22CHEE22	Chemistry for EEE	(2-2-2) 4

Contact Hours: 40 Theory + 12 Lab Sessions

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- To enable students to acquire knowledge on principles of chemistry for engineering applications.
- To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
- To provide students with a solid foundation in analytical reasoning required to solve societal problems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12) / PSOs(13-16)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** the terms and processes involved in scientific and engineering applications.	1	-	2,3,7
CO-2	**Explain** the phenomena of chemistry to describe the methods of engineering processes.	1	-	2,3,7
CO-3	**Solve** for the problems in chemistry that are pertinent in engineering applications.	1	-	2,3,7
CO-4	**Apply** the basic concepts of chemistry to explain the chemical properties and processes.	1	-	2,3,7
CO-5	**Analyze** properties and processes associated with chemical substances in multidisciplinary situations.	1	-	2,3,7

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Mapping Level	3.0	1.0	1.0	-	-	-	1.0	-	-	-	-	-	-	-	-	-

Pre-requisites: Basics of Electrochemistry.

Contents:

Unit-I

Electrode System: Introduction, types of electrodes. Ion selective electrode – definition, construction, working and applications of glass electrode. Determination of pH using glass electrode. Reference electrode - Introduction, calomel electrode – construction, working and applications of calomel electrode.

Concentration cell – Definition, construction and Numerical problems.

Sensors: Introduction, working principle and applications of Conductometric sensors, Electrochemical sensors, Thermometric sensors, and Optical sensors.

Analytical Techniques: Introduction, principle and instrumentation of Colorimetric sensors; its application in the estimation of copper, Potentiometric sensors; its application in the estimation of iron, Conductometric sensors; its application in the estimation of weak acid.

Self-study: IR and UV- Visible spectroscopy. **8 Hrs**

Unit-II

Batteries: Introduction, classification of batteries. Components, construction, working and applications of modern batteries; Na-ion battery, solid state battery (Li-polymer battery) and flow battery (Vanadium redox flow battery).

Fuel Cells: Introduction, construction, working and applications of methanol–oxygen and polymer electrolyte membrane (PEM) fuel cell.

Solar Energy: Introduction, importance of solar PV cell, construction and working of solar PV cell, advantages and disadvantages.

Self-study: Li-ion battery, H_2-O_2 fuel cell **8 Hrs**

Unit-III

Corrosion Chemistry: Introduction, electrochemical theory of corrosion, types of corrosion-differential metal and differential aeration. Corrosion control - galvanization, anodization and sacrificial anode method. Corrosion Penetration Rate (CPR) - Introduction and numerical problems.

E-waste Management: Introduction, sources, types, effects of e-waste on environment and human health, methods of disposal, advantages of recycling. Extraction of copper and gold from e-waste.

Self-study: Recycling of PCB and battery components. **8 Hrs**

Unit-IV

Nanomaterials: Introduction, size dependent properties of nanomaterials (Surface area, Catalytic, Conducting), preparation of nanomaterials by sol-gel and co-precipitation method with example. Introduction, properties and applications - Nanofibers, Nanophotonics, Nanosensors.

Display Systems: Liquid crystals (LC's) - Introduction, classification, properties and application in Liquid Crystal Displays (LCD's). Properties and application of Organic Light Emitting Diodes (OLED's) and Quantum Light emitting diodes (QLED's).

Perovskite Materials: Introduction, properties and applications in optoelectronic devices.

Self-study Properties & electrochemical applications of carbon nano tubes and graphene. **8 Hrs**

Unit-V

Conductors and Insulators: Introduction, principle with examples.

Semiconductors: Introduction, production of electronic grade silicon- Czochralski process (CZ) and Float Zone (FZ) methods.

Polymers: Introduction, Molecular weight - Number average, Weight average and numerical problems. Conducting polymers – synthesis and conducting mechanism of polyacetylene. Preparation, properties and commercial applications of graphene oxide.

PCB: Electroless plating – Introduction, Electroless plating of copper in the manufacture of double-sided PCB.

Self-study: Technological importance of metal finishing and distinction between electroplating and electroless plating. **8Hrs**

PRACTICAL MODULE

A – Demonstration (any two) offline/virtual:

A1. Synthesis of polyurethane

A2. Determination of strength of an acid in Pb-acid battery.

A3. Synthesis of iron oxide nanoparticles

A4. Electroplating of copper on metallic objects.

B – Exercise (compulsorily any 4 to be conducted):

B1.Conductometric estimation of acid mixture

B2. Potentiometric estimation of FAS using $K_2Cr_2O_7$

B3. Determination of pKa of vinegar using pH sensor (Glass electrode)

B4. Determination of rate of corrosion of mild steel by weight loss method

B5.Estimation of total hardness of water by EDTA method

C – Structured Enquiry (compulsorily any 4 to be conducted):

C1. Estimation of Copper present in electroplating effluent by optical sensor (colorimetry)

C2. Determination of Viscosity coefficient of lubricant (Ostwald's viscometer)

C3. Estimation of iron in TMT bar by diphenyl amine/external indicator method

C4. Estimation of Sodium present in soil/effluent sample using flame photometry

C5. Determination of Chemical Oxygen Demand(COD) of industrial waste water sample

D – Open Ended Experiments (any two):

D1. Estimation of metal in e-waste by optical sensors.

D2. Electroless plating of Nickle on Copper

D3. Determination of glucose by electrochemical sensors

D4. Synthesis of polyaniline and its conductivity measurement

Reference Books:

1. A Text book of Engineering Chemistry, SS Dara & Dr. SS Umare, S Chand & Company Ltd., 12th Edition, 2011.
2. A Text Book of Engineering Chemistry, R.V. Gadag and Nityananda Shetty, I. K. International Publishing house. 2nd Edition, 2016.
3. Text Book of Polymer Science, F.W. Billmeyer, John Wiley & Sons, 4th Edition, 1999.
4. Nanotechnology A Chemical Approach to Nanomaterials, G.A. Ozin & A.C. Arsenault, RSC Publishing, 2005.
5. Corrosion Engineering, M. G. Fontana, N. D. Greene, McGraw Hill Publications, New York, 3rd Edition, 1996.
6. Linden's Handbook of Batteries, Kirby W. Beard, Fifth Edition, McGraw Hill, 2019.
7. OLED Display Fundamentals and Applications, Takatoshi Tsujimura, Wiley–Blackwell , 2012.
8. Principles of Instrumental Analysis, Douglas A. Skoog, F. James Holler, Stanley R. Crouch Seventh Edition, Cengage Learning, 2020.
9. Polymer Science, V R Gowariker, N V Viswanathan, Jayadev, Sreedhar, Newage Int. Publishers, 4th Edition, 2021.
10. Engineering Chemistry, P C Jain & Monica Jain, Dhanpat Rai Publication, 2015-16th Edition.
11. Chemistry for Engineering Students, B. S. Jai Prakash, R. Venugopal, Sivakumaraiah & Pushpa Iyengar., Subash Publications, 5th Edition, 2014
12. “Engineering Chemistry”, O. G. Palanna, Tata McGraw Hill Education Pvt. Ltd. New Delhi, Fourth Reprint, 2015.