

ENGINEERING CHEMISTRY
With effect from 2020-21
 (Common for all branches)

Course Code - Category: 113/123

Credits:3
 Sessional Marks:40

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End Exam: 3 Hours

End Exam Marks:60

Course Objectives:

- To familiarize Engineering Chemistry and its applications
- To provide knowledge on problem associated with impure water and various treatment technologies
- To train the students on the principles and applications of electrochemistry,
- To introduce nano, smart and composite materials

Course Outcomes:

CO No.	Statement	Marks Allotted					
		Mid-1	Assign-	Assign-	CT/Quiz	CT/Quiz	Total Marks
CO-1	Identify the problems associated with raw water used in drinking & boilers and solve the problems by using ion exchange , desalination technologies for raw water treatment	15	10		10		35
CO-2	Select anodic and cathodic materials used in batteries/ cells based on concepts of electrode potentials to meet the demands of alternate energy sources	15		7	8		30
CO-3	Apply protective coatings or by modifying environment a metal or structure can be protected from corrosion	10		3	2		15
		Marks Allotted					
		Mid-2	Assign-	Assign-	CT/Quiz	CT/Quiz	Total Marks
CO-3	Apply protective coatings or by modifying environment a metal or structure can be protected from corrosion	10	3		3		16
CO-4	Predict the electrical conductivity of solids based on band theory and selection of ceramic materials for construction, furnace design	15	7		7	3	32
CO-5	Describe the principle and instrumentation of SEM and TEM used for characterisation of nanomaterials. Identify composite and smart materials for automobiles and sensor application, respectively.	15		10		7	32

CO-PO-PSO Mapping (Low-1, Medium-2, High-3)

PO/CO's	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	1				1	1	1	1			1		
CO2	2	1				1	2	1	1			1		
CO3	2	1				1	1	1	1			1		
CO4	2	1				1			1			1		
CO5	2	1				1	1		1			1		

SYLLABUS

UNIT I

12 Periods

Water Chemistry: Introduction- Impurities in water; Hardness of water – types of Hardness, units and calcium carbonate equivalents, problems, disadvantages of hard water; Boiler troubles- Scale & Sludge formation, prevention- Internal treatment - (Phosphate, Carbonate and Calgon conditioning) ,Caustic embrittlement

Water treatment techniques: Softening of water by ion exchange method- Principle, Process, advantages; Desalination of water – Reverse Osmosis and Eelectrodialysis; WHO standards for drinking water, Municipal water treatment - Sedimentation, Coagulation, Chlorination-Break point chlorination.

Learning Outcomes:

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

- **List** the differences between temporary and permanent hardness of water (L1)
- **Illustrate** the problems associated with hard water (L2)
- **Explain** the principles of reverse osmosis, electro dialysis and municipal water treatment processes (L2)
- **Solve** problems associated with hard water - scale and sludge (L3)

UNIT-II

10 Periods

Electrochemical cells: Electrode potential, Nernst equation, reference electrodes-SHE and Calomel electrode, Electrochemical series, Electrochemical cell, Cell potential; Primary cells – Dry cell, alkaline battery, hydrogen-oxygen, methanol fuel cells – working of the cells; Secondary cells – lead acid, lithium ion batteries- working of the batteries including cell reactions.

Solar Energy: Photovoltaic cell -Working & applications, Photo galvanic cells with specific examples

Learning Outcomes:

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

- **Apply** Nernst equation for calculating electrode and cell potentials (L3)
- **Explain** the theory and construction of battery and fuel cells (L2)
- **Identify** the applications of solar energy (L2)
- **Construct** different cells (L3)

UNIT – III

10 Periods

Corrosion Chemistry: Definition, Theories of corrosion-Chemical corrosion, metal oxide formation, Pilling Bedworth rule, Electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion; Factors affecting corrosion. **Prevention and control:** Protection- cathodic protection, Corrosion inhibitors, electroplating of Copper and electroless plating of Nickel, organic coatings-paint and varnish

Learning Outcome:

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

- **Apply** Pilling Bedworth rule for corrosion and corrosion prevention (L3)
- **Demonstrate** the corrosion prevention methods and factors affecting corrosion (L2)
- **Develop** the corrosion resistant materials for industrial and marine applications (L5)
- **Identify** different organic coatings (L3)

UNIT IV

10 Periods

Semiconducting Materials: Band theory of solids – band diagrams for conductors, semiconductors and insulators, Role of doping on band structures. Organic semiconductors and applications.

Ceramic Materials: Cement – raw materials, Manufacturing process, Setting and hardening of cement (hydration and hydrolysis equations); Refractories- classification; engineering applications of ceramics

Learning Outcome:

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

- **Explain** the manufacturing of portland cement (L2)
- **Enumerate** the reactions at different temperatures in the manufacture of cement (L2)
- **Describe** the mechanism of conduction in conducting polymers (L2)
- **List out** the applications of ceramics (L2)

UNIT V

10 Periods

Nanomaterials: Introduction to Nanomaterial- nanoparticles, nanocluster, carbon nanotube (CNT); Chemical synthesis of nanomaterials- sol-gel method; Characterization- Principle and applications of Scanning electron microscope (SEM) and Transmission electron microscope (TEM).

Polymer Composites: Definition, constituents of composites, types - Fiber Reinforced Plastics, Particulate composites, Layer composites, engineering applications of composites;

Smart polymers: Introduction, types of smart polymers and applications

Learning Outcome:

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

- **Classify** nanomaterials (L2)

- **Explain** the synthesis and characterisation of nanomaterials (L2)
- **Explain** the different types of composites and their applications (L2)
- **Identify** different types of smart materials (L2)

Prescribed Text Book

1. **P.C. Jain and M. Jain** “*Engineering Chemistry*”, 16th edition, - DhanapathiRai& Sons, Delhi, 2015.
2. **S.S. Dara** “*A text book of Engineering Chemistry*”, 15th edition, S. Chand& Co. New Delhi, 2014.

Reference books

1. **O.G.Palanna** “*Engineering Chemistry*” Tata McGraw Hill Education pvt ltd, New Delhi, 2009.
2. **V.Raghavan** “*A Material Science and Engineering*”, 5th edition, Printice Hall India Ltd, 2011.