26UCHECS12	Chemistry for CS Stream	(42-0-28-50) 4

Total Hours: 120

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- To enable students to acquire knowledge on principles of chemistry for engineering applications.
- To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
- To provide students with a solid foundation in analytical reasoning required to solve societal problems.

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	-	2,3,7
CO-2	**Explain** the phenomena of chemistry to describe the methods of engineering processes.	1	2	3,4
CO-3	**Solve** for the problems in chemistry that are pertinent in engineering applications.	1	2	7,11
CO-4	**Apply** the basic concepts of chemistry to explain the chemical properties and processes.	1	2	3,7
CO-5	**Analyze** properties and processes associated with chemical substances in multidisciplinary situations.	1,7	-	2,6,11

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11
Mapping Level	3.0	1.6	1.0	1.0	-	1.0	1.5	-	-	-	1.0

Contents:

Unit-I

Memory Devices: Introduction, organic semiconductors: types of organic semiconductors used in memory devices, p-type semiconductor-pentacene and n-type semiconductor- perfluoro pentacene. Construction, working and advantages of pentacene semiconductor chip.

Display Systems: Introduction, liquid crystals (LCs)-classification, properties and its applications. Construction, working principle and applications of Light Emitting Diodes (LEDs), Organic Light Emitting Diodes (OLEDs) and Quantum Light Emitting Diodes (QLEDs).

Self-learning: Resistive RAM (RERAM): Introduction, properties and application. **8 Hrs**

Unit-II

Quantum Dots: Introduction, size dependent properties: quantum confinement effect, surface-to-volume ratio & electrical conductance. Synthesis of SiO_2 nanoparticle by solgel method. Construction, working principles and applications of quantum dot sensitized solar cells (QDSSCs).

Polymer: Introduction, number average and weight average molecular weight of the polymers and numerical problems. Synthesis and properties of nylon- 6,6 and its advantages in 3D printing applications. Synthesis, properties and applications of polyvinyl chloride and PMMA.

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

Self-learning: Mechanism of Free radical addition polymerization of polyethylene.

8 Hrs

Unit-III

Energy Systems: Introduction, basic overview of Nerns't equation. Construction and working of concentration cell and numerical problems. Batteries -component of batteries, classification of batteries. Characteristic of batteries – Capacity, Electrical storage density, Energy efficiency, cycle life and shelf life. Construction, working and application of Li-ion battery.

Next-Generation Energy Devices: Introduction, construction and working of sodium ion battery for EV applications. Construction and working of super capacitors and its applications.

Sustainable Energy Devices: Introduction, fuel cells, 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 by TiO_2 catalyst and its advantages.

Self-learning: Types of electrodes **9 Hrs**

Unit-IV

Sensors: Introduction, terminologies-Transducer, Actuators and Sensors. Conductometric sensor-principle, construction and its application in the estimation of acid mixture. Colorimetric sensor-principle, instrumentation and its application in the estimation of copper. Electrochemical sensors- principle, construction and its application in the detection of DO and pharmaceuticals (Diclofenac) in liquid sample.

Corrosion: Introduction, factors affecting rate of corrosion: Nature of corrosive product, Anode and Cathode area, pH and conductivity of media. Electrochemical theory of corrosion, types of corrosion-differential metal and differential aeration corrosion: waterline and pitting corrosion, stress corrosion. Corrosion control- galvanization and anodization. Vapour corrosion inhibitors for protecting computer circuit boards, corrosion penetration rate (CPR)-definition and numerical problems.

Self learning: Electrochemical sensors for the detection of SO_X and NO_X **8Hrs**

Unit-V

Green Chemistry: Introduction, properties and applications of green solvents for server heat management. Synthesis and properties of glycerol trioleate ester and its uses in IT infrastructure applications. Green synthesis of ZnO nanoparticles and its uses in magnetic Radio Frequency Identification (RFID) and Internet of Nano Things (IONT) system applications.

Biomaterials: Introduction, synthesis and properties of polylactic Acid (PLA) and polyethylene glycol (PEG) and its uses in touch screen applications. Synthesis and properties of Alginate Hydrogel and its uses in 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, extraction of gold from e- waste by bioleaching method, Role of stake holders in e-waste management.

Self-learning: Green computing, benefits of green computing **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. Ishihara, Kobayashi & Ukai, High Quality Liquid Crystal Displays and Smart Devices, (2019, IET), ISBN: 9781785619397.

2. Yotishkumar Parameswaranpillai, Poushali Das, Sayan Ganguly, Quantum Dots and Polymer Nanocomposites: Synthesis, Chemistry, and Applications- Publisher: CRC Press, 2022, ISBN 13: 978 1032210148.

3. Prasanna Chandrasekhar (IIT Delhi alumnus), Conducting Polymers, Fundamentals and Applications: Including Carbon Nanotubes and Graphene:, Springer, 2019 (2nd ed.), ISBN 13: 978 3030098858.

4. Vijay Kumar, Pardeep Singh, Devendra Kumar Singh (India), Green Carbon Quantum Dots: Environmental Applications: Springer Nature Singapore, Oct 2024, ISBN 13: 978 9819762026.

5. Deepak Verma, Semiconducting Materials and Devices-, ISBN: 978 9394777712