2004.
7. Wavelets: from math too practice, Desanka.P.Radunovik, springer, 2009.
8. Insight into wavelets from theory to practice, K P Soman and KL Ramachandran, PHI, 2008.
9. Gilbert Strang and Truong Nguyen, “Wavelets and Filter banks”, Wellesley Cambridge Press, 1996.

Wavelets Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-340P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Wavelets) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Obtain the CWT of the chirp signal and plot the CWT along with the true instantaneous frequencies plotted as dashed lines.
2. To plot and analyse the chirp signal using Short-time FT.
3. Observe and detect transient changes in a time series data using CWT.
4. Observe the steady-state oscillations and transient events denoting the heartbeats of ECG signal (QRS complexes) using CWT.
5. To Plot and observe the wavelet coherence of the two signals using CWT.
6. Analyse and plot a suitable signal using a wavelet MRA.
7. Demonstrate the reconstruction of a signal from MRA.
8. Demonstrate denoising of a real-valued 1-D signal using wavelet signal denoiser.
9. Demonstration of wavelet-based image compression.
10. Wavelet correlation analysis of financial data (GDP component data).

Web and Mobile Application Testing and Deployment	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	FSD-EAE	FSD-EAE-5	FSD-439T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce students to the concepts, methodologies, and best practices of web and mobile application testing and deployment.
2.	To familiarize students with performance testing, optimization, and security considerations in web and mobile application development.
3.	To equip students with the knowledge and skills to implement continuous integration, delivery, and deployment processes.
4.	To enhance students' ability to effectively test, deploy, and maintain web and mobile applications in various environments.

Course Outcomes (CO)

CO 1	Demonstrate a clear understanding of the importance of testing and deployment in the software development life cycle and apply functional testing techniques to ensure the quality and reliability of web and mobile applications.
CO 2	Perform performance testing, analyze results, and optimize web and mobile applications for better performance and Conduct security testing to identify vulnerabilities and implement necessary countermeasures.
CO 3	Implement continuous integration, delivery, and deployment pipelines for efficient software development and deployment and apply industry best practices for deploying web and mobile applications in different environments.
CO 4	Develop the ability to use appropriate tools and technologies for web and mobile application testing and deployment and collaborate effectively in teams to test, deploy, and maintain web and mobile applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	3	-	3	3	2	2	3
CO 2	3	3	3	2	2	3	-	3	3	2	2	3
CO 3	3	3	3	2	2	3	-	3	3	2	2	3
CO 4	3	3	3	2	2	3	-	3	3	2	2	3

UNIT I

Introduction to Web and Mobile Application Testing and Deployment: Overview of web and mobile application testing and deployment, Importance of testing and deployment in software development life cycle, Testing methodologies and strategies, Deployment models and techniques

Functional Testing of Web and Mobile Applications: Introduction to functional testing, Test case design techniques, Test automation frameworks and tools, Cross-browser and cross-platform testing, Mobile application testing

UNIT II

Performance Testing and Optimization: Performance testing concepts and objectives, Load testing and stress testing, Performance measurement and profiling tools, Performance optimization techniques, Mobile performance testing considerations.

UNIT III

Security Testing and Deployment Best Practices: Introduction to security testing, Security vulnerabilities and threats, Security testing techniques and tools, Secure deployment best practices, Compliance and regulatory considerations.

UNIT IV

Continuous Integration, Delivery, and Deployment: Introduction to continuous integration, delivery, and deployment, Continuous integration and build automation tools, Continuous delivery pipelines
Deployment strategies and techniques, Monitoring and error tracking in production

Textbooks:

1. "Software Testing: Principles and Practices" by Srinivasan Desikan and Gopalaswamy Ramesh
2. "Agile Testing: A Practical Guide for Testers and Agile Teams" by Lisa Crispin and Janet Gregory
3. ”Software Testing”: Yogesh Singh Cambridge University Press

Reference Books:

1. "Effective Software Testing: 50 Specific Ways to Improve Your Testing" by Elfriede Dustin, et al.
2. "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation" by Jez Humble and David Farley
3. "Selenium WebDriver Recipes in Python: The problem-solving guide to Selenium WebDriver in Python" by Zed A. Shaw
4. "Hands-On Mobile App Testing: A Guide for Mobile Testers and Anyone Involved in the Mobile App Business" by Daniel Knott
5. "The Art of Application Performance Testing: Help for Programmers and Quality Assurance" by Ian Molyneaux
6. "Web Performance Tuning: Speeding Up the Web" by Patrick Killelea
7. "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws" by Dafydd Stuttard and Marcus Pinto
8. "OWASP Testing Guide" by The Open Web Application Security Project (OWASP)
9. "How to Break Software: A Practical Guide to Testing" by James A. Whittaker
10. "Performance Testing Guidance for Web Applications" by Microsoft Corporation
11. "Software Security: Building Security In" by Gary McGraw
12. "Continuous Integration: Improving Software Quality and Reducing Risk" by Paul M. Duvall

Web and Mobile Application Testing and Deployment Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	7	FSD-EAE	FSD-EAE-5	FSD-43P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Web and Mobile Application Testing and Deployment) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1: **Introduction to Web Technologies**

Objective: Familiarize students with basic web technologies, HTML, CSS, and JavaScript.

Activities: Create a simple web page using HTML, style it with CSS, and add interactivity using JavaScript.

2: **Web Application Testing**

Objective: Introduce students to various testing techniques and tools for web applications.

Activities: Test a web application for functional and non-functional requirements; perform unit testing, integration testing, and regression testing.

3: **Mobile Application Development**

Objective: Enable students to develop mobile applications using a cross-platform framework.

Activities: Build a simple mobile application using a framework like React Native or Flutter.

4: **Mobile Application Testing**

Objective: Introduce students to the challenges and techniques of testing mobile applications.

Activities: Test a mobile application for usability, performance, compatibility, and security.

5: **Web Application Deployment**

Objective: Teach students the process of deploying a web application to a hosting environment.

Activities: Deploy a web application on a cloud hosting platform like Amazon Web Services (AWS) or Heroku.

6: **Continuous Integration and Deployment**

Objective: Introduce students to the concepts of continuous integration and deployment for web and mobile applications.

Activities: Set up a CI/CD pipeline using tools like Jenkins, Travis CI, or GitLab CI/CD.

7: **Performance Testing for Web Applications**

Objective: Teach students how to analyze and improve the performance of web applications.

Activities: Perform load testing, stress testing, and optimize the performance of a web application.

8: **Security Testing for Web and Mobile Applications**

Objective: Introduce students to the fundamentals of security testing for web and mobile applications.

Activities: Conduct vulnerability assessments, penetration testing, and analyze security issues in a web or mobile application.

Web Development using MEAN Stack	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	FSD-320T
EAE	6	FSD-EAE	FSD-EAE-2A	FSD-320T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide the solid foundation in web development, covering the fundamental skills of frontend and backend technologies using mean environment
2.	To learn and implement the concept of AngularJS
3.	To learn and implement the concept of NodeJS and ExpressJS
4.	To learn and implement the connectivity of MongoDB with web applications

Course Outcomes (CO)

CO 1	Apply web designing using mark-up languages.
CO 2	Understand the utility of Node.js and Express.js.
CO 3	Apply the concept of angular in web designing.
CO 4	Implement the concept of Mongo DB in web development.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	2	3	2	3	3	2	2	3	3	2	3
CO 2	1	2	3	2	3	3	2	2	3	3	2	3
CO 3	1	2	3	2	3	3	2	2	3	3	2	3
CO 4	2	2	3	2	3	3	2	2	3	3	2	3

UNIT-I

Web Development Introduction: Front end technology, Back end technology, HTML, CSS AND JAVA Script basics, JavaScript Essentials: Variables, Data Types, Operators, Control Structures, Functions, Objects
MEAN Full Stack: Three-tier web application development, The evolution of JavaScript Introducing MEAN , features of MEAN, MEAN components setup, Exploring the project structure

UNIT-II

Node.js: Introduction, JavaScript event-driven programming , Node.js event-driven programming, JavaScript closures, Node modules , CommonJS modules , Node.js core modules , Node.js third-party modules , Node.js ile modules , Node.js folder modules , Developing Node.js web applications , Meet the Connect module , Connect middleware , Understanding the order of Connect middleware, Mounting Connect middleware
Introduction to Express, Creating your first Express application , The application, request, and response objects,

External middleware , Implementing the MVC pattern , Application folder structure, Horizontal folder structure, Vertical folder structure, File-naming conventions , Rendering Views

UNIT-III

Introduction to Angular: Angular and its Key concepts, Angular components, Modules, Services, and Dependency Injection
Angular Templates and Data Binding: Template syntax, Interpolation, Property binding, Event binding, Two-way binding
Angular Directives: Introduction, Built-in Directives, Custom Directives, Structural Directives
Angular Routing: Introduction, Configuring Routes, Route Parameters, Route Guards, Lazy Loading

UNIT - IV

MongoDB: Introduction to NoSQL and MongoDB, Key features of MongoDB, The BSON format 83, MongoDB ad hoc queries, indexing, replica set, sharding, shell, databases, collections, CRUD operations, new document creation(using insert, update, save, read document, use of operators,
Deleting documents

Textbook(s):

1. Web Application Development with MEAN by Amos Q. Haviv Adrian Mejia, Robert Onodi, Packt Publishing.
2. Write Modern Web Apps with the Mean Stack: Mongo, Express, Angularjs, and Node.js (Develop and Design) by Jeff Dickey, Pearson Publishing.

References:

1. HTML, CSS, and JavaScript All in One by Julie C. Meloni, Jennifer Kyrnin, Pearson Publishing.
2. Full-Stack JavaScript Development: Develop, Test and Deploy with Mongodb, Express, Angular and Node on Aws by Eric Bush, Maura Van Der Linden, Red Sky Publishing.

Web Development using MEAN Stack Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	FSD-320P
EAE	6	FSD-EAE	FSD-EAE-2A	FSD-320P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Web Development using MEAN Stack) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Create a static website using HTML / CSS / JavaScript and deploy it on a web server.
2. Install and set up Node.js and Express.js on the local machine.
3. Use Angular CLI to create a new component and implement data binding techniques such as string interpolation, property binding, two-way data binding, and event binding.
4. Implement component interaction using @Input, @Output decorators, and @ViewChild decorator to get hold of DOM.
5. Use built-in directives such as ngFor, ngIf, ngSwitch, ngClass, ngStyle to manipulate the DOM elements.
6. Implement Dependency Injection by injecting a service into a component and accessing its functions.
7. Use Http client module to perform HTTP requests to a server, handle responses, and errors.
8. Implement Routing in an Angular app, including redirection, wild card route, relative paths, and routing guards.
9. Create a basic server using Node.js and Express.js, and handle requests and responses.
10. Connect a Node.js server to a MongoDB database, and perform CRUD (Create, Read, Update, and Delete) operations using Mongoose library.
11. Implement authentication and authorization using Passport.js and JSON Web Tokens (JWT).
12. Deploy the MEAN stack application to cloud platforms such as Heroku, AWS, or Azure.

Web Development using MERN Stack	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	FSD-322T
EAE	6	FSD-EAE	FSD-EAE-2B	FSD-322T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To learn the Web Development, Designing and validations using HTML, XHTML, XML, CSS, XSLT and JavaScript
2.	To learn and implement the concept of ReactJS
3.	To learn and implement the concept of NodeJS and ExpressJS
4.	To learn and implement the connectivity of MongoDB with web applications

Course Outcomes (CO)

CO 1	To be able to learn the basic implementation and apply HTML, XHTML, XML, CSS, XSLT and JavaScript concepts in web applications
CO 2	To be able to develop a Web application using ReactJS
CO 3	To be able to develop a Web application based on NodeJS and ExpressJS
CO 4	To be able to connect the applications using MongoDB

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	2	1	1	3	1	-	1	2	-	3	3
CO 2	1	2	1	1	3	1	-	1	2	-	3	3
CO 3	1	2	1	1	3	1	-	1	2	-	3	3
CO 4	1	2	1	1	3	1	-	1	2	-	3	3

UNIT-I

Introduction: Fundamentals of Web Design, Webpage and Website, Web application, Client-server architecture
Markup languages: Introduction to HTML, basics of XTHML, HTML elements, HTML tags, lists, tables, forms, defining XHTML's abstract syntax, XML.
CSS style sheets: Introduction, CSS core syntax, text properties, CSS box model, normal flow box layout, other properties like list, tables, XSLT
Client Side Programming: JAVA Scripts, basic syntax, variables & data-types, literals, functions, objects, arrays, built-in objects, JAVA Script form programming, Intrinsic event handling, modifying element style, document trees, ECMAScript5, ECMAScript6

UNIT-II

ReactJS: Introduction, Templating using JSX, Classes using JSX, Components, State and Props, Lifecycle of Components, Rendering List and Portals, Error Handling, Routers, Redux and Redux Saga, Immutable.js, Service Side Rendering, Unit Testing, Webpack

UNIT-III

NodeJS: Node js Overview, Node js Basics and Setup, Node js Console, Node js Command Utilities, Node js Modules, Node js Concepts, Node js Events, Node js Database Access, Node.js with Express.js, Express.js Request, Express.js Response, Express.js Get, Express.js Post, Express.js Routing, Express.js Cookies, Express.js File Upload, Express.js Middleware, Express.js Scaffolding, Express.js Template.

UNIT - IV

MongoDB: SQL and NoSql concepts, Create and manage MongoDB, Migration of data into MongoDB, MongoDB with NodeJS, Services offered by MongoDB

Textbook(s):

1. Vasan Subramanian, “Pro MERN Stack”, Apress Publisher, 2 Edition, ISBN: 9781484243916
2. Chris Northwood, “The Full Stack Developer”, Apress Publisher, ISBN: 978-1484241516

References:

1. Greg Lim, “Beginning MERN Stack Applications”, Independently Published, Third Edition.
2. ”Road for Being MERN STACK Developer”, Independently published, ISBN:9798766684855
3. Shama Hoque, “ Full Stack React Projects”, O'Reilly Media , 2nd Edition.

Web Development using MERN Stack Lab

L	P	C
	2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-in-EA	6	OAE-CSE-EA	OAE-1	FSD-322P
EAE	6	FSD-EAE	FSD-EAE-2B	FSD-322P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Web Development using MERN Stack) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Task management tool: Login/Register to the application, add daily tasks, Assign a due date of completion, Mark them as complete/incomplete and View weekly/monthly statistics of their to-dos.
2. Blogging platform:
3. Social media platform
4. Weather Forecasting APP.
5. Bookstore Library and Stock keeping APP:

   a) **User Interface**: Browse Books from library, filter them based on category, author, publications, pay & rent them for a specific duration, like/review them

   b) **Admin interface**: List/manage books, track rented books and their availability and send notifications via email to users once lease expires.
6. Build a simple CRUD application: create a web application that allows users to create, Read, Update and Delete data from a MongoDB database.
7. Design a web platform to help small businesses manage their inventory.
8. Create a web-based system to streamline the process of booking appointments.
9. Develop a web-based tool for medical professionals to easily store and access patient records.
10. Develop a web application to facilitate collaboration between teachers and students.

Web Intelligence and Big Data Analytics	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	7	PCE	PCE-5	CIE-429T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the importance of web intelligence.
2.	To define big data and to do perform big data analytics.
3.	To perform decision making and predictive data analysis on big data.
4.	To understand various technologies used for big data.

Course Outcomes (CO)

CO 1	Able to apply various techniques of web intelligence.
CO 2	Able identify various tools for big data analysis.
CO 3	Able to perform decision making and predictive data analysis on big data.
CO 4	Able to perform big data analytics using Hadoop.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT-I

Web Intelligence: Web Scale AI and Big Data, Web Intelligence, Big Data Look: Indexing- Index creation, Ranking, Page Rank Searching- Enterprise search, Searching structured data, Object Search, Locality Sensitive Hashing and Memory.

UNIT-II

Big Data Introduction: The Evolution of Data Management, Defining Big Data, Traditional and advanced analytics. Distributed Computing, need of distributed computing for big data, economics of computing, latency problem.

Examining Big Data Types, Structured Data, sources of big structured data, role of relational databases in big data, Unstructured Data, sources of unstructured data, role of a CMS in big data management.

Big Data Stack: Redundant Physical Infrastructure, Security Infrastructure, Operational Databases. Organizing Data Services and Tools, Analytical Data Warehouses, Big Data Analytics, Big Data Applications.

UNIT-III

Virtualization and big data: Server virtualization, Application virtualization, Network virtualization, Processor and memory virtualization, Data and storage virtualization, Managing Virtualization with the Hypervisor. MapReduce Fundamentals, Putting map and reduce Together, Optimizing MapReduce Tasks. Hadoop, Hadoop Distributed File System (HDFS), Name Nodes, Data nodes, Hadoop MapReduce.

UNIT - IV

Big Data Analytics: Basic analytics, Advanced analytics, Operationalized analytics, Monetizing analytics, Text Analytics and Big Data, Social media analytics, Text Analytics Tools for Big Data, Attensity, Clarabridge, OpenText.

Integrating Data Sources: Dealing with Real-time Data Streams and Complex Event Processing, Operationalizing Big Data, Applying Big Data within Your Organization, Security and Governance for Big Data Environments.

Textbook(s):

1. The Intelligent Web: Search, Smart Algorithms and Big Data published by Oxford University Press, UK, in November 2013, authored by Dr. Gautam Shroff.
2. Judith S. Hurwitz, Alan F. Nugent, Fern Halper, Marcia A. Kaufman, “Big Data For Dummies”, John Wiley & Sons, Inc.(2013)
3. Robert D. Schneider, “Hadoop For Dummies”, John Wiley & Sons, Inc. (2012)

References:

1. Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, by Paul Zikopoulos,McGraw Hill 2012.

Web Intelligence and Big Data Analytics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	7	PCE	PCE-5	CIE-429P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Web Intelligence and Big Data Analytics as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Analyze the link structure of web using page rank algorithms.
2. Analyze the link structure of web using HITS algorithms.
3. Analyze different Web caching Algorithm: LRV, FIFO, LRU etc.
4. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files
5. Implement the following file management tasks in Hadoop: i. Adding files and directories ii. Retrieving files iii. Deleting files Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities
6. Implement of Matrix Multiplication with Hadoop Map Reduce
7. Write a Map Reduce program that mines weather data. Hint: Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented
8. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
9. Implementation of K-means clustering using Map Reduce.
10. Installation of Hive along with practice examples.
11. Installation of HBase, Installing thrift along with Practice examples

Web Mining	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT	7	PCE	PCE-5	CIE-431T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the scope of Web mining, identifying the opportunities and the challenges
2.	To learn to apply different data mining/ML techniques in web mining
3.	To learn graph based representation of WWW
4.	To understand techniques for web crawling for web contents to build useful statistics like page ranking

Course Outcomes (CO)

CO 1	Understand the scope of Web mining, identifying the opportunities and the challenges
CO 2	Learn to apply different data mining/ML techniques in web mining
CO 3	Learn graph based representation of WWW
CO 4	Understand techniques for web crawling for web contents to build useful statistics like page ranking

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	-	-	-	-	-	-	-	-	-	2
CO 2	2	2	3	1	-	-	-	-	-	-	-	2
CO 3	2	2	2	-	-	-	-	-	-	-	-	2
CO 4	3	2	2	1	3	-	-	-	-	-	-	2

UNIT-I

World Wide Web – Data Mining Vs Web Mining – Data Mining Foundations: Association rules and Sequential Patterns – Machine Learning in Data Mining, Web Mining: Web Structure Mining, Web Content Mining, and Web Usage Mining. Web Structure Mining: Web Graph - Extracting pattern from hyperlinks – Mining Document Structure - PageRank.

UNIT-II

Web Content Mining: Text and Web Page Pre-processing – Inverted Indices – Latent Semantic Indexing – Web Spamming – Social Network Analysis – Web Crawlers – Structured Data Extraction – Opinion mining and Sentiment Analysis.

UNIT-III

Web usage Mining: Data collection and Pre-processing – Data Modelling – Discovery and Analysis of Web Usage

– Recommender System and Collaborative Filtering – Query log mining

UNIT – IV

Web Mining Applications and Other Topics: Data integration for e-commerce, Web personalization and recommender systems, Web content and structure mining, Web data warehousing, Review of tools, applications, and systems

Textbook(s):

1. Liu B. Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data. Springer Science & Business Media; 2007.

References:

1. Markov Z, Larose DT. Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage. John Wiley & Sons; 2007.
2. Web Mining:: Applications and Techniques by Anthony Scime
3. Mining the Web: Discovering Knowledge from Hypertext Data by Soumen Chakrabarti

Web Mining Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT	7	PCE	PCE-5	CIE-431P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Web Mining) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Implement Page Rank Algorithm in Web Mining
2. Analyze the link structure of web using page rank algorithms.
3. Text and webpage pre-processing
4. Social network analysis
5. Opinion mining
6. Sentiment analysis
7. Privatization of web content
8. Web usage mining
9. Recommender system
10. Web structure mining

Web Technologies	L	P	C
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-3	CIE-356T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To explain web application development with HTML and CSS
2.	Learn about scripting languages Java Script and JSP Technologies
3.	To Learn Server-side Development with PHP
4.	Develop web applications using PHP and MYSQL

Course Outcomes (CO)

CO 1	Identify and illustrate the basic concepts of HTML and CSS & apply those concepts to design web pages
CO 2	Understand various concepts related to dynamic web pages and validate them using JavaScript and JSP
CO 3	Outline and understand the concepts of PHP for Web Development
CO 4	Integrate PHP, MYSQL and Scripting languages for web applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1		3	-	-	-	2	-	2	-	-	3	2
CO 2		-	2	-	-	-	2	-	-	3	-	-
CO 3	-	-	-	2	3	-	-	3	-	-	2	-
CO 4	3	-	3	-	-	3	3	-	3	-	-	3

UNIT-I

HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, Html styles, Elements, Attributes, Heading, Layouts, I frames Images, Hypertext Links, Lists, Tables, Forms, Dynamic HTML.
CSS**:** Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors, and properties, manipulating texts, using fonts, borders, boxes, margins, padding lists, positioning using CSS, CSS2, The Box Model, Working with XML: Document Type Definition (DTD), XML schemas, Document object model, Parsers -DOM, and SAX. Introduction to XHTML: XML, Meta tags, Character entities, frames, and frame sets.

UNIT-II

JavaScript - Client-side scripting, Introduction to JavaScript, Objects, Primitives Operations and Expressions, Control Statements, Arrays, Functions, Constructors, JavaScript, and objects, JavaScript own objects, the DOM and web browser environments, forms and validations
Introduction to JSP**:** The Anatomy of a JSP Page, JSP Processing, Declarations, Directives, Expressions, Code

Snippets, implicit objects, Using Beans in JSP Pages, Using Cookies and session for session tracking, connecting to database in JSP

UNIT-III

Introduction to Server-Side Development with PHP, what is Server-Side Development, A Web Server's Responsibilities, Quick Tour of PHP, Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions.

UNIT – IV

PHP and MySQL: Basic commands with PHP examples, Connection to the server, creating a database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting the database, deleting data, and tables, PHP my admin and database bugs. Managing State, The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path, Cookies, Serialization, Session State.

Textbooks:

1. Web Technologies: A Computer Science Perspective, Jackson, Pearson Education India, 2007.
2. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson, 2013.

References:

1. Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech, 2009.
2. An Introduction to Web Design, Programming, 1st Edition, Paul S Wang, Sanda S Katila, Cengage Learning, 2003.
3. PHP and MySQL Web Development, Luke Welling, Addison Wesley

Web Technologies Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-3	CIE-356P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Web Technologies) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Design web pages for your college containing a description of the courses, departments, faculties, library etc, use href, list tags.
2. Write html code to develop a webpage having two frames that divide the webpage into two equal rows and then divide the row into equal columns fill each frame with a different background color.
3. Design a web page of your home town with an attractive background color, text color, an Image, font etc. (use internal CSS).
4. Use External, Internal, and Inline CSS to format college web page that you created.
5. Create HTML Page with JavaScript which takes Integer number as input and tells whether the number is ODD or EVEN
6. Create HTML Page that contains form with fields Name, Email, Mobile No, Gender , Favourite Colour and a button now write a JavaScript code to combine and display the information in textbox when the button is clicked and implement validation.
7. Create XML file to store student information like Enrolment Number, Name Mobile Number , Email Id.
8. Write a php script to read data from txt file and display it in html table (the file contains info in format Name: Password: Email)
9. Write a PHP Script for login authentication. Design an html form which takes username and password from user and validate against stored username and password in file.
10. Write PHP Script for storing and retrieving user information from MySql table.

    a. Design A HTML page which takes Name, Address, Email and Mobile No. From user (register.php)

    b. Store this data in Mysql database / text file.

    c. Next page display all user in html table using PHP (display.php)

Windows System Administration	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ITE	6	PCE	PCE-2	CIE-350

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	The course provides an insight in windows server 2022.
2.	The course provides the ability to install and configure windows server 2022.
3.	The course provides tools and techniques to administer users in windows server 2022.
4.	The course peeps in to data storage and virtualization techniques.

Course Outcomes (CO)

CO 1	Ablility to install windows 2022 server
CO 2	Ablilty to setup various services in windows 2022 server
CO 3	Ability to configure windows 2022 server and implement virtualization
CO 4	Ability to fine tune and trouble shoot windows server 2022

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	1	3	3	-	1	-	-	-	2
CO 2	3	2	2	1	3	3	-	1	-	-	-	2
CO 3	3	2	2	1	3	3	-	1	-	-	2	2
CO 4	3	2	2	1	3	3	-	1	-	-	3	2

UNIT-I

Introducing Windows Server and Installing Windows Server 2022: Getting Started with Windows Server, Getting to know computer networks, Exploring computer network components, Investigating computer network architectures, Getting to know IP addressing and subnetting, Exploring servers, Understanding a NOS, Understanding Windows Server, Introducing Windows Server 2022: An overview of Windows Server 2022, Installing Windows Server 2022: Understanding the installation of Windows Server 2022, Various Windows Server 2022 installation methods, Post-Installation Tasks in Windows Server 2022: Understanding devices and device drivers, Understanding the Windows Registry and its services, Understanding Windows Server initial configuration.

UNIT-II

Setting Up Windows Server 2022: Directory Services in Windows Server 2022, Understanding the Active Directory infrastructure, Understanding DNS, Understanding OUs and containers, Understanding accounts and groups, Exercise: installing the AD DS and DNS roles and promoting the server to a DC , Adding Roles to

Windows Server 2022: Understanding server roles and features, Understanding application servers, Understanding web services, Understanding Remote Access, Understanding file and print services, Understanding user rights, NTFS permissions, and share permissions, Exercise – installing the Web Server (IIS) and PDS roles.

UNIT-III

Configuring Windows Server 2022: Group Policy in Windows Server 2022, Understanding GP, Types of GP editors, Exercise – examples of GPOs for system administrators, Virtualization with Windows Server 2022: Understanding server virtualization, Getting to know Hyper-V Manager, Exercise – installing Hyper-V on Windows Server 2022, Storing Data in Windows Server 2022: Understanding storage technologies, Understanding RAID, Understanding disks.

UNIT – IV

Keeping Windows Server 2022 Up and Running: Tuning and Maintaining Windows Server 2022, Understanding server hardware components, Understanding performance monitoring, Understanding logs and alerts, Exercise – working with the Performance Logs & Alerts service, Updating and Troubleshooting Windows Server 2022: Understanding updates, Understanding the troubleshooting methodology, Understanding the startup process, Understanding business continuity, Exercise – using Event Viewer to monitor and manage logs.

Textbook(s):

1. Bekim Dauti, “Windows Server 2022 Administration Fundamentals”, Packt Publishing.

References:

1. Tom Carpenter, “Microsoft Windows Server Administration Essentials”, John Wiley & Sons.
2. Crystal Panek “Windows Server Administration Fundamentals”, Sybex.

Wireless Communication and Networks	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-NET	6	PC	PC	WMC-340T
EAE	6	WMC-EAE	WMC-EAE-1C	WMC-336T
IT	7	PCE	PCE-4	CIE-415T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To know the evolution, principles and architecture of cellular systems and various concepts associated with mobility management and network signaling
2.	To study design and operation of various 2G systems (GSM/GPRS/IS-95/UMTS).
3.	To know features and technical aspects of 3G/4G standards evolved from IMT 2000 vision.
4.	To know technical standards related to 4G, 5G, Bluetooth, Zigbee, NFC, WiMAX.

Course Outcomes (CO)

CO 1	Understand the evolution, principles and architecture of cellular systems and various concepts associated with mobility management and network signaling.
CO 2	Develop an understanding of design and operation of various 2G systems (GSM/GPRS/IS-95/CDMA).
CO 3	Analyze the features and technical aspects of 3G standards evolved from IMT 2000 vision
CO 4	Analyze the features and technical aspects of 4G, 5G, Bluetooth, Zigbee, NFC and WiMax standards

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	2	3	3	2	2	-	2	2	3	3
CO 2	3	1	2	2	2	2	3	-	3	2	2	3
CO 3	3	3	3	2	3	2	3	-	2	2	3	2
CO 4	3	3	3	3	3	3	2	-	2	3	3	2

UNIT I

Introduction To Wireless Communication Systems: Evolution of mobile radio communications; Overview of generations of cellular systems, comparison of various wireless systems.

Introduction to Personal Communication Services (PCS): PCS architecture, Mobility management, Networks signaling. A basic cellular system, multiple access techniques: FDMA, TDMA, CDMA.

Introduction to Wireless Channels and Diversity: Fast Fading Wireless Channel Modeling, Rayleigh/Ricean, Fading Channels, BER Performance in Fading Channels, Introduction to different modulation technique.

UNIT II

2G Networks: AMPS, ETACS, GSM: GSM Architecture, Mobility Management, Network signalling, mobile management, voice signal processing and coding, 2.5G Mobile Data Networks: Introduction to Mobile Data Networks, General Packet Radio Services (GPRS): GPRS architecture, GPRS Network nodes, EDGE, Mobile IP,CDMA IS-95: Spread Spectrum, Frequency and Channel Specifications, Forward and Reverse CDMA Channel, Near-Far Problem, Power Control, Spread Spectrum Systems Cellular Code Division Access Systems-Principle, Power Control, effects of multipath propagation on code division multiple access.

UNIT III

Third Generation (3G) Mobile Services: The Universsal Mobile Telecommunication System (UMTS) & CDMA 2000 standards, UMTS Network Architecture Release 99, UMTS Interfaces, UMTS Network Evolution, UMTS Channels, UMTS Time Slots.

UNIT IV

Evolution of Generations: Features of 4G (LTE & VoLTE), 5G, Bluetooth: Architecture, Feature, Frequency Band, Master-Slave, IEEE Standard, Zigbee: Architecture, Feature, Frequency Band, IEEE Standard, NFC: IEEE Standard, Architecture, Feature, IEEE 802.16 (WiMax): Standard Architecture, Spectrum Allocation, Overview of WiMAX PHY, MAC Layer, Scheduling services, UGS, rtPS, nrtPS, Best Effort (BE).

Textbook(s):

1. Raj Pandya, “Mobile & Personnel communication Systems and Services”, Prentice Hall India, 2001.
2. Theodore S. Rappaport, “Wireless Communication- Principles and practices,” 2nd Ed., Pearson Education Pvt. Ltd, 5th Edition, 2008.
3. Wireless Networks: Applications and Protocols, T.S Rappaport, Pearson Education.
4. Wireless Communication and Networks: 3G and Beyond, I. Saha Mishra, TMH Education

References:

1. T.L.Singhal “Wireless Communication”, Tata McGraw Hill Publication.
2. Jochen Schiller, “Mobile communications,” Pearson Education Pvt. Ltd., 2002.
3. Yi –Bing Lin & Imrich Chlamatac, “Wireless and Mobile Networks Architecture,” John Wiley & Sons, 2001.
4. Lee, W.C.Y., “Mobile Cellular Telecommunication”, 2nd Edition, McGraw Hill,1998.
5. Smith & Collins, “3G Wireless Networks,” TMH, 2007
6. Schiller, Jochen, “Mobile Communications”, 2nd Edition, Addison Wesley.

Wireless Communication and Networks Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-NET	6	PC	PC	WMC-340P
EAE	6	WMC-EAE	WMC-EAE-1C	WMC-336P
IT	7	PCE	PCE-4	CIE-415P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Wireless Communication and Networks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. An introduction to basic digital baseband communication through MATLAB® simulations
2. Simulate Bluetooth voice transmission to observe effect of AWGN and interference of 802.11b on transmission using MATLAB and Simulink.
3. Develop a mobile application for wireless technology using any wizards such as available on www.appypie.com or any other.
4. Simulate the line coding techniques using MATLAB and Simulink
5. Simulate the Binary amplitude shift keying using MATLAB and Simulink
6. Simulate the Binary phase shift keying using MATLAB and Simulink
7. Simulate the Quadrature phase shift keying using MATLAB and Simulink
8. Simulate the Delta Modulation using MATLAB and simulink.
9. Simulate the Adaptive delta Modulation using MATLAB and simulink.
10. Simulate the Direct sequence spread spectrum using MATLAB and Simulink
11. Simulate WSN node to determine position on node and blink LED using cupcarbon simulator and senscript.

Wireless Sensor Networks	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-342T
CSE-IoT	6	PC	PC	IOT-328T
EAE	6	IOT-EAE	IOT-EAE-2C	IOT-332T
EAE	6	ICB-EAE	ICB-EAE-2C	IOT-332T
EEE	7	PCE	PCE-4	EEE-415T
CSE-NET	7	PC	PC	NET-475T
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OECE-421T
EAE	7	NET-EAE	NET-EAE-5	NET-475T
OAE	7	ECE-OAE	ECE-OAE-4B	OECE-421T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To make students understand the basics of Wireless sensor Networks.
2.	To familiarize with learning of the Architecture of WSN.
3.	To familiarize with learning of the Architecture of WSN.
4.	To study the design consideration of topology control and solution to the various problems.

Course Outcomes (CO)

CO 1	Understand challenges and technologies for wireless networks.
CO 2	Understand architecture and sensors.
CO 3	Describe the communication, energy efficiency, computing, storage and transmission.
CO 4	Explain the concept of programming the in WSN environment.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2	1	2	1	-	-	-	-	3	3
CO 2	3	2	2	1	2	1	-	-	-	-	3	3
CO 3	3	2	2	1	2	1	-	-	-	-	3	3
CO 4	3	2	2	1	2	1	-	-	-	-	3	3

UNIT-I

Introduction: Mobile Ad-hoc Networks (MANETs), Introduction to Sensor Networks, Constraints and Challenges, Advantage of Sensor Networks, Applications of Sensor Networks. Architecture: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems, Network Architecture -Sensor Network Scenarios, Optimization Goals, Gateway Concepts.

UNIT-II

Networking Sensors: Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, classification of MAC protocols, MAC protocols for sensor network, location discovery, S-MAC, IEEE 802.15.4. Routing Protocols- Energy-Efficient Routing, Geographic Routing.

UNIT-III

Infrastructure Establishment: Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. Case study of WSN‟s for different applications.

UNIT – IV

Platform, Tool and Security: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators. Security issues in Sensor Networks. Future Research Direction.

Textbook(s):

1. Holger Karl and Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley.
2. Feng Zhao and Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier.
3. C.Siva Ram Murthy and B.S.Manoj, "Ad hoc Wireless Networks Architectures and Protocols", Pearson Education.

References:

1. Dr. Xerenium, Shen, Dr. Yi Pan , "Fundamentals of Wireless Sensor Networks", Theory and Practice",Wiley.
2. KazemSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks- Technology, Protocols, And Applications", John Wiley.

Wireless Sensor Networks Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-342P
CSE-IoT	6	PC	PC	IOT-328P
EAE	6	IOT-EAE	IOT-EAE-2C	IOT-332P
EAE	6	ICB-EAE	ICB-EAE-2C	IOT-332P
EEE	7	PCE	PCE-4	EEE-415P
CSE-NET	7	PC	PC	NET-475P
CSE-in-EA	7	OAE-CSE-EA	OAE-2	OECE-421P
EAE	7	NET-EAE	NET-EAE-5	NET-475P
OAE	7	ECE-OAE	ECE-OAE-4B	OECE-421P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Wireless Sensor Networks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction of Wireless sensor network applications and its simulation.
2. Network Simulator installation of wireless sensor network
3. Write TCL script for transmission between mobile nodes.
4. Write TCL script for sensor nodes with different parameters.
5. Generate tcl script for udp and CBR traffic in WSN nodes.
6. Generate tcl script for TCP and CBR traffic in WSN nodes.
7. Implementation of routing protocol in NS2 for AODV protocol.
8. Implementation of routing protocol in NS2 for DSR protocol.
9. Implementation of routing protocol in NS2 for TORA protocol.
10. Study other wireless sensor network simulators (Mannasim. Contiki.)