| 26UCHEE22 | Chemistry for EE Stream | (42-0-28-50) 4 |
|---|---|---|

**Total Hours: 120**

**Course Learning Objectives (CLOs):**

The course focuses on mesh and nodal techniques, network theorems and topology, responses of RLC network, AC networks and two port network parameters.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1-11)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | **Identify** the terms and processes involved in scientific and engineering applications. | 1 | 7 | 2,3 |
| **CO-2** | **Explain** the phenomena of chemistry to describe the methods of engineering processes. | 1 | - | 2,3,7 |
| **CO-3** | **Solve** for the problems in chemistry that are pertinent in engineering applications. | 1 | 2 | 3,4,7 |
| **CO-4** | **Apply** the basic concepts of chemistry to explain the chemical properties and processes. | 1 | - | 2,3,7,9 |
| **CO-5** | **Analyze** properties and processes associated with chemical substances in multidisciplinary situations. | 1,7 | - | 2,3,6,11 |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 3.0 | 1.2 | 1.0 | 1.0 | - | 1.0 | 1.6 | - | 1.0 | - | 1.0 |

**Contents:**

**Unit-I**

Semiconductors: Introduction, organic semiconductors: types of organic semiconductors, p-type semiconductor-pentacene and n-type semiconductor- perfluoropentacene. Inorganic semiconductors, types, p-type and n-type silicon

Organic photovoltaics -working principle and applications of Poly (3-hexylthiophene) (P3HT) as a donor and PhenylC61-butyric acid methyl ester (PCBM) as an acceptor.

Energy Storage Devices: Introduction, classification of batteries-primary, secondary and reserve battery, characteristics - capacity, power density, shelf life & cycle life. Construction and working of lithium-ion battery and its advantages in EV applications.

Energy Conversion Devices: Introduction, construction, working principal, advantages and limitations of solar photovoltaic cell (PV cell). Working principle and applications of Microelectromechanical systems (MEMS)-based energy harvesters.

**Self-learning:** Construction and working of supercapacitor and its applications.

**8 Hrs**

**Unit-II**

Nano materials: Introduction, size-dependent properties of nanomaterials - surface area, catalytic, optical properties, and electrical conductivity. Synthesis of TiO2 nanoparticles by sol-gel method and their uses in sensor applications.
Quantum Dot Materials: Introduction, types, optical and electronic properties of quantum dots (QDs).
Inorganic Quantum Dot Materials (IQDMs): Introduction, synthesis and properties of silicon based QDs by sol-gel method and Cd-Se Quantum Dots by hot injection method, and applications in optoelectronic devices.
Organic Quantum Dot Materials (OQDMs): Introduction, synthesis, and properties of chitosan-carbon quantum dots hydrogel and its applications in next-generation flexible and wearable electronics.
**Self-learning:** Properties & electrochemical applications of carbon nanotubes and graphene oxide **8 Hrs**

**Unit-III**

Polymers: Introduction, Molecular weight of polymers: Number average and weight average molecular weight of polymers-numerical problems. Synthesis, conduction mechanism of polyacetylene and its applications in electronic devices. Synthesis and properties of Polyvinylidene Fluoride (PVDF) and its applications in E-nose devices.
Polymer Composites: Introduction, synthesis and properties of epoxy resin-magnetite ($Fe_3O_4$) composite (ultrasonication method) for sensor applications. Synthesis and properties of Kevlar Fiber Reinforced Polymer (KFRP) for smart electronic devices applications.
Stretchable and Wearable Microelectronics: Introduction, basic principle and working of lithography for micro-patterned copper deposition. Synthesis, properties and applications of PDMS (Polydimethylsiloxane) and its uses in e-skin (electronic skin) and RFID applications.
**Self-learning:** Preparation, properties and commercial applications of graphene oxide.
**9 Hrs**

**Unit-IV**

Electrode System: Introduction, types of electrodes, reference electrode-construction and working of calomel electrode, its application in the determination of electrode potential of unknown electrode. Ion selective electrode- definition, construction, working of glass electrode, determination of pH using glass electrode.
Construction and working of concentration cell and numerical.
Electrochemical Sensors: Introduction, principle and instrumentation of colorimetric sensors; its application in the estimation of copper. Principle and instrumentation of potentiometric sensors and its application in the estimation of iron, conductometric sensors; its application in the estimation of acid mixture in the sample.
**Self-learning:** Galvanic cells and overview of Nernst equations. **8 Hrs**

**Unit-V**

Corrosion Chemistry: Introduction, electrochemical theory of corrosion, types of corrosion, differential metal corrosion in electronic circuits and differential aeration corrosion, waterline and pitting corrosion. Corrosion control- galvanization, anodization, cathodic protection, and impressed current method. Corrosion penetration rate (CPR) - definition,

importance and weight loss method, numerical problems.
Metal Finishing: Introduction, technological importance of metal finishing, difference between electroplating & electroless plating, electroplating of chromium for hard and decorative coatings, electroless plating of copper on PCBs.
E-waste: Introduction, sources of e-waste, need of e-waste management & effects of e-waste on environment and human health. Extraction of gold from e-waste from bioleaching method.
**Self-learning:** Factors affecting rate of corrosions, Recycling of e-waste by hydrometallurgy and pyrometallurgy**.**

**9 Hrs**

## PRACTICAL MODULE

1. Estimation of total hardness of given water sample by EDTA method.
2. Estimation of percentage of CaO in cement by complexometric method.
3. Determination of chemical oxygen demand (COD) of industrial effluents.
4. Determination copper in brass by iodometric method.
5. Estimation of iron in Haematite ore solution by external indicator method.
6. Estimation of Chloride by argentometric method.
7. Determination of alkalinity of water sample by HCl method.
8. Estimation of acid mixture using conductometric sensor.
9. Estimation of iron in rust sample using potentiometric sensor.
10. Determination of pKa value of vinegar solution using pH sensor.
11. Estimation of copper present in e-waste (WPCB) by optical sensor (Colorimetry).
12. Determination of viscosity coefficient of green fuel using Ostwald's viscometer.
13. Estimation of percentage of iron in steel industry effluent by using optical sensor.
14. Estimation of Li/Na/K by using Flame photometer.

**Reference Books:**


1. S. K. Malik, Materials Science: Publisher: New Age International Publishers, ISBN: 978- 8122418713.

2. Dr. K. K. Rajeshwar (IIT Madras), Electrochemical Energy System: Publisher: IIT Madras Open Courseware (Free PDF & videos), ISBN: N/A (Open Educational Resource).

3. Vrushabendra B, C Manasa and Srikantamurthy, "Applied Chemistry for Civil Engineering and Allied Branches" by N, Publisher: Astitva Prakashan, ISBN: 9788119064465.

4. Dhanpat Rai, Engineering Chemistry: Jain & Jain, Publisher: Publishing Company, ISBN: 978-9353161181

5. M.G. Fontana, R.W. Staettle, Advances in Corrosion Science and Technology, Springer publications, 2012, ISBN: 9781461590620.