Code: BCHEE102/202 **Course:** Chemistry for Electrical and Electronics Engineering stream

Credits:	**4**	**L: T:P 2:2:2/ 2:0:2**
SEE:	**100 Marks**	**CIE: 100 Marks**
SEE Hours:	**3**	**Max. Marks:100**

Prerequisites if any	**None**
Learning objectives	1. To impart a sound knowledge on the principles of chemistry involving the different applications-oriented topics required for Electrical & Electronics Engineering and Allied branches 2. To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Impart the knowledge of solid-state chemistry, metal finishing, developments in energy conversion and Storage devices.	Understand Apply
CO2	Apply the concepts of corrosion and its control, e-waste management and display systems for various engineering applications.	Understand Apply
CO3	Understand the principle and characteristics of Nanomaterials, Sensors, polymers, and analytical techniques for various engineering applications	Understand Apply
CO4	Perform accurate quantitative measurements and equipment handling to analyse the data and interpret the results to arrive at a conclusion.	Understand Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2					2					2	To be identified for each branch by Course Instructor			
CO2	3	2					2					2				
CO3	3	2					2					2				
CO4	3	2					2					2				

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module-1: Solid state chemistry and Metal finishing				
1.1	**Solid state chemistry:** Introduction, conductors, semiconductors, and insulators. Production of electronic grade silicon by Czochralski (CZ) process, Float Zone (FZ) method and semiconductor grade silicon by Chemical Vapor Deposition (CVD) and Epitaxy method.	2	-	-
1.2	Ion implantation - basic concepts and process. Properties of dielectrics in transmission systems. Applications of IGBT and MOSFET.	2	-	-
1.3	**Metal finishing:** Introduction, electroforming, electropolishing, electrochemical etching (Wet and Dry Chemical etching). Electroplating-Surface preparation, electroplating of nickel using Watt's bath and its applications.	2	-	-
1.4	Electroless plating- introduction, composition of bath and its advantages. Electroless plating of copper on PCB, difference between electroplating and electroless plating.	-	2	-
Module-2: Energy Conversion and Storage				
2.1	**Batteries:** Introduction, classification of batteries. construction, working and applications of lithium batteries (Li-MnO_2 and Li-ion battery), recycling of Li-ion batteries.	2	2	-
2.2	Construction, working and applications of Na-ion battery, and flow battery (Vanadium redox flow battery).	1	-	-
2.3	**Fuel Cells**: Introduction and classification of fuel cells. Construction, working and applications of methanol-oxygen fuel cell and polymer electrolyte membrane (PEM) fuel cell. Difference between batteries and fuel cells.	2	-	-
2.4	**Solar Energy:** Introduction, construction, working, applications, advantages, and disadvantages of PV cell.	1	-	-
Module-3: Corrosion Science and E-waste Management				
3.1	**Chemistry of corrosion:** Introduction, types and electrochemical theory of corrosion. Factors influencing the corrosion rate: Physical state of the metal, nature of the metal, area effect, pH, temperature, and nature of the corrosion product.	3	-	-
3.2	Types of corrosion - differential metal (Galvanic) corrosion and Differential aeration (Pitting) corrosion.	1	-	-
3.3	Corrosion control - Galvanization, Anodization, and Sacrificial anode method.	1	-	-
3.4	**E-waste Management:** Introduction, sources, types, effects of e-waste on environment and human health, methods of disposal, and advantages of recycling. Extraction of copper and gold from e-waste. Impact of heavy metals on environment and human health.	1	2	-
Module-4: Nanomaterial's and Display Systems				
4.1	**Nanomaterials:** Introduction, size dependent properties of nanomaterial's (surface area, catalytic, conducting and optical), preparation of nanomaterial's by sol-gel and co-precipitation method with example.	1	2	-
4.2	Introduction, properties, and applications of - nanofibers, nanophotonics, and nanosensors.	1	-	-
4.3	**Display Systems**: Liquid crystals (LC's) - Introduction, classification, properties, and application of Liquid Crystals in Displays (LCD's).	1	2	-
4.4	Properties and applications of Organic Light Emitting Diodes (OLED's) and	1	-	-

	Quantum Light Emitting Diodes (QLED's).			
Module-5: Sensors, Polymers and Analytical techniques				
5.1	**Sensors:** Introduction, working principle and applications of electrochemical sensors, thermometric sensors, optical sensors, and smart sensors.	1	2	-
5.2	**Polymers:** Introduction, methods of polymerization (Bulk, solution, suspension and emulsion), Determination of molecular weight of polymers by number average and weight average method.	2	-	-
5.3	**Conducting polymers** - Synthesis and conducting mechanism of Polyacetylene. Preparation, properties, and commercial applications of Teflon and Polyurethane.	1	-	-
5.4	**Analytical Techniques**: Introduction, principle, working and applications of Colorimetry (estimation of copper in PCB effluent), Potentiometry (estimation of iron/FAS), Conductometry (estimation of acid and acid mixtures), pH meter (determination of pH/p^{Ka} of vinegar using glass electrode).	-	2	-
List of Experiments:				
1	D1. Quantitative estimation of copper in brass	-	-	2
2	D2. Determination of strength of an acid in Pb-acid battery	-	-	2
3	D3. Synthesis of iron oxide nanoparticles	-	-	2
4	D4. Electroplating of copper on metallic objects	-	-	2
5	E1. Conductometric estimation of acid mixture	-	-	2
6	E2. Potentiometric estimation of FAS using $K_2Cr_2O_7$	-	-	2
7	E3. Determination of pKa of vinegar using pH sensor (Glass electrode)	-	-	2
8	E4. Estimation of total hardness of water by EDTA method	-	-	2
9	S1. Estimation of Copper present in electroplating effluent by optical sensor (colorimetry)	-	-	2
10	S2. Determination of Viscosity coefficient of lubricant (Ostwald's viscometer)	-	-	2
11	S3. Estimation of iron in TMT bar by diphenyl amine/external indicator method	-	-	2
12	S4. Determination of Chemical Oxygen Demand (COD) of industrial wastewater sample	-	-	2
13	O1. Estimation of metal in e-waste by optical sensors	-	-	2
14	O2. Electroless plating of Nickle on Copper	-	-	2
15	O3. Determination of glucose by electrochemical sensors	-	-	2
16	O4. Synthesis of polyaniline and its conductivity measurement	-	-	2
	Total No. of Lecture Hours	**26**		
	Total No. of Tutorial Hours		**14**	**-**
	Total No. of Practical Hours			**10/16**

Self-learning topics:

1. Technological importance of metal finishing
2. Construction, working and applications of H_2–O_2 Fuel cell.
3. Cathodic protection by impressed current method.
4. Methods of polymerisation
5. Biomedical applications of nanomaterials

Textbooks:

1. A Text book of Engineering Chemistry, R.V. Gadag and Nityananda Shetty, I. K. International Publishing house. 2nd Edition, 2016.
2. Engineering Chemistry, Edited by Dr. Mahesh B and Dr. Roopashree B, Sunstar Publisher, Bengaluru, ISBN 978-93-85155-70-3, 2022.

3. Textbook of Engineering Chemistry by Dr. K. Pushpalatha, published by Wiley publications 2nd edition.
4. A textbook of Engineering Chemistry 15th Edition by P. C. Jain and Monica Jain, Dhanpat Rai Publishing Co (P) Ltd., New Delhi.

Reference Books:

1. Principles of Physical Chemistry by B.R. Puri, L.R. Sharma and M.S. Pathania, S. Nagin Chand and Co.
2. Textbook of Physical Chemistry by Soni and Dharmatha, S. Chand & Sons.
3. Textbook of Polymers science by Gowarikar and Vishwanathan.
4. Corrosion Engineering by M.G. Fontana, Mc Graw Hill Publications.

Online Resources:

1. http://libgen.rs/
2. https://nptel.ac.in/downloads/122101001/
3. https://nptel.ac.in/courses/104/103/104103019/
4. https://ndl.iitkgp.ac.in/
5. https://www.youtube.com/watch?v=faESCxAWR9k