22CHEC12	Chemistry for Civil	(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. Reference electrode - Introduction, calomel electrode – construction, working and applications of calomel electrode. Ion selective electrode – definition, construction, working and applications of glass electrode. Determination of pH using glass electrode.

Concentration cell– Definition, construction and Numerical problems..

Energy conversion: Introduction, construction, working, and applications of Photovoltaic cells, methanol-oxygen fuel cell.

Storage devices: Introduction, construction and working of Li-ion battery.

Self-study: Nernst equation, Galvanic cell **8 Hrs**

Unit-II

Water technology: Introduction, water parameters, hardness of water, determination of temporary, permanent and total hardness by EDTA method, numerical problems, softening of water by ion exchange method, desalination of water by electrodialysis, determination of COD, numerical problems. Forward osmosis: Introduction, Process and applications.

Nanotechnology: Introduction, size dependent properties of nanomaterial (surface area and catalytic), Synthesis of nanomaterial by sol-gel method and co-precipitation method.

Nano materials: Introduction, properties and engineering applications of carbon nanotubes, graphene and nanomaterials for water treatment (Metal oxide).

Self-study: Sewage treatment (Primary, secondary and tertiary) **8 Hrs**

Unit-III

Polymer: Introduction, methods of polymerization, molecular weight of polymers, numerical problems. Synthesis, properties and engineering applications of polyethylene (PE) and Chlorinated polyvinyl chloride (CPVC).

Fibers: Synthesis, properties and applications of polypropylene and nylon fibers.

Polymer composites: Introduction, properties and applications of fiber reinforced polymers composites (FRPC).

Geo polymer concrete: Introduction, synthesis, constituents, properties and applications.

Adhesives: Introduction, properties and applications of epoxy resin.

Biodegradable polymers: Synthesis of polylactic acid (PLA) and their applications.

Self-study: Biopolymers Introduction, structural properties, and applications of cellulose and lignin. **8 Hrs**

Unit-IV

Phase rule: Introduction, Definition of terms: phase, components, degree of freedom, phase rule equation. Phase diagram: Two component-lead-silver system..

Corrosion: Introduction, electrochemical corrosion of steel in concrete, types (differential metal and aeration), Stress corrosion in civil structures, corrosion control (design and selection of materials, galvanization, and anodization and sacrificial anode method).

Analytical Techniques: Optical sensors and its application in the estimation of beverages. pH sensors and its application in the determination of soil sample.

Self-study: Corrosion inhibitors, Factors affecting corrosion. **8 Hrs**

Unit-V

Metals and Alloys: Introduction, Properties and application of Iron and its alloys, Aluminium and its alloys

Cement: Introduction, composition, properties, classification, manufacturing process of cement, process of setting and hardening of cement, additives for cement and testing of cement.

Refractories: Introduction, classification based on chemical composition, properties and application of refractory materials.

Glass: Introduction, Composition, Types, Preparation of Soda-lime glass, properties and applications of glass.

Self-study: Chemistry of reinforced concrete from various sources of water (seawater, groundwater, treated water). **8 Hrs**

PRACTICAL MODULE

A – Demonstration (any two) offline/virtual:

A1. Synthesis of polyurethane

A2. Quantitative estimation of Aluminium by precipitation method.

A3. Synthesis of iron oxide nanoparticles.

A4. Determination of chloride content in the given water sample by Argentometric method

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. Gravimetric estimation of gypsum in Portland cement

D2. Electroplating of desired metal on substrate

D3. Estimation of manganese dioxide in pyrolusite

D4. Analysis of cement for its components

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.