Semester: I/II			
Course Title	Applied Chemistry for Electrical and Electronics Engineering stream	**CIE Marks**	50
Course Code	BEECHE102/202	**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: Chemistry of Electronic Materials	**(8 hrs)**
Conductors, Insulators and Semiconductors: Introduction, principle based on band theory with examples and applications. Production of electronic grade silicon- Czochralski process (CZ) and Float Zone (FZ) methods. **Polymers:** Introduction, Molecular weight- Number average, Weight average and numerical problems. Conducting polymers: synthesis, properties and engineering applications of poly aniline. Preparation, properties and engineering applications of graphene oxide. Electroless Plating: Introduction, Electroless plating of copper. Manufacture of double-sided PCB. **Self-learning:** Technological importance of metal finishing and distinction between electro plating and electroless plating.	
Module--2: Energy Conversion and Storage	**(8 hrs)**
Batteries: Introduction, components, classification of batteries. Construction, working and applications of Na-ion battery, solid state battery -Li-polymer battery and flow battery -Vanadium redox flow battery. **Fuel Cells**: Introduction, types, construction, working and applications of methanol-oxygen and polymer electrolyte membrane (PEM) fuel cell. **Solar Energy:** Introduction, importance of solar PV cell, construction and working and applications of PV cell, advantages and disadvantages. **Self-learning:** Electrodes for electrostatic double layer capacitors, pseudo capacitors, hybrid capacitor and super capacitors	
Module-3: Corrosion Science and E-waste Management	**(8 hrs)**
Corrosion Chemistry: Introduction, electro chemical theory of corrosion, types of corrosion- differential metal and differential aeration, pitting corrosion. Corrosion control- anodizing, galvanization, and sacrificial anode method. Corrosion Penetration Rate (CPR) – Introduction and numerical problem. **E-waste Management**: Introduction, sources of e-waste, effects of e-waste on environment and human health, methods of e- waste disposal, recycling and its advantages. Extraction of copper and gold from e-waste of PCBs. **Self-learning:** Recycling of PCB and battery components	

Module-4: Nanomaterials and Display Systems	(8 hrs)
Nanomaterials: Introduction, size dependent properties of nanomaterials (Surface area, Catalytic, Conducting, Optical), preparation of nanomaterials by sol-gel and chemical vapour deposition (CVD) with example. Introduction, properties and applications- Nanofibers, Nanophotonics, Nanosensors. **Display Systems**: Liquid crystals (LC's)-Introduction, general 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). **Perovskite Materials:** Introduction, properties and engineering applications in optoelectronic devices. **Self-learning:** Properties & electrochemical applications of carbon nanotubes (CWCNT and MWCNT).	
Module-5: Sensors in Analytical Techniques	**(8 hrs)**
Electrode System and Sensors: Introduction, single and standard electrode potential, Derivation of Nernst equation, Reference electrode- types of reference electrodes. Calomel electrode: Introduction, construction, working and its applications. Concentration cell: Electrolyte concentration cell: Determination of cell potential of concentration cell and numerical problems. Ion selective electrode: definition, construction, working and applications of glass electrode. Determination of pH using glass electrode. **Sensors:** Introduction, principle, working and engineering applications of Conductometric sensors, Electrochemical sensors. **Analytical Techniques**: Introduction, theory, instrumentation and application of Colorimetric, Conductometric and potentiometric sensors **Self-learning:** IR and UV- Visible spectroscopy.	

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	PO5	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