Civil Engineering

Course Title:	Applied Chemistry for Civil Engineering		
Course Code:	23CHEC22	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03+02
Total Hours of Pedagogy	40 hours Theory + 10 to12 Lab slots	Credits	04

Course objectives

- To enable students to acquire knowledge on principles of chemistry for engineeringapplications.
- To develop an intuitive understanding of chemistry by emphasizing the relatedbranches of engineering.
- To provide students with a solid foundation in analytical reasoning required to solvesocietal problems.

Teaching-Learning Process

These are sample strategies, which teacher can use to accelerate the attainment of thevarious course outcomes and make Teaching–Learning more effective

- Tutorial & remedial classes for needy students (not regular T/R)
- Conducting Makeup classes / Bridge courses for needy students
- Demonstration of concepts either by building models or by industry visit
- Experiments in laboratories shall be executed in blended mode (conventional or non–conventional methods)
- Use of ICT – Online videos, online courses
- Use of online platforms for assignments / Notes / Quizzes (Ex. Google classroom)

MODULE 1: Electrode and Energy conversion System (8hr)

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

Energy Conversion Systems: Introduction to batteries, construction, working and applications of Lithium ion. Construction, working and applications of photovoltaic cells. Quantum Dot Sensitized Solar Cells (QDSSC's)-Principle, Properties and Applications.

Self-learning: Working of glass electrode, Silver-Silver chloride electrode Sodium ion batteries.

MODULE 2: Water and Green Chemistry (8hr)

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

Green Chemistry: Introduction, definition, Major environmental pollutants, Basic principles of green chemistry, Synthesis of organic compound Adipic acid and Paracetamol by green route.

Self-learning: Sewage treatment (Primary, secondary and tertiary), Biocatalysed reactions.

Module-3:Polymer and its Composites (8 hr)

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

Fibers: Synthesis, properties and applications of 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-learning: Biopolymer: Introduction, structural properties, and applications of cellulose and lignin.

MODULE 4: Structural Materials and Analytical Techniques (8hr)

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.

Analytical Techniques: Introduction, principle and instrumentation of Conductometry; its application in the estimation of weak acid. Potentiometry; its application in the estimation of iron.

Self-learning: Chemistry of reinforced concrete from various sources of water (seawater, groundwater, treated water).

MODULE 5: Chemistry of E-Waste & its Management (8hr)

E-Waste: Introduction, sources of e-waste, Composition, Characteristics, and Need of ewaste management. Toxic materials used in manufacturing electronic and electrical products, health hazards due to exposure to e-waste. Recycling and Recovery: Different approaches of recycling (separation, thermal treatments, hydrometallurgical extraction, pyro metallurgical methods, direct recycling). Extraction of gold from E-waste. Role of stake holders in environmental management of e-waste (producers, consumers, recyclers and statutory bodies).

Self-learning: Impact of heavy metals on environment and human health.

NOTE: RBT LEVELS FOR ALL MODULES L1, L2 & L3

PRACTICAL MODULE

A – Demonstration (any two) offline/virtual:

A1. Chemical Structure drawing using software: ChemDraw or ACD/ChemSketch

A2. Determination of strength of an acid in Pb-acid batteryA3.

Determination of EMF Measurement of Cell.

A4. Electrolysis of water

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: Evaluation of acid content in beverages by using pH sensors and simulation.

D2. Construction of photovoltaic cell.

D3. Design an experiment to Identify the presence of proteins in given sample.

D4. Searching suitable PDB file and target for molecular docking.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1.	Identify the terms and processes involved in scientific and engineering applications.
CO2.	Explain the phenomena of chemistry to describe the methods of engineeringprocesses
CO3.	Solve for the problems in chemistry that are pertinent in engineering applications
CO4.	Apply the basic concepts of chemistry to explain the chemical properties and processes
CO5.	Analyze properties and processes associated with chemical substances in multidisciplinary situations

Assessment Details (both CIE and SEE)

Evaluation Type		Component	Max. Marks	Marks reduced to	Min. Marks	Evaluation Details
Theory Component	Internal Assesment Tests(IAT)	IAT-1	**25**	**15**	**10**	**Average of two IAT's Scaled down to 15 marks**
		IAT-2	**25**			
	Comprehensive Continuous Evaluation(CCE)	CCE-1	**10**	**10**		**Any two Assessment methods as per 22OB4.2 of regulation, Average of two CCE's scaled down to 10 marks**
		CCE-2	**10**			
	Total CIE - Theory			**25**	**10**	**Scale down marks of IAT and CCE to 25**
Laboratory Component	Practicals and lab record	-	**15**	**25**	**10**	**Conduction of Experiments and preparation of Lab records, etc.**
	Lab test	50	**10**			**One test to be conducted after the completion of all lab experiments.**
Total CIE - Practical				**25**	**10**	**40**
Total CIE – (Theory + Lab)				**50**	**20**	
SEE			**100**	**50**	**18**	**Conducted for 100 marks and scaled down to 50.**
CIE + SEE				**100**	**40**	

The minimum marks to secured in CIE to appear for SEE shall be 10(40% of maximum marks: 25) In theory component and 10(40% minimum marks:25) in the practical component. The laboratory Component of the IPCC/Integrated course shall be for CIE only. However, in SEE, the question from The laboratory component shall be included in the question paper.

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

1. Wiley Engineering Chemistry, Wiley India Pvt. Ltd. New Delhi, 2013- 2nd Edition.
2. Nanotechnology A Chemical Approach to Nanomaterials, G.A. Ozin & A.C. Arsenault, RSCPublishing, 2005.
3. Corrosion Engineering, M. G. Fontana, N. D. Greene, McGraw Hill Publications, New York, 3rd Edition, 1996.
4. Polymer Science, V R Gowariker, N V Viswanathan, Jayadev, Sreedhar, Newage Int. Publishers,4th Edition, 2021
5. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma & M.S. Pathania, S. Nagin Chand & Co., 41 Edition, 2004.

Web links and Video Lectures (e-Resources):

- https://ndl.iitkgp.ac.in/
- https://www.youtube.com/watch?v=faESCxAWR9k
- https://www.youtube.com/watch?v=TBqXMWaxZYM&list=PLyhmwFtznRhuz8L1bb3X-9IbHrDMjHWWh
- https://www.youtube.com/watch?v=j5Hml6KN4TI
- https://www.youtube.com/watch?v=X9GHBdyYcyo
- https://www.youtube.com/watch?v=1xWBPZnEJk8
- https://www.youtube.com/watch?v=wRAo-M8xBHM

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- https://www.vlab.co.in/broad-area-chemical-sciences
- https://demonstrations.wolfram.com/topics.php
- https://interestingengineering.com/science

COs and POs Mapping (Individual teacher has to fill up)

PO											
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1				1					
CO2	3	1	1				1					
CO3	3	1	1				1					
CO4	3	1	1				1					
CO5	3	1	1				1					
Average	3	1	1				1					