

DEPARTMENT OF CHEMISTRY

AY 2023-24

Subject title : APPLIED CHEMISTRY FOR EE, EC, ET, EI BRANCHES		
Subject Code : 22CHU102B	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	<u>Unit –III : Macromolecules for Engineering application</u>	8
	<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 (Tg) –significance and factors affecting Tg, 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.</p> <p>Self-study: Polycarbonates, Recycling of PET.</p>	
4	<u>Unit – IV : Nano Technology, Sensors and e-waste management</u>	8
	<p>Nano Technology: Introduction, size dependent properties of nanomaterials (Surface area, Catalytic, Conducting), preparation of nanomaterials by sol-gel (TiO₂), chemical vapour deposition (CVD) method (CNTs and GO by Hummer’s Method).</p> <p>Sensors: Introduction, Construction, working and applications of Conductometric sensors (Estimation of Acid Mixtures), Electrochemical sensors (Potentiometric estimation of FAS), Optical sensors (Colorimetric estimation of copper), Gas sensors.</p> <p>E-waste Management: Introduction, sources, types, effects of e-waste on environment and human health, methods of disposal, advantages of recycling. Extraction of gold from e-waste.</p> <p>Self-study: Micro-electromechanical system (MEMS), Nanoelectromechanical systems (NEMS).</p>	
5	<u>Unit – V : Electronic Materials and Display System</u>	7
	<p>Conductors, Semiconductors and Insulators: Introduction, Band theory and examples.</p> <p>Semiconductors: production of electronic grade silicon, Refining- Float Zone method and Czochralski process.</p> <p>Memory Devices: Introduction, concepts of electronic memory. Classification of electronic memory materials -organic/polymer electronic memory devices (organic molecules, polymeric materials, organic-inorganic hybrid materials).</p> <p>Display Systems: Liquid crystals (LC’s) - Introduction, classification, properties and application in Liquid Crystal Displays (LCD’s). Jablonski Diagram. Photoactive and electroactive materials, Light emitting electrochemical cells. Nanomaterials(QLED’s) and organic materials (OLED’s) used in optoelectronic devices.</p> <p>Self-study: Properties and functions of Silicon (Si), Germanium (Ge), Copper (Cu), Aluminum (Al), and Brominated flame retardants in computers.</p>	

TEACHING AND LEARNING PROCESS	Chalk and talk method, power point presentation, Videos, Animations. Practical topic: Demonstration and Virtual Lab along with Performing experiments
--------------------------------------	--

Course outcomes: On completion of the course, the student will have the ability to:	POs Mapped	Strength of mapping
--	-------------------	----------------------------

Dr AMBEDKAR INSTITUTE OF TECHNOLOGY
Autonomous Institute, Affiliated to VTU

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.
- 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