Course Title:	**Chemistry for Computer Science & Engineering stream**	Semester	I/II
Course Code:	**BCHES102/202**	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. Use of online platforms for assignments/Notes/Quizzes(Ex. Google classroom)

Module-1: Sensors and Energy Systems (8hours)

Self-study: Types of electrochemical sensor, Gas sensor - O2 sensor, Biosensor- Glucose sensors

Sensors: Introduction, working, principle and applications of Conductometric sensors, Electrochemical sensors, Thermometric sensors, and Optical sensors (Colorimetry). Sensors for the measurement of dissolved oxygen (DO). Electrochemical sensors for the pharmaceuticals. Electrochemical gas sensors for Sox and NOx. Disposable sensors in the detection of biomolecules and Herbicides.
Energy Systems: Introduction to batteries, construction, working and applications of Lithium ion and Sodium ion batteries. Quantum Dot Sensitized Solar Cells (QDSSC's)-Principle, Properties and Applications.

Applications: Detection of Biomolecules, Insecticides, Pesticides, Environmental pollutants, Pharmaceuticals, Dissolved oxygen, Toxic metal concentration in water, pH of water, alkalinity of water
(RBTLevels:L1,L2andL3)

Module-2: Materials for Memory and Display Systems (8hours)

Self-study: Properties and functions of Silicon (Si), Germanium (Ge), Copper (Cu), Aluminium (Al), and Brominated flame retardants in computers

Memory Devices: Introduction, Basic concepts of electronic memory, Classification of electronic memory devices, types of organic memory devices (organic molecules, polymeric materials, organic-inorganic hybrid materials).
Display Systems: Photoactive and Electroactive materials, Nanomaterials and organic materials used in optoelectronic devices. Liquid crystals (LC's) - Introduction, classification, properties and application in Liquid Crystal Displays (LCD's). Properties and application of Organic Light Emitting Diodes (OLED's) and Quantum Light Emitting Diodes (QLED's), Light emitting electrochemical cells.

Applications: Electronic devices, Television set, Computer monitors, Medical monitors, Smartphone displays, Video walls
(RBTLevels:L1,L2andL3)

Module-3: Corrosion and electrode system (8hours)

Self-study*:* Corrosion Inhibitors, salt spray test

Corrosion chemistry: Introduction, electrochemical theory of corrosion, types-differential metal, differential aeration, corrosion control-galvanization, anodization and sacrificial anode method. Corrosion penetration rate (CPR) - introduction and numerical problem.
Electrode system: Introduction, Electrochemical cells, Conventions, Emf of the cell, Problems on Emf of the cell, Derivation of Nernst Equation, Ion selective electrode – definition and its applications. Determination of pH using glass electrode. Reference electrode: Introduction, calomel electrode – construction, working and applications of calomel electrode. Concentration cell – Definition, construction, working and Numerical problems.

Applications: Understanding corrosion control methods, mitigate damage from corrosion, calomel electrode as reference electrode - pH measurement, Cyclic voltammetry, and in general aqueous electrochemistry. Analytical techniques – Identify the adulterants, soil tests, medical tests, water analysis.
(RBTLevels:L1,L2andL3)

Module-4: Polymers, Green fuels, and Analytical Techniques (8hours)

Self-study*:* Regenerative fuel cells

Polymers: Introduction, Molecular weight - Number average, weight average and numerical problems, Conducting polymers – synthesis and commercial applications of polyacetylene Synthesis, Properties

and applications of PMMA, Teflon and Kevlar Fiber, Preparation, properties, and commercial applications of graphene oxide.

Green Fuels: Introduction, construction and working of solar photovoltaic cell, advantages, and disadvantages. Generation of energy (green hydrogen) by electrolysis of water and its advantages.

Analytical Techniques: Introduction, principle and instrumentation: Conductometry – estimation of weak acid. Colorimetry – estimation of Copper. Numerical on Beer-Lambert's law

Applications: Marine, civil, aerospace, biomedical. Green fuels - environmentally friendly energy, cost-effective and offer significant long-term economic benefits.

(RBT Levels: L1, L2 and L3)

Module-5: E-Waste Management (8hours)

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

E-Waste: Introduction, sources of e-waste, Composition, Characteristics, and Need of e- waste 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, Pyrometallurgical methods, direct recycling). Extraction of gold from E-waste. Role of stakeholders in environmental management of e-waste (producers, consumers, recyclers, and statutory bodies).

Applications: Decrease Raw material demand, Energy efficiency, Reduce greenhouse gas emission, Better livelihood

(RBTLevels:L1,L2andL3)

PRACTICALMODULE

A–Demonstration (any two)offline/virtual:

A1.Chemical Structure drawing using software: Chem Draw or ACD/Chem Sketch

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

A3.Synthesis of iron oxide nano particles

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

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 Assessmentand 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/Biosensor
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. New Delhi, 2013-2nd Edition.
2.Engineering Chemistry, Satyaprakash & Manisha Agrawal, Khanna Book Publishing, Delhi
3.A Text Book of Engg. Chemistry, Shashi Chawla, DhanpatRai & 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. 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. Roopashree B, Sunstar Publisher, Bengaluru, ISBN97 8-93-85155-70-3, 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. 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