Semester: I/II		
Applied Chemistry for CSE/AIML/ISE		
Course Code: 23CHC112/122	**L:T:P:J 2:2:2:0**	**CIA Marks:** 50
Credits: 4		**SEA Marks:** 50
Hours: 40L+24P		**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to	
1	Master the basic knowledge of applied Chemistry in their day to day life, various types of industries and in research and development
2	To develop an intuitive understanding of Chemistry by emphasizing the related branches of engineering
3	To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence

Module-1: Corrosion Science and Engineering	**No. of Hrs**	**RBT**
Teaching component: **Corrosion:** Fundamentals of corrosion, Importance of corrosion in industry, Electrochemical theory of corrosion, Factors affecting the rate of corrosion: ratio of anodic to cathodic areas, nature of corrosion product, nature of medium – pH. Types of corrosion - Differential metal, differential aeration - pitting and water line). Corrosion control: Anodizing – Anodizing of aluminium and its applications, Cathodic protection (Process & Applications)- sacrificial anode and impressed current methods, Metal coatings- Galvanization (Process & Applications). Corrosion Penetration Rate (CPR) – Introduction and numerical problem	**4**	**Apply**
Metal finishing: Technological importance. Electroplating: Electroplating of chromium (hard and decorative). Electrolessplating: electrolessplating of nickel and its application, electrolessplating of copper and its application in PCB, distinction between electroplating and electrolessplating processes.	**4**	
Case study: Material failure		
Module-2: Electrochemical Systems		
Teaching component:		
Electrode system: Ion-selective electrode - construction, working and application (determination of pH) of glass electrode. Electrolyte concentration cells, numerical problems.	**3**	**Apply**
Energy storage systems: Classification – primary, secondary and reserve batteries. Battery characteristics (Voltage, Capacity, Energy density, electricity storage density, Cycle life and Shelf life), Construction, working and applications of Classical battery – Lead acid battery. Modern laptop battery (Li-ion battery). Recycling of Li-ion battery (Hydrometallurgy & Pyrometallurgy). Future battery - Sodium-ion battery.	**3**	

Analytical Techniques: Introduction, principle and instrumentation of Conductometry; its application in the estimation of weak acid. Potentiometry; its application in the estimation of iron in industrial effluent. **Case study**: Batteries used in electronic gadgets	**2**	
Module-3: Green Energy		
Green Fuel: Synthesis of biofuel (biodiesel & power alcohol), Production of Hydrogen from Biomass (Pyrolysis) and water (PEM Electrolyzer)	**3**	**Apply**
Fuel Cells: Differences between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell with H_2SO_4 as electrolyte, and polymer electrolyte membrane (PEM) fuel cell.	**3**	
Solar Energy: Preparation of solar grade silicon by Union Carbide Process. Photovoltaic cell - construction, working and applications of a PV cell. **Case study**: Renewable energy sources	**2**	
Module-4: Sensors & Polymer Technology		
Teaching component: **Sensors:** Introduction, working principle and applications of Electrochemical sensors, Thermometric sensors and Optical sensors. Electrochemical sensors for the estimation of dissolved oxygen (DO), pharmaceuticals (diclofenac) and hydrocarbons (hydroxypyrene). Electrochemical gas sensors for SO_2 and NOx. Disposable sensors in the detection of biomolecules (ascorbic acid) and pesticides.	**4**	**Apply**
Polymer Technology: Synthesis, properties and applications of composite polymers - Kevlar. Conducting polymers - Mechanism of conduction in polyacetylene (p & n-doping) and its applications. Biodegradable polymers: Synthesis and properties of Poly lactic acid. Applications of biodegradable polymers in medical industry. **Case study**: Sensors in allied applications	**4**	
Module-5: Materials for Memory and Display Systems		
Teaching component: **Memory Devices:** Introduction, Classification of electronic memory devices – based on materials used and data storage, types of organic memory devices (organic molecules, polymeric materials, organic-inorganic hybrid materials).	**4**	**Apply**
Display Systems: Photoactive and electroactive materials, Nanomaterials and organic materials used in optoelectronic devices. Liquid crystals (LC's) - Introduction, classification of Liquid crystals, Construction, working, properties and application in Liquid Crystal Displays (LCD's), Organic Light Emitting Diodes (OLED's) and Quantum Light Emitting Diodes (QLED's).	**4**	

Case Study: Materials in Engineering products		

List of Experiments	RBT Level
1. Estimation of Total hardness of water by EDTA Complexometric method	Apply
2. Determination of COD of wastewater sample	Apply
3. Estimation of Iron in rust by external indicator method	Apply
4. Colorimetric estimation of copper in e-waste	Apply
5. Estimation of residual chlorine in drinking water by Iodometric method	Apply
6. Determination of pKa of vinegar using pH meter	Apply
7. Estimation of ion exchange capacity (IEC) capacity of resin Conductometrically	Apply
8. Estimation of iron in industrial effluents potentiometrically using standard $K_2Cr_2O_7$ solution	Apply
9. Determination of acidity of soft drinks using pH sensor	
10. Demonstration on Detection of adulteration in food products	

Course Outcomes: After completing the course, the students will be able to	
23CHC112/122.1	Modify the surface properties of metals to develop resistance to corrosion, wear, abrasion and impact by corrosion control methods, electroplating and electrolessplating.
23CHC112/122.2	Construct electrochemical cells by using the principles of electrochemistry & So lve energy crisis for the sustainable development of environment.
23CHC112/122.3	Apply the processes involved in scientific and engineering applications, and replacement of conventional materials by polymers for domestic and industrial applications
23CHC112/122.4	Apply the knowledge of chemistry to construct the engineering devices.
23CHC112/122.5	Employing the classical method for the determination of constituents present in the sample and handling different types of instruments for analysis of constituents present in the sample for quick and accurate results

Reference Books

1. A textbook of Engineering Chemistry, S. S. Dara, 10th Edition, S Chand & Co., Ltd., New Delhi, 2014
2. Physical Chemistry, P. W. Atkins, Oxford Publications (Eighth edition-2006)
3. Polymer Science, Vasant R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar New Age International, 1986
4. OLED Display Fundamentals and Applications, Takatoshi Tsujimura, Wiley–Blackwell, 2012.
5. Expanding the Vision of Sensor Materials. National Research Council 1995, Washington, DC: The National Academies Press. doi: 10.17226/4782.
6. Vogel's Text Book of Quantitative Chemical Analysis G.H.Jeffery, J. Bassett, J.Mendham and R.C.Denney
7. Analytical chemistry, Gary D. Christian, 6th Edition, Wiley India
8. Detect Adulteration with Rapid Test, FSSAI, Ministry of Health and Family Welfare Government of India
9. Chemistry for Engineering Students, B. Jaiprakash, R. Venugopal, Sivakumaraiah and Pushpa Iyengar, Subhash Publications, Bengaluru, (2015- Edition)

Semester: I/II		
Applied Chemistry for ECE/EEE/ME		
Course Code: 23CHE112/122	**L:T:P:J 2:2:2:0**	**CIA Marks:** 50
Credits: 4		**SEA Marks:** 50
Hours: 40L+24P		**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to	
1	Master the basic knowledge of applied Chemistry in their day to day life, various types of industries and in research and development
2	To develop an intuitive understanding of Chemistry by emphasizing the related branches of engineering
3	To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence

Module-1: Corrosion Science and Engineering	**No. of Hrs**	**RBT**
Teaching component: **Corrosion:** Fundamentals of corrosion, Importance of corrosion in industry, Electrochemical theory of corrosion, Factors affecting the rate of corrosion: ratio of anodic to cathodic areas, nature of corrosion product, nature of medium – pH. Types of corrosion - Differential metal, differential aeration - pitting and water line). Corrosion control: Anodizing – Anodizing of aluminium and its applications, Cathodic protection (Process & Applications)- sacrificial anode and impressed current methods, Metal coatings- Galvanization (Process & Applications). Corrosion Penetration Rate (CPR) – Introduction and numerical problem	**4**	**Apply**
Metal finishing: Technological importance. Electroplating: Electroplating of chromium (hard and decorative). Electrolessplating: electrolessplating of nickel and its application, electrolessplating of copper and its application in PCB, distinction between electroplating and electrolessplating processes.	**4**	
Case study: Material failure		
Module-2: Electrochemical Systems		
Teaching component:		
Electrode system: Ion-selective electrode - construction, working and application (determination of pH) of glass electrode. Electrolyte concentration cells, numerical problems.	**3**	**Apply**
Energy storage systems: Classification – primary, secondary and reserve batteries. Battery characteristics (Voltage, Capacity, Energy density, electricity storage density, Cycle life and Shelf life), Construction, working and applications of Classical battery – Lead acid battery. Modern laptop battery (Li-ion battery). Recycling of Li-ion battery (Hydrometallurgy & Pyrometallurgy). Future battery - Sodium-ion battery.	**3**	
Analytical Techniques: Introduction, principle and instrumentation of Conductometry; its application in the estimation of weak acid.	**2**	

Potentiometry; its application in the estimation of iron in industrial effluent. **Case study**: Batteries used in electronic gadgets		
Module-3: Green Energy		
Green Fuel: Synthesis of biofuel (biodiesel & power alcohol), Production of Hydrogen from Biomass (Pyrolysis) and water (PEM electrolyzer). **Fuel Cells:** Differences between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell with H_2SO_4 as electrolyte, and polymer electrolyte membrane (PEM) fuel cell. **Solar Energy**: Preparation of solar grade silicon by Union Carbide Process. Photovoltaic cell - construction, working and applications of a PV cell. **Case study**: Renewable energy sources	**3** **3** **2**	**Apply**
Module-4: Macromolecules for Engineering Applications		
Teaching component: **Polymer Technology:** Introduction, methods of polymerization (Condensation and Addition). Mechanism of polymerization - Free radical mechanism taking vinyl chloride as example. Molecular weight - number average, weight average, and numerical problems. Conducting polymers- Mechanism of conduction in polyacetylene (p & n-doping) and its applications. **Plastics:** Introduction, synthesis, properties and industrial applications of PMMA and Teflon **Composites:** Synthesis, properties and applications of Kevlar. Introduction, properties and industrial applications of carbon-based reinforced composites (graphene as fillers) and metal matrix polymer composites. **Biodegradable polymers:** Synthesis and properties of Poly lactic acid. Applications of biodegradable polymers in medical industry. **Case study**: Polymers in engineering applications	**4** **4**	**Apply**
Module-5: Advanced Materials and Display Systems		
Teaching component: **Nanomaterials:** Introduction, size dependent properties of nanomaterials (Surface area, Catalytic, Conducting, Thermal), preparation of nanomaterials by sol-gel and co-precipitation method with example. Properties and engineering applications of carbon nanotubes and graphene. **Ceramics:** Introduction, classification based on chemical composition, properties and applications of perovskite's ($CaTiO_3$). **Display Systems:** Liquid crystals (LC's) - Introduction, classification of Liquid crystals, Construction, working, properties and application in Liquid Crystal Displays (LCD's), Organic Light Emitting Diodes (OLED's) and Quantum Light Emitting Diodes (QLED's).	**4** **4**	**Apply**

Case study: Materials in display systems		

List of Experiments	RBT Level
1. Estimation of Total hardness of water by EDTA Complexometric method	Apply
2. Determination of COD of wastewater sample	Apply
3. Estimation of Iron in rust by external indicator method	Apply
4. Colorimetric estimation of copper in e-waste	Apply
5. Estimation of residual chlorine in drinking water by Iodometric method	Apply
6. Determination of pKa of vinegar using pH meter	Apply
7. Estimation of ion exchange capacity (IEC) capacity of resin Conductometrically	Apply
8. Estimation of iron in industrial effluents potentiometrically using standard $K_2Cr_2O_7$ solution	Apply
9. Determination of acidity of soft drinks using pH sensor	
10. Demonstration on Detection of adulteration in food products	

Course Outcomes: After completing the course, the students will be able to	
23CHE112/122.1	Modify the surface properties of metals to develop resistance to corrosion, wear, abrasion and impact by corrosion control methods, electroplating and electrolessplating.
23CHE112/122.2	Construct electrochemical cells by using the principles of electrochemistry & So lve energy crisis for the sustainable development of environment.
23CHE112/122.3	Illustrate the replacement of conventional materials by polymers for domestic and industrial applications
23CHE112/122.4	Apply the basic concepts of applied materials to construct the engineering devices
23CHE112/122.5	Employing the classical method for the determination of constituents present in the sample and handling different types of instruments for analysis of constituents present in the sample for quick and accurate results

Reference Books

1. A textbook of Engineering Chemistry, S. S. Dara, 10th Edition, S Chand & Co., Ltd., New Delhi, 2014
2. Physical Chemistry, P. W. Atkins, Oxford Publications (Eighth edition-2006)
3. Polymer Science, Vasant R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar New Age International, 1986
4. OLED Display Fundamentals and Applications, Takatoshi Tsujimura, Wiley–Blackwell, 2012.
5. Expanding the Vision of Sensor Materials. National Research Council 1995, Washington, DC: The National Academies Press. doi: 10.17226/4782.
6. Vogel's Text Book of Quantitative Chemical Analysis G.H.Jeffery, J. Bassett, J.Mendham and R.C.Denney
7. Analytical chemistry, Gary D. Christian, 6th Edition, Wiley India
8. Detect Adulteration with Rapid Test, FSSAI, Ministry of Health and Family Welfare Government of India
9. Chemistry for Engineering Students, B. Jaiprakash, R. Venugopal, Sivakumaraiah and Pushpa Iyengar, Subhash Publications, Bengaluru, (2015- Edition)