Course Title:	**Chemistry for Electrical and Electronics Engineering stream**	Semester	I/II
Course Code:	**BCHEE102/202**	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
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. Useofonlineplatformsforassignments/Notes/Quizzes(Ex.Googleclassroom)

Module-1: Polymers and Metal Finishing (8hours)

Self-study: Principles governing Metal finishing and Factors influencing Plating process.

Polymers: Introduction, Molecular weight-Number average, Weight average and numerical problems. Conducting polymers-synthesis and conducting mechanism of polyacetylene. Preparation, properties and commercial applications of graphene oxide.
Metal Finishing: Introduction, Technological Importance of Metal Finishing, Electroplating–Definition, Process, Electroplating of Chromium (Hard and Decorative) and its applications**.** Electrolessplating, Introduction, Difference between Electroplating and Electrolessplating, Electrolessplating of copper in the manufacture of double-sided PCB.

Applications: Electropolishing, Electrophoretic painting, Conversion coatings, Metal grinding, Polishing, Powder coating, Plating(Au, Ni, Teflon, Sn, Zn)
(RBTLevels:L1,L2andL3)

Module-2: Energy Conversion and Storage, Chemistry of Electronic materials (8 hours)

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

Batteries: Introduction, classification of batteries. Components, construction, working and applications of modern batteries; Li-ion battery and flow battery (Vanadium redox flow battery).
Fuel Cells: Introduction, construction, working and applications of methanol–oxygen and Polymer electrolyte membrane (PEM) fuel cell.
Conductors and Insulators: Introduction, Principle with examples
Semiconductors: Production of electronic grade Si-Czochralski process**(CZ)** and Float zone process(FZ)
Solar Energy: Introduction, construction and working of solar PV cell, Quantum Dot Sensitized Soar cells (QDSSC), Electronic and chemical applications of (GaAs), (SiGe) and (InP), Perovskite Material for PV cells-Structural requirements, construction, working and Limitations.

Applications: Design of spring in for Automatic door closure, Design of effective energy transfer system
(RBTLevels:L1,L2andL3)

Module-3: Corrosion Science and E-waste Management(8hours)

Self-study: Factors affecting the rate of corrosion, Recycling of PCB and battery components

Corrosion Chemistry: Introduction, electrochemical theory of corrosion, Types of corrosion-differential metal and differential aeration. Corrosion control-Inorganic coatings- anodizing and phosphating, Metal coating- Anodic and cathodic metal coatings with examples, galvanization, Cathodic Protection, Principle, Sacrificial anode method. Corrosion Penetration Rate (CPR)–Introduction and numerical problem.
E-waste Management: Introduction, sources, types, effects of e-waste on environment and human health, methods of disposal, advantages of recycling. Extraction of copper and gold from e-waste

Applications: Understanding corrosion control methods, mitigate damage from corrosion
(RBTLevels:L1,L2andL3)

Module-4: Nanomaterials and Display Systems (8hours)

Self-study: Properties & electrochemical applications of Single walled carbon nanotubes, Multiwalled carbon nanotubes and graphene.

Nanomaterials: Introduction, size dependent properties of nano materials (Surface area, Catalytic, Conducting), preparation of nano materials by sol-gel and co-precipitation method with example. Introduction, properties and applications-Nanofibers, Nanophotonics, Nanosensors.

Display Systems: Liquid crystals (LC's)-Introduction, classification, working, properties and application in Liquid Crystal Displays (LCD's).Introduction, Properties, Types of materials, Construction, and working of Organic Light Emitting Diodes (OLED's) and Quantum Light emitting diodes (QLED's).

Applications: Sensors, Medical and Electronic fields.
(RBTLevels:L1,L2andL3)

Module-5: Electrode System and Analytical Techniques (8hours)

Self-study: Principle and working of UV- visible spectroscopy

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

Analytical Techniques: Introduction, Principle and Instrumentation: Potentiometric sensors–estimation of Iron, Conductometric sensors–estimation of weak acid, Colorimetry- estimation of Copper, Numerical on Beer-Lambert's law.

Applications: Analytical instruments finds application in Chemical, Pharmaceutical, food-Processing industries, and oil refineries.
(RBTLevels:L1,L2andL3)

PRACTICALMODULE

A–Demonstration(anytwo)offline/virtual:

A1.Synthesis of polyurethane

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

A3.Synthesis of iron oxide nanoparticles

A4.Electroplating of copper on metallic objects

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(compulsorilyany 4 to be conducted):

C1.Estimationof Copper present in electroplating effluent by optical sensor(Colorimetry)

C2.Determinationof 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.Determinationof Chemical Oxygen Demand(COD) of industrial waste water sample

D–Open Ended Experiments(anytwo):

D1.Estimation of metal in e-waste by optical sensors

D2.Electroless plating of Nickel on Copper

D3.Determinationofglucosebyelectrochemicalsensors

D4.Synthesis of polyaniline and its conductivity measurement

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 (bothCIE andSEE)

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. Demonstrate the working of Chemical/Bio sensor
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 λmax and Molar absorption Coefficient (ε)
8. Extraction of copper from e-waste through leaching and electrolysis.
9. Demonstrate the working of LCD using polarisers.
10. Boiler troubles: Causes and remedial actions.

Suggested Learning Resources:

Text Books:

1. Wiley Engineering Chemistry,Wiley India Pvt.Ltd.NewDelhi, 2013-2nd Edition.
2. Engineering Chemistry,Satyaprakash&Manisha Agrawal, Khanna Book Publishing, Delhi
3. A TextBook of Engg.Chemistry, Shashi Chawla, DhanpatRai& Co.(P)Ltd.
4. Engineering Chemistry,Baskar,Wiley
5. AText Book of Engineering Chemistry, R.V.Gadag and Nityananda Shetty,I.K.International Publishing house. 2ndEdition, 2016.

Instrumental Methods of Analysis, Dr.K. R. Mahadik and Dr.L.Sathiyanarayanan, Nirali Prakashan,2020

6. Engineering Chemistry, Edited by Dr.Mahesh B and Dr.RoopashreeB,Sunstar Publisher, Bengaluru, ISBN97 8-93-85155-70-3, 2022
7. ChemistryforEngineering Students, B.S.JaiPrakash,R.Venugopal,Sivakumaraiah & PushpaIyengar., Subash Publications, 5th Edition, 2014
8. "Engineering Chemistry",O.G.Palanna, Tata McGraw Hill EducationPvt.Ltd.NewDelhi, 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. Sathiyanarayanan, 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-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

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