Semester: I/II			
Course Title	Applied Chemistry for Computer Science & Engineering stream	**CIE Marks**	50
Course Code	BCSCHE102/202	**SEE Marks**	50
Course Type	Integrated	**Total Marks**	100
Course Category	ASC	**SEE Duration**	03 hrs
Hours Per Week	2L: 2 T: 2P	**SEE Type**	Written
Total Hours	40 hrs of theory + 18-20 hrs of practical sessions	**Credits**	04

Course Learning Objectives
This course will enable the students to
• Acquire knowledge on principles of chemistry for engineering applications.
• Develop the understanding of chemistry by emphasizing the related branches of engineering.
• Provide students with a solid foundation in analytical reasoning required to solve societal problems
Pre-Requisites
• Basics of Organic, Inorganic, Physical and Analytical Chemistry.
• Polymers, Water Chemistry and Nanomaterial's.

Module-1: Sensors and Energy Systems	**(8 hrs)**
Sensors: Introduction, principle, theory and applications of Electrochemical sensors. Sensors for the measurement of dissolved oxygen (DO). Electrochemical sensors for analysis in pharmaceuticals (Diclofenac). Electrochemical gas sensors for the estimation SOx and NOx in pollutants. Use of disposable sensors in the detection of biomolecules (Ascorbic Acid) and pesticides (Gylophosate). **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. **Self-learning:** Types of electrochemical sensor, Gas sensor - O2 sensor, Biosensor – Glucose sensors.	
Module-2: Materials for Memory and Display Systems	**(8 hrs)**
Memory Devices: Introduction, Classification of electronic memory devices, types of organic memory devices (organic molecules, polymeric materials). **Display Systems**: Photo active and electro active materials, Nano materials 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. **Self-learning:** Properties and functions of Silicon (Si), Germanium (Ge), Copper (Cu), Aluminium (Al), and Brominated flame retardants in computers.	
Module-3: Corrosion and Electrode System	**(8 hrs)**
Corrosion Chemistry: Introduction, electro chemical theory of corrosion, types of corrosion-differential metal, differential aeration and pitting corrosion. Corrosion control galvanization, anodization and sacrificial anode method. Corrosion Penetration Rate (CPR) -Introduction and numerical problem. **Electrode System**: Introduction, Electrode potential, Derivation of Nernst equation, types of electrodes. Reference electrode-Introduction, calomel electrode–construction, working and applications of calomel electrode. Concentration cell–Definition, construction and Numerical problems. Ion selective electrode:	

definition, construction, working and applications of glass electrode. Determination of pH using glass electrode.

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

Self-learning: IR and UV-Visible spectroscopy.

Module-4: Polymers and Green Fuels	**(8 hrs)**

Polymer: Introduction, classification, preparation properties and application of epoxy resin, Teflon, polylactic acid. Molecular weight- Number average, weight average and numerical problems. Preparation, properties and commercial applications of Kevlar.

Conducting polymers: Synthesis and conducting mechanism of polyacetylene and commercial applications.

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.

Self-learning: SOFC, PEM Fuel Cell

Module-5: E-Waste Management	**(8 hrs)**

Introduction, sources and composition of e-waste, characteristics, and need of e- waste management. Toxic materials used in manufacturing of electronic and electrical products; health hazards effects of e-waste.

Recycling and Recovery: Different approaches of recycling (separation, thermal treatments, hydro metallurgical extraction, pyro metallurgical methods). Extraction of gold from E-waste of PCB. Role of stakeholders in environmental management of e-waste (producers, consumers, recyclers, and statutory bodies).

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

Practical Components

Part -A: Demonstration (Any Two Can be Conducted)	
Sl .No	**Title**
1.	Determination of chloride content in the given water sample by Argentometric method
2.	Synthesis of iron oxide nanoparticles- (common to all)
3.	Synthesis of polyurethane
4.	Electrolysis of water
5.	Chemical Structure drawing using software: ChemDraw or ACD/ChemSketch
Part - B: Exercise (Compulsory)	
Sl .No	**Title**
1.	Conductometric estimation of the acid mixture.
2.	Potentiometric estimation of FAS using standard $K_2Cr_2O_7$ solution.
3.	Determination of pKa value of a given weak acid using a pH meter
4.	Estimation of Total hardness of water by EDTA complexometric method
Part -C: Structured Enquiry (Compulsory)	
Sl .No	**Title**
1.	Estimation of Copper present in electroplating effluent by optical sensor (colorimetry)
2.	Determination of Viscosity coefficient of a given liquid using Ostwald's viscometer
3.	Estimation of iron in TMT bar by diphenyl amine/external indicator method
4.	Determination of Chemical Oxygen Demand (COD) of industrial waste water sample

Part -D: Open Ended (Any Two Can be Conducted)	
Sl .No	**Title**
1.	Estimation of manganese dioxide in pyrolusite
2.	Electroplating of desired metal on substrate
3.	Construction of photovoltaic cell.
4.	Design an experiment to identify the presence of proteins in given sample.
5.	Electroless plating of Nickel on Copper
6.	Synthesis of polyaniline and its conductivity measurement
7.	Synthesis of Biodiesel

Text Books:	
1.	"Engineering Chemistry" by Wiley India, John Wiley, 2nd Edition, Wiley India Pvt. New Delhi.
2.	"Engineering Chemistry" by Sathya Prakash & Manisha Agarwal, Revised edition, Khanna Book Publishing, Delhi
3.	"Engineering Chemistry" By Shashi Chawla, Dhanpat Rai &Co.(P) Ltd.
4.	"Engineering Chemistry" by Sunitha Rattan, Katson Books.
5.	"Engineering Chemistry "by I, D. Grour Krishana, Vikas Publishing
6.	"A Textbook of Engineering Chemistry" by S S Dara & Dr. S S Umare, 12th Edition, 2011.S Chand & Company Ltd.,
7.	"A Text Book of Engineering Chemistry" by R.V. Gadag and Nityananda Shetty, 4th Edition, I.K. International Publishing house.
Reference Books:	
1.	"Text Book of Polymer Science" by F.W. Billmeyer, 4th Edition, John Wiley & Sons.
2.	"Essentials of Physical Chemistry" by B S Bahl & Tuli, 28th edition, S. Chand Publishing house, New Delhi.
3.	"Nanotechnology A Chemical Approach to Nanomaterials" by G.A. Ozin & A.C. Arsenault, RSC Publishing.
4.	"Corrosion Engineering" by M.G.Fontana, N.D.Greene, 3rd Edition. McGraw Hill Publications, New York.
5.	"Linden's Handbook of Batteries" by Kirby W. Beard, Fifth Edition, McGraw-Hill, 2019.
6.	OLED Display Fundamentals and Applications "by Takatoshi, Tsujimura, Wiley–Blackwell.
7.	Analytical Chemistry by B K Sharma, 6th Revised Edition, Krishna Prakashan Publications.

Course Outcome Statements: After the successful completion of the course, the student will be able to	
CO1	Define the terms and processes involved in conducting, structural, energy conversion and storage, sensor materials, corrosion, water technology, nano, polymeric materials and analytical techniques.
CO2	Explain the phenomenon of engineering materials, energy storage, display devices, corrosion control, water analysis, polymeric materials and instrumentation.
CO3	Apply the basic concepts of chemistry to solve the problems related to conducting and structural materials, sensors, memory device, design of materials, corrosion prevention, use of nanomaterial, polymers, phase separation, e-waste management and instrumental analysis.
CO4	Qualitatively and quantitatively analyse constituents of water, cement, ore, acids and alkalis.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	1	-	-	-	-	1
CO2	2	2	1	1	-	-	1	-	-	-	-	1
CO3	2	2	1	1	-	-	1	-	-	-	-	1
CO4	-	-	1	-	-	-	1	2	-	-	1	1
Avg.	**2**	**2**	**1**	**1**	**-**	**-**	**1**	**2**	**-**	**-**	**1**	**1**

3: High, 2: Medium, 1: Low