Semester: I/II			
Course Title	Applied Chemistry for CSE stream	**CIE Marks**	50
Course Code	BCSCHE112/212	**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 of smart, quantum and functional materials 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: Sustainable Chemistry for Energy Devices	**(8 hrs)**
Batteries: Introduction, basic overview of Nernst equation, concentration cell and numerical problems, classification of batteries, construction, working and applications of Li-Ion battery. **Next-Generation Energy Systems:** Introduction, construction and working of sodium ion battery and redox flow battery for EV applications. Super capacitor and its applications in IoT/wearable devices. **Clean Energy Chemistry:** Introduction, fuel cell, difference between fuel cell and battery, construction, working principle, applications and limitations of solid-oxide fuel cell (SOFCs) and solar photovoltaic cell (PV cell). Production of green hydrogen by photocatalytic water splitting using TiO_2 method and its advantages. **Self Learning**: Li-ion battery for EV, Construction and working of ultra-small asymmetric super capacitor.	
Module-2: Chemical Sensors and Corrosion Control	**(8 hrs)**
Sensors: Introduction, terminologies- Transducer, Actuators and Sensors, working principle and applications of electrochemical sensor for the detection of Dissolved Oxygen (DO). Electrochemical gas sensors for the detection of NO_x & SO_x in air sample, Biosensor-principle and working mechanism for detection of glucose in biofluids. **Corrosion:** Introduction, electrochemical theory of corrosion, types-differential metal and differential aeration corrosion, corrosion control- Galvanization and anodization, vapour corrosion inhibitors for protecting computer circuit boards, corrosion penetration rate (CPR)- definition, importance and numerical problems. **Self Learning:** Conductometric sensor and colorimetric sensor.	
Module-3: Functional Materials for Memory and Display Systems	**(8 hrs)**
Memory Devices: Introduction, organic semiconductors; types of organic semiconductors used in memory devices, p-type semiconductor-pentacene and n- type semiconductor -perfluoropentacene, difference between organic and inorganic memory devices. **Resistive RAM (ReRAM) Materials:** Introduction, synthesis of TiO_2-RAM nanomaterial by sol-gel method, properties and its applications. **Display Systems:** Introduction, liquid crystals (LCs)- classification, properties and its applications in	

Liquid Crystal Displays (LCDs), construction, working principle and applications of LEDs, OLEDs. Active-Matrix Organic Light Emitting Diodes (AMOLEDs) and Quantum Light Emitting Diodes (QLEDs): Properties and applications.

Self Learning: Construction, working and advantages of pentacene semiconductor chip.

Module-4: Quantum Materials and Polymers	**(8 hrs)**

Quantum Dots: Introduction, size dependent properties -quantum confinement effect, surface-to-volume ratio & band gap, synthesis and applications of Cd-Se Quantum dots by wet chemical method, quantum dot sensitized solar cells (QDSSCs)-construction, working principle and applications.

Polymer: Introduction, classification based on origin and thermal behavior. Molecular weight of polymers - number and weight average molecular weight of polymers, numerical problems. Synthesis and properties of nylon-12 and its advantages in 3D printing applications. Synthesis and properties of PVC and PMMA for device applications.

Conducting polymers- Introduction, synthesis of polyaniline, conduction mechanism and its engineering applications.

Self Learning: Structure-property relationship of polymers.

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

Green Chemistry: Introduction, properties and applications of green solvents for server heat management. Green synthesis of ZnO nanoparticles for magnetic Radio Frequency Identification (RFID) & Internet of Nano Things (IoNT) system applications

Biomaterials: Introduction, synthesis and properties of polylactic Acid (PLA) and polyethylene glycol (PEG) for touch screen applications. Properties of Alginate Hydrogel for Brain-Computer Interfaces (BCIs) applications.

E-waste: Introduction, sources, composition of e-waste, effects of e-waste on environment and human health, Artificial intelligence in e-waste management and its applications, extraction of gold from e-waste by bioleaching method, direct recycling method of lithium-ion batteries.

Self Learning: Biosynthesis and properties of glycerol trioleate ester for server and IT infrasrtrure applications. Synthesis of Alginate Hydrogel for Brain-Computer Interfaces.

Practical Components

Fixed Set of Experiments

1. Estimation of total hardness of water by EDTA method.
2. Determination of chemical oxygen demand (COD) of industrial effluent sample.
3. Estimation of iron in TMT bar by diphenyl amine indicator method.
4. Determination of alkalinity of given boiler water sample.
5. Green synthesis of copper nanoparticles for conductive ink applications.
6. Estimation of acid mixture by conductometric sensor (Conductometry).
7. Estimation of iron in rust sample by Potentiometric sensor (Potentiometry).
8. Determination of pKa of vinegar using pH sensor (Glass electrode).
9. Estimation of copper present in e-waste by optical sensor (Colorimetry).
10. Smartphone-Based colorimetric estimation of total phenolic content in coffee products.
11. Data analysis of pKa of a week acid and its interpretation using origin software.
12. Chemical structure drawing using software: Chem Draw/ Chem Sketch.

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.	"A Textbook of Engineering Chemistry" by S S Dara & Dr. S S Umare, 12th Edition, 2011.S Chand & Company Ltd.,
Reference Books:	
1.	"Text Book of Polymer Science" by F.W. Billmeyer, 4th Edition, John Wiley & Sons.
2.	"Nanotechnology A Chemical Approach to Nanomaterials" by G.A. Ozin & A.C. Arsenault, RSC Publishing.
3.	"Corrosion Engineering" by M.G.Fontana, N.D.Greene, 3rd Edition. McGraw Hill Publications, New York.
4.	"Linden's Handbook of Batteries" by Kirby W. Beard, Fifth Edition, McGraw-Hill, 2019.
5.	OLED Display Fundamentals and Applications "by Takatoshi, Tsujimura, Wiley–Blackwell.
6.	Organic Thin Film Transistor Applications: Materials to Circuits-Brajesh K. Kaushik et al. ISBN 9781498736534
7.	Quantum Dots and Polymer Nanocomposites: Synthesis, Chemistry, and Applications-Yotishkumar Parameswaran Pillai, Poushali Das, Sayan Ganguly, Publisher: CRC Press, 2022, ISBN 13: 978 1032210148
8.	Green Carbon Quantum Dots: Environmental Applications; Vijay Kumar, Pardeep Singh, Devendra Kumar Singh (India), Springer Nature Singapore, Oct 2024, ISBN 13: 978 9819762026.
9.	Conducting Polymers, Fundamentals and Applications: Including Carbon Nanotubes and Graphene: Prasanna Chandrasekhar (IIT Delhi alumnus), Springer, 2019 (2nd ed.), ISBN 13: 978 3030098858.

Course Outcome Statements: After the successful completion of the course, the student will be able to	
CO1	Explain the principles of sustainable chemistry for energy devices and clean energy.
CO2	Explain the principles of chemistry involved in corrosion phenomena and metal finishing, engineering materials viz. sensors, functional materials, quantum materials, polymers.
CO3	Explain the principles of chemistry involved in green, bio materials and e-waste management.
CO4	Apply the principles of chemistry to solve the problems related to computer science and engineering
CO5	Qualitatively and quantitatively analyze the constituents of, ores, organic molecules, polymers, acids.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	-	-	1	-	-	-	-	1
CO2	2	1	-	-	-	1	-	-	-	-	1
CO3	2	1	-	-	-	1	-	-	-	-	1
CO4	2	1	-	-	-	1	-	-	-	-	1
CO5	-	-	-	-	-	1	-	2	-	-	1
Avg.	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**2**	**-**	**-**	**1**

3: High, 2: Medium, 1: Low