

CHEMISTRY OF MATERIALS

I Year B. Tech. I Semester
(Common to CIVIL, MECH, MECH (R&AI))

Course Code:

L	T	P	C
3	0	2	4

Course Outcomes: At the end of the Course the student shall be able to

CO1: Analyze the causes of corrosion and apply suitable corrosion control methods

CO2: Analyze water quality and determine suitable remedial measures for domestic and industrial use

CO3: Interpret the properties and applications of lubricants, cement and refractories.

CO4: Apply the knowledge of polymers and smart materials in relevant applications.

CO5: Explain sustainable fuels and fuel cell technology.

UNIT-I

(9 Hours)

CORROSION AND ITS CONTROL

Corrosion: Definition and types of corrosion: dry corrosion and electrochemical corrosion; Galvanic corrosion and Differential aeration corrosion; factors affecting corrosion.

Corrosion Control Methods- Proper design; cathodic protection methods, including sacrificial anode and impressed-current cathodic protection; electroplating and electroless plating.

Smart Corrosion Monitoring: Linear polarization resistance (LPR) for monitoring corrosion and assessing pipeline wall thickness and corrosion rates.

Learning Outcomes:

At the end of this unit, the student will be able to

1. Explain the types and causes of corrosion.
2. Describe methods for corrosion prevention and control.
3. Explain modern techniques for corrosion monitoring.

UNIT- II

(9 Hours)

WATER TREATMENT AND SUSTAINABLE WATER MANAGEMENT

Water Quality Parameters: Water quality parameters for industrial use: pH, alkalinity, hardness, total dissolved solids (TDS), dissolved oxygen (DO), chemical oxygen demand (COD), and biochemical oxygen demand (BOD). Municipal water treatment.

Industrial Boiler Troubles: Scale formation, sludge deposition, caustic embrittlement, and boiler corrosion.

Advanced Filtration Methods: Reverse osmosis (RO) and nanofiltration (NF).

Sustainable Water Management: Zero liquid discharge (ZLD) and green disinfection.

Learning Outcomes:

At the end of this unit, the student will be able to

1. Identify important water quality parameters.
2. Explain water treatment and boiler water problems.
3. Describe advanced and sustainable water treatment methods.

UNIT-III

(9 Hours)

ENGINEERING MATERIALS

Lubricants- Functions and classification of lubricants. Mechanisms of Lubrication: Hydrodynamic lubrication, boundary lubrication, and extreme- pressure lubrication.

Properties of Lubricants: Viscosity, flash point, fire point, cloud point, pour point, aniline point, and mechanical stability.

Cement: Portland cement: Constituents; manufacture of Portland cement; composition of Portland cement; chemistry of setting and hardening of cement; and heat of hydration of cement.

Refractories: Definition, classification, characteristics, and failure of refractories.

Learning Outcomes:

After completing this unit, students will be able to:

1. Classify lubricants and explain their mechanisms of lubrication.
2. Explain the manufacture and properties of cement.
3. Describe the types, properties and applications of refractories.

UNIT-IV

(9 Hours)

POLYMERS AND SMART MATERIALS

Polymers: Definition, classification, Polymerization methods: addition, condensation, copolymerization, effect of polymer structure on properties, effect of heat on polymers.

Plastics: Thermoplastic (recyclable), thermosetting(non-recyclable) plastics, plastic waste management - plastic to fuel conversion, construction materials and composite materials.

Conducting polymers: Preparation, properties and applications of Polyacetylene, polyaniline.

Smart Materials-Introduction, Characteristics and applications of Piezoelectric materials, Shape memory alloys (SMA), Electrochromic and Photochromic Materials.

Learning Outcomes:

After completing this unit, students will be able to:

1. Classify polymers and explain their polymerization methods.
2. Relate polymer structure and properties to engineering applications.
3. Explain the properties and applications of conducting and smart materials.

UNIT-V

(9 Hours)

FUELS AND FUEL CELLS

Fuels: Classification and characteristics of fuels; calorific value; conventional fuels and their environmental impacts: coal, petrol, diesel, LPG, and CNG.

Biofuels: Production, advantages, and limitations of biodiesel and bioethanol.

Hydrogen as a Fuel of the Future: Types of hydrogen based on their sources; challenges associated with hydrogen storage and transportation.

Fuel Cells: Electrochemical cells and their EMF; merits and demerits of fuel cells; construction and working principles of hydrogen–oxygen fuel cells, including alkaline fuel cells (AFCs) and polymer electrolyte membrane fuel cells (PEMFCs).

Learning Outcomes:

After completing this unit, students will be able to:

1. Classify fuels and explain their characteristics and environmental impact.
2. Explain the production and applications of biofuels and hydrogen.
3. Describe the working, advantages and limitations of fuel cells.

TEXT BOOKS:

1. Jain & Jain, "A text book of Engineering Chemistry", 17th Edition, Dhanapat Roy Publishing Company, 2023.
2. Sasichawla, "Engineering Chemistry", 9th Edition, Dhanapat Roy Publishing Company, 2013.

REFERENCE BOOKS:

1. S.S.Dara, "Engineering Chemistry", 12th Edition, S. Chand & Co, 2022.
2. M.M.Uppal, "Engineering Chemistry", 8th Edition, Khanna Publishers, 2020.
3. Concrete Technology by M.S. Shetty, S. Chand Publishing

LIST OF EXPERIMENTS**At the end of course the students will be able to:**

CO1: Determine water quality parameters using standard analytical methods.

CO2: Estimate metal ions in ores, cement, and steel samples

CO3: Evaluate the quality and properties of fuels and lubricants

CO4: Analyze coal and flue gases to assess fuel characteristics

CO5: Determine the viscosity and surface tension of lubricants

1. Preparation and standardization of solutions
2. Determination of Total hardness of a groundwater sample.
3. Determination of alkalinity of water sample.
4. Determination of ferrous iron in an iron ore sample
5. Determination of chloride by argentometric method.
6. Determination of Calcium in cement by gravimetry.
7. Testing of corrosion by weight loss method.
8. Determination of Flash and Fire points of a lubricant
9. Determination of carbon residue of Lubricant oil.
10. Determination of viscosity of a liquid by Redwood Viscometer.
11. Determination of surface tension of a liquid
12. Determination of Fe(III) in cement by spectrophotometry.

Reference Books:

1. N.K Bhasin and Sudha Rani, Laboratory Manual on Engineering Chemistry, 3rd edition, Dhanpat Rai & Sons, New Delhi, 2007.
2. A.I.Vogel, A Textbook of quantitative chemical analysis, 6th edition, Pearson Education Pvt. Ltd, 2002.