Code: BCHEC102/202 **Course:** Applied Chemistry for Civil Engineering Stream

Credits: 4 **L:T:P 2:2:2**

SEE: 100 Marks **CIE: 100 Marks**

SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	
Learning objectives	1. To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for relevant engineering 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	Explain basic concepts of energy storage and energy conversion devices, solar cells. Understand the principles of corrosion and corrosion control.	Understand Apply
CO2	Understand the principles of water analysis and concept of phase rule.	Understand Apply
CO3	To understand and apply the concepts of polymers, structural materials and nano materials.	Understand Apply
CO4	To understand and apply the concept of analytical techniques in various technological applications	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 Structural material				
1.1	**Metals and alloys:** Introduction, properties and applications of Iron and its alloys, Aluminum, and its alloys.	2	-	-
1.2	**Cement:** Introduction, composition, properties, classification, manufacturing process of cement, process of setting and hardening of cement, additives for cement and testing of cement.	2	2	-
1.3	**Glass:** Introduction, composition, types, preparation of soda–lime glass, properties, and applications of glass.	2	-	-
Module - 2 Storage and energy conversion devices, corrosion				
2.1	**Storage devices:** Introduction, construction and working of Li-ion battery.	1	-	-
2.2	**Energy conversion:** Introduction, Fuel cell- classification, comparison with battery, construction, working and applications of methanol - oxygen fuel cell. construction, working and applications of photovoltaic cells.	2	-	-
2.3	**Corrosion:** Introduction, electrochemical corrosion of steel in concrete, types: differential metal corrosion (galvanic corrosion) and differential aeration corrosion (pitting corrosion), seasonal cracking of brass in the presence of ammonia, stress corrosion in civil structures, corrosion control. (i) design and selection of materials. Cathodic protection - sacrificial anode method and impressed current method. Corrosion inhibitors (Cathodic and anodic with examples)	3	2	-
Module – 3 Water technology and Nanotechnology				
3.1	**Water technology:** Introduction, water parameters, hardness of water, determination of hardness by EDTA method - numerical problems, desalination of water by electrodialysis, determination of COD of water effluent -numerical problems. Sewage treatment (Primary, secondary and tertiary).	2	2	-
3.2	**Nanotechnology:** Introduction, size dependent properties of nanomaterials (surface area and catalytic), synthesis of nanomaterial by sol – gel method and co-precipitation method. Nanomaterials for water treatment (metal oxide).	2	2	-
Module – 4 polymer and composites				
4.1	**Polymer:** Introduction, methods of polymerization (Bulk, solution, suspension, and emulsion), molecular weight of polymers-numerical problems (number average and weight average methods). Synthesis, properties, and engineering applications of polyethylene (PE) and polyvinylchloride (PVC).	2	2	-
4.2	**Fibers:** Synthesis, properties and applications of polypropylene and nylon fibers.	1	-	-

4.3	**Geo polymer concrete:** Introduction, synthesis, constituents, properties, and applications. **Adhesives:** Introduction, properties, and applications of epoxy resin.	2	-	-
4.4	**Biodegradable polymers:** Synthesis of polylactic acid (PLA) and their applications.	1	-	-
	Module – 5 Phase rule and Analytical techniques			
5.1	**Phase rule:** Introduction, definition of terms: phase, components, degree of freedom, phase rule equation. Condensed phase rule, phase diagram: Two component-lead-silver system, de-silverisation of Pb.	1	2	-
5.2	**Analytical techniques:** Introduction, Potentiometry: principle, instrumentation, and application in the estimation of iron, Conductometry: principle and its application in the estimation of acid mixture, pH - sensors and its application in the determination of soil sample.	3	2	-
	List of Experiments:			
1	D1. Synthesis of polyurethane.	-	-	2
2	D2. Quantitative estimation of Aluminium by precipitation method.	-	-	2
3	D3. Synthesis of iron oxide nanoparticles.	-	-	2
4	D4. Determination of chloride content in the given water sample by Argentometric method	-	-	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 method.	-	-	2
12	S4. Determination of chemical oxygen demand (COD) of industrial waste water sample.	-	-	2
13	O1. Gravimetric estimation of gypsum in Portland cement.	-	-	2
14	O2. Electroplating of desired metal on substrate.	-	-	2
15	O3. Estimation of manganese dioxide in pyrolusite.	-	-	2
16	O4. Analysis of cement for its components.	-	-	2
17	O5. Estimation of percentage of iron in steel.	-	-	2
	Total No. of Lecture Hours	**26**	-	-
	Total No. of Tutorial Hours		**14**	-
	Total No. of Practical Hours			**10/17**

Self-learning topics identified: (Maximum of 5 topics)

1. Refractories: Classification based on chemical composition, properties and applications of refractory materials.
2. Metal coatings- galvanization and tinning.
3. Forward osmosis: Process and applications.
4. Polymer composites: Properties and applications of fiber reinforced polymers composites (FRPC).
5. Colorimetry: Principle and its application in the estimation of the copper.

Textbooks:

1. A Textbook of Engineering Chemistry, R.V. Gadag and Nityananda shetty, I.K. International Publishing house, 2nd Edition, 2016.
2. Textbook of engineering chemistry by Dr. K. Pushpalatha, published by wiley publications, 2nd edition.
3. Engineering Chemistry, Edited by Dr. Mahesh B and Dr. Roopashree B, Sunstar Publisher, Bengaluru, ISBN 978-93-85155-70-3, 2022.
4. A text book 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