



R R Institute of Technology

PKM EDUCATIONAL TRUST®
RAJA REDDY LAYOUT, NEAR CHIKKABANAVARA RAILWAY STATION, CHIKKABANAVARA, BENGALURU - 560090

An Autonomous Institution under VTU
Approved by AICTE, New Delhi & Government of Karnataka



Course Title:	Chemistry for Civil Engineering Stream	Semester	I/II
Course Code:	BCHEC102/202	CIE Marks	50
CourseType(Theory/Practical /Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory+10to12 Lab slots	Credits	04

Course Learning Objectives

- CLO1.** To enable students to acquire knowledge on principles of chemistry for engineering applications.
- CLO2.** To develop an intuitive understanding of chemistry by emphasizing the related branches of Engineering.
- CLO3.** To provide students with a solid foundation in analytical reasoning required to solve societal Problems.

Teaching-Learning Process

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

Module-1: Structural Materials (8hours)

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

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 applications of refractory materials.

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

Applications: Construction of aircraft, industries, medical equipment, manufacturing and military (RBT Levels: L1, L2 and L3)

Module-2: Energy Conversion and Storage, Corrosion (8hours)

Self-study: Corrosion inhibitors, Electrodes for electrostatic double layer capacitors, pseudocapacitors, and Hybrid capacitor

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

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

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, anodization and sacrificial anode method), Corrosion penetration rate (CPR)-numerical problems

Applications: Access to lower priced electricity, Retention of surplus self-generated electricity, Emergency power supply

(RBT Levels: L1, L2 and L3)

Module-3: Water Technology and Nanomaterials (8hours)

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

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.

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

Applications: Treatment of impurities in water, sensors, medical tools and therapies (RBT Levels: L1, L2 and L3)

Module-4: Polymers and Composites (8hours)

Self-study: Structural properties and applications of cellulose and lignin

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.

Bio-degradable polymers: Synthesis of Poly Lactic acid (PLA) and their applications

Applications: Marine, civil, aerospace, biomedical

(RBT Levels: L1, L2 and L3)

Module-5: Phase Rule and Analytical Techniques (8 hours)

Self-study: Chromatographic technique, application of chromatography (column and thin-layered chromatography) in the separation of components

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

Analytical techniques: Introduction, principle, instrumentation of Potentiometric sensors and its application in the estimation of iron, Optical sensors and its application in the estimation of the beverages, Numerical on Beer-Lambert's law, pH-sensors and its application in the determination of soil sample.

Applications: Television set, Computer monitors, Medical monitors, Smartphone displays, Video walls.

(RBT Levels: L1, L2 and L3)

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. Estimation of sulphate content in the given cement solution by gravimetric method

D2. Electroplating of desired metal on substrate

D3. Estimation of manganese dioxide in pyrolusite

D4. Estimation of percentage of copper in the brass sample by Iodometric method.

Course outcome

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

1. Classify Engineering materials and apply its knowledge to select suitable materials for specific

application.

2. Explain the phenomena of chemistry to describe the methods of engineering processes
3. Solve the problems in chemistry that are pertinent in engineering applications
4. Apply the basic concepts of chemistry to explain the chemical properties and processes
5. Analyze properties and multi processes associated with chemical substances in disciplinary situations

Course Assessment and Evaluation Details (both CIE and SEE)

Continuous Internal Evaluation: 50 marks		
Theory Assessment Tool	Marks	Reduced marks
IAT-1	25	15
IAT-2	25	
Assessment -1(activity based)	25	10
Assessment -2(activity based)	25	
Lab Assessment Tool	Marks	Reduced marks
Conducting Experiment and Laboratory Record(10 labs)	15(each lab)	15
Lab Test	10	10
Semester End Examination (SEE) : 50 marks		
SEE	Marks	Reduced marks
Course end examination (Answer any one question from each unit – Internal choice)	100	50

Activity Based Learning/ Practical Based learning

Suggested activities are:

1. List out various alloys, their composition, properties and applications
2. Construction and working of Zn-Air Battery.
3. Determination of Molecular weight of the polymer by viscosity method
4. Manufacturing of epoxy based polymer composites using natural fiber
5. Synthesis of ZnO nano particles by precipitation method
6. Estimation of Total Dissolved Solids of water using conductometric sensor.
7. Estimation of λ_{\max} and Molar absorption Coefficient (ϵ)
8. Identifying the possibilities of various types of alkalinities in a given water sample.
9. Estimation of gypsum in the given cement sample.
10. Boiler troubles: Causes and remedial actions.

Suggested Learning Resources:

Text Books:

1. Wiley Engineering Chemistry, Wiley India Pvt. Ltd. New Delhi, 2013-2nd Edition.
2. Engineering Chemistry, Satyaprakash & Manisha Agrawal, Khanna Book Publishing, Delhi
3. A Text Book of Engg. Chemistry, Shashi Chawla, Dhanpat Rai & Co.(P)Ltd.
4. Engineering Chemistry, Baskar, Wiley
5. A Text Book of Engineering Chemistry, R.V.Gadag and Nityananda Shetty, I.K. International Publishing house. 2nd Edition, 2016. Instrumental Methods of Analysis, Dr. K .R. Mahadik and Dr. L. Sathiyarayanan, Nirali Prakashan, 2020
6. Engineering Chemistry, Edited by Dr. Mahesh B and Dr. Roopashree B, Sunstar Publisher, Bengaluru, ISBN 978-93-85155-70-3, 2022
7. Chemistry for Engineering Students, B.S. JaiPrakash, R.Venugopal, Sivakumaraiah & Pushpa Iyengar., Subash Publications, 5th Edition, 2014
8. "Engineering Chemistry", O.G.Palanna, Tata McGraw Hill Education Pvt. Ltd. New Delhi, Fourth Reprint, 15.

Reference Books:

- 1.Principles of Instrumental Analysis, Douglas A. Skoog, F.James Holler, Stanley R. Crouch Seventh Edition, Cengage Learning, 2020
- 2.Polymer Science, VR Gowariker, NV Viswanathan, Jayadev, Sreedhar, NewageInt.Publishers,4th Edition, 2021
3. Engineering Chemistry, PC Jain & Monica Jain, Dhanpat Rai Publication, 2015-16th Edition.
- 4.Nano structured materials and nanotechnology, Hari Singh, Nalwa, academic press, 1stEdition,2002.
- 5.Nanotechnology Principles and Practices, Sulabha K Kulkarni, Capital Publishing Company, 3rd Edition 2014
25. Principles of nanotechnology, Phanikumar, Scitech publications,2nd Edition,2010.
- 6.Nanotechnology A Chemical Approach to Nanomaterials, G.A.Ozin & A.C.Arsenault, RSC Publishing, 2005 .
- 7.Corrosion Engineering, M.G.Fontana, N.D.Greene, McGrawHill Publications, NewYork,3rd Edition,1996. Corrosion Engineering, M.G. Fontana, N.D. Greene, McGraw Hill Publications, New York, 3rd Edition, 1996.
8. Linden's Handbook of Batteries, Kirby W. Beard, Fifth Edition, McGrawHill, 2019.
- 9.High Performance Metallic Materials for Cost Sensitive Applications, F.H. Froes, et al. JohnWiley & Sons, 2010
- 10.Instrumental Methods of Analysis, Dr. K. R. Mahadik and Dr. L. Sathiyarayanan, Nirali Prakashan,2020
11. Chemistry of Engineering materials, MaliniS, KSAnanthaRaju, CBS publishers Pvt Ltd.,
12. Laboratory Manual Engg. Chemistry, Anupma Rajput, Dhanpat Rai & Co.
13. Engineering materials, MaliniS, KSAnanthaRaju, CBS publishers Pvt Ltd., Laboratory Manual Engg.Chemistry, Anupma Rajput, DhanpatRai& Co.

Weblinks and Video Lectures (e-Resources):

- <http://libgen.rs/>
- <https://nptel.ac.in/downloads/122101001/>
- <https://nptel.ac.in/courses/104/103/104103019/>
- <https://ndl.iitkgp.ac.in/>
- <https://www.youtube.com/watch?v=faESCxAWR9k>
- <https://www.youtube.com/watch?v=TBqXMWaxZYM&list=PLyhmwFtznRhuz8L1bb3X-9IbHrDMjHWWWh>
- <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>

Cos and POs Mapping (CO-PO mapping are only Indicative)

COs and POs Mapping (CO – PO mappings are only Indicative)												
	PO											
	PO1	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					

Level3- HighlyMapped, Level 2-ModeratelyMapped, Level1-LowMapped, Level0-NotMapped