

DEPARTMENT OF CHEMISTRY

2023-24

Subject title : APPLIED CHEMISTRY FOR ME, AE, IEM BRANCHES		
Subject Code : 22CHU102A	No. of credits: 3 : 0 : 1 (L-T-P)	No. of lecture hour per week : 3
Exam duration : 3 hours.	CIE + SEE = 50 + 50 = 100	Total No. of lecture hours : 40

Course Objectives:

To interconnect the acquaintance of Chemistry involved in Basics of Electrochemical cells, Corrosion and its control; renewable sources of energy; Polymers for Electronic materials; memory and display systems; sensors in instrumental analytical methods and water treatment; e-waste management; Nanomaterials and its application.

Syllabus:

Unit No.	Syllabus content	No. of hours
	<u>Unit I :Electrode Systems and Corrosion Science</u>	
1	<p>Electrodes and Cells – Introduction- Classification of electrochemical cells and concentration cells, numerical on concentration cells. ; Reference electrodes - Calomel electrode; Ion-selective electrodes - Glass electrode. Determination of pH using glass electrode.</p> <p>Corrosion - Definition, Electrochemical theory of corrosion, Types of corrosion - differential metal, differential aeration and stress corrosion; Factors affecting the rate of corrosion; Corrosion Penetration Rate (CPR) , numerical. Corrosion control: Inorganic coatings – anodizing and phosphating. Cathodic protection – Sacrificial anode, Impressed current method. Metal finishing - Introduction, technological importance; Electroplating – Chromium Plating; Electroless plating - Electroless plating of copper on PCB.</p> <p>Self-study: Galvanic series and its importance, Electroplating of Gold.</p>	8
	<u>Unit – II : Energy conversion and Storage</u>	
2	<p>Chemical fuels - Introduction, Calorific value - definition, gross and net calorific values; Determination of calorific value of a solid / liquid fuel using Bomb calorimeter and numerical on calorific value; Petroleum cracking - fluidized bed catalytic cracking; Knocking- Mechanism of Knocking in IC engine; Octane number and Cetane number; Reformation of petrol.</p> <p>Sustainable energy sources: Hydrogen as a fuel - advantages, production and storage. Biofuels- Production of Biodiesel. Solar cells - Construction and working of Si based PV cell, advantages and disadvantages.</p> <p>Electrochemical Energy Systems: Introduction to batteries, Classification of batteries - primary and secondary batteries; Battery characteristics; construction, working and applications of Sodium ion batteries.</p> <p>Self-study: Fuel cells and Zinc-Air, Li-Ion batteries</p>	8

3	<p style="text-align: center;"><u>Unit –III : Macromolecules for Engineering application</u></p> <p>Polymers - Polymerization – Classification- addition and condensation polymerization with examples: Free radical mechanism for the formation of polyvinyl chloride as an example, Introduction to Molecular weight - number average and weight average molecular weight, Polydispersion index and its significance, numerical problems; Glass transition temperature (T_g) –significance and factors affecting T_g, compounding of resins into plastics. Synthesis and applications- PMMA, Phenol-formaldehyde resin. Elastomers: Introduction, vulcanization of rubber. Synthesis and applications of neoprene and butyl rubber; adhesives: synthesis of epoxy resins. Conducting polymers: mechanism of conduction in polyacetylene and its applications. Biodegradable polymers - Introduction, Polyglycolic acid - synthesis, degradation and uses. Self-study: Polycarbonates, Recycling of PET.</p>	8
4	<p style="text-align: center;"><u>Unit – IV : Materials for Engineering Applications</u></p> <p>Alloys: Introduction, classification, composition, properties and applications of stainless steel, solders, brass, alnico and shape memory alloys. Glasses & Ceramics: Introduction, Properties & Types of glasses, Manufacture and application of glasses. Ceramics - classification based on chemical composition. Lubricants: Introduction, classification, properties and applications of lubricants. Nanomaterials - Introduction, size dependent properties (Surface area, Electrical, Optical, Catalytic and Thermal properties). Synthesis of nanomaterials: top-down and bottom-up approaches; Synthesis by sol-gel (ZrO₂), chemical vapor deposition methods (CNTs). Graphene by Hummer’s method – properties and applications. Self-Study: Abrasives</p>	8
5	<p style="text-align: center;"><u>Unit – V : Phase Rule, Water Treatment and Analytical Techniques</u></p> <p>Phase Rule – Gibbs phase rule; Concept of Phase component, degrees of freedom with examples; Numericals. Application of Phase rule to i) one component system - water system; ii) two component system - Pb-Ag system, Water treatment - Introduction, hardness of water, types, determination of hardness by EDTA method, disadvantages of hard water, removal of hardness by ion exchange method, Desalination of water – Electrodialysis. BOD and COD - introduction and their significance in waste water treatment, experimental determination of COD of waste water - numerical on hardness & COD. Analytical Techniques - Principle, Instrumentation and applications of Colorimetry (Copper), Potentiometry(FAS estimation), Conductometry (Acid Mixtures).\ Self-Study: Solid waste management.</p>	8

TEACHING AND LEARNING PROCESS	Chalk and talk method, power point presentation, Videos, Animations. Practical topic: Demonstration and Virtual Lab along with Performing experiments
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Course outcomes: On completion of the course, the student will have the ability to:		POs Mapped	Strength of mapping
CO1	Understand and explain the principles of chemistry involved in water treatment, corrosion, energy sources, polymers, Green chemistry and instrumental methods of analysis.	PO1	3
CO2	Apply the acquired knowledge to solve the Engineering Chemistry problems .	PO1 & PO2	3, 3
CO3	Examine the Engineering Chemistry problems and draw meaningful interpretations .	PO1, PO3 & PO4	3, 3, 2
CO4	Instrument solutions through concepts of Engineering Chemistry in the field of Energy and Environment.	PO1, PO3 & PO7	3, 2, 3
CO5	Engage in self-study and make an effective oral presentation on contribution of Engineering Chemistry to society.	PO1, PO6, PO9 & PO12	3, 1, 3, 3

MAPPING of COs with POs for Applied Chemistry

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3	3										
CO3	3		3	2								
CO4	3		2				3					
CO5	3					1			3			3
Strength of correlation: Low-1, Medium- 2, High-3												

REFERENCE:

- Principles of Physical Chemistry B.R.Puri, L.R.Sharma & M.S.Pathania,
- S.Nagin Chand & Co.
- Text Book of Polymer Science by F.W.Billmeyer, John Wiley & Sons
- Corrosion Engineering – by M.G.Fontana, Mc Graw Hill Publications.
- Environmental Chemistry by Stanley E. Manahan, 7th Edition, Lewis Publishers, 2000
- Engineering Chemistry by Dr Renu bapna, Macmillan publisher India limited
- Engineering Chemistry by Jayaprakash and Venugopal Subhash Publications.
- Nano Metal Oxides For Environmental Remediation. United Publications Dr. Jahagirdar A.A and Dr. Nagaswarupa H P.
- A Text Book of Engg. Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Ltd.
- Engineering Chemistry, Edited by Dr. Mahesh B and Dr. Roopashree B, Sunstar Publisher, Bengaluru, ISBN 978-93-85155-70-3, 2022.

Reference Books

- Wiley's Engineering Chemistry (Wiley India), 2nd Edition, 2013, 1026 pages.
- Engineering Chemistry, Satyaprakash & Manisha Agrawal, Khanna Book Publishing, Delhi
- A Text book of Engineering Chemistry, SS Dara & Dr. SS Umare, S Chand & Company Ltd., 12th Edition, 2011.

NPTEL/SWAYAM/MOOCs

- <http://nptel.ac.in/>
- <https://swayam.gov.in/>

Practical Module

Sl. No.	Syllabus content
<u>A – Compulsory Experiments:</u>	
1	Potentiometric estimation of Iron using std. $K_2Cr_2O_7$ (Electrochemical sensor).
2	Determination of pKa of a weak acid using glass electrode (pH sensor)
3	Conductometric estimation of mixture of strong and weak acid (conductometric sensors)
4	Estimation of copper in $CuSO_4$ by colorimetry (optical sensor).
5	Determination of viscosity coefficient of a given liquid using Ostwald's viscometer.
6	Estimation of total hardness of water by EDTA method.
7	Determination of COD of an industrial wastewater.
8	Estimation of percentage of copper in brass (analysis of alloy).
<u>B – Demonstration (offline/virtual)</u>	
1	Determination of Iron in the given sample of Haematite ore solution using $K_2Cr_2O_7$ crystals by external indicator method.
2	Synthesis of oxide nanoparticles.
<u>C – Open Ended Experiments:</u>	
1	Design an experiment to Identify the presence of proteins in given sample.
2	Determination of glucose by electrochemical sensors.

References Books:

1. Laboratory manual in Engineering Chemistry Sudharani, Dhanpatrai Publishing Company.
2. Vogel's Text Book of Quantitative Chemical Analysis revised by G.H.Jeffery, J.Bassett, J.Mendham and R.C Denney.

VIRTUAL LAB LINK DETAILS:

- <https://www.labster.com/chemistry-virtual-labs/>
- <https://youtu.be/OwZbw6Mhrqc>
- <https://youtu.be/UOLOsKZxi6Y>

HOD

Department of Chemistry