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| **Paper Code: BS103 / BS104** | **Paper: Applied Chemistry** | **L** | **T/P** | **C** |
| **PaperID: 99103 / 99104** |  | **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 examination question paper.
2. The first question 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 question will have a total weightage of 15 marks.
3. Apart from question 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.
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| **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** | **P005** | **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. [9 Hrs][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. [9 Hrs] [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. [9 Hrs] [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. [9 Hrs] [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 Dutta, New Age Int. PO 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. Chand and Co., 2012.
5. Engineering Chemistry by K.N. Jayaveera, G.V. Subba Reddy, and C. Ramachandariah, 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 by E.R. Nagarajan and S. Ramalingam, Wiley, 2017.