26UCHEME22	Chemistry for ME 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.	1,11	6	2,7
CO-3	**Solve** for the problems in chemistry that are pertinent in engineering applications.	1	-	2,3,6,7,11
CO-4	**Apply** the basic concepts of chemistry to explain the chemical properties and processes.	1	-	2,3,6,7
CO-5	**Analyze** properties and processes associated with chemical substances in multidisciplinary situations.	1	-	2,3,7,9,11

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Mapping Level	3.0	1.0	1.0	-	-	1.3	1.0	-	1.0	-	1.6

Contents:

Unit-I

Corrosion: Introduction, electrochemical theory of corrosion, , factors affecting rate of corrosion-Nature of the metal, nature of the corrosion product, anodic and cathodic area, pH, temperature and conductance of the medium, types of corrosion-differential metal and differential aeration corrosion-water line and pitting corrosion, and stress corrosion. Corrosion control- metal coating; galvanization, surface conversion coating; anodization and cathodic protection; sacrificial anode method, corrosion penetration rate (CPR) - Introduction and numerical problems.

Coating Technologies: Introduction, technological importance, electroplating - electroplating of chromium-decorative and hard chromium, electro-less plating - electroless plating of Nickel, difference between electroplating and electroless plating.

Self-learning: Tinning processes and voltage impressive method. **8 Hrs**

Unit-II

Fuels: Introduction, calorific value, determination of calorific value using bomb's calorimeter, numerical problems on GCV and NCV. Knocking in internal combustion (IC) engines - knocking mechanism in IC engines. Anti-knocking agents lead petrol and unleaded petrol - methyl tertiary butyl ether (MTBE) and ethyl tert-butyl ether (ETBE). power alcohol – properties, applications Importance of octane and cetane rating of fuel.

Green Fuels: Biodiesel- synthesis by trans-esterification method, advantages and its applications. Production of green hydrogen by photocatalytic water splitting and its advantages.

Self-learning: Hydrogen storage – introduction, advantages and limitations of metal hydride and ammonia as chemical hydrogen carriers. **08 Hrs**

Unit-III

Nanomaterials: Introduction, Size-dependent properties of nanomaterial-surface area, catalytical, electrical and thermal conductivity. Graphene - Synthesis by chemical vapor deposition (CVD) method, properties and engineering applications. synthesis of TiO_2 nanomaterials by sol-gel method and its uses in catalytic converter.

Energy Systems: Batteries - Introduction, classification of batteries, characteristics-capacity, power density, shelf life and cycle life. Construction, working and applications of lead-acid & Li-ion battery.

Fuel cells - Introduction, construction and working of solid oxide fuel cells (SOFCs) and its uses in auxiliary power units (APUs). Differences between fuel cells and battery.

Self-learning: Fuel cell-classification, advantages and disadvantages. Solar photovoltaic cells (PV cells) - construction, working, advantages and limitations. **09 Hrs**

Unit-IV

Polymers: Introduction, classification, Number average and weight average molecular weight of polymer-numerical problems. Glass transition temperature (Tg), factor affecting Tg and its significance. synthesis, properties and engineering applications of chlorinated polyvinyl chloride (CPVC), polymethyl methacrylate (PMMA), ABS polymer and polycarbonate. Preparation, properties and industrial applications of graphene oxide by Hummer's method.

Polymer Composites: Introduction, fiber-reinforced polymers (FRPs); Kevlar – Synthesis, properties and industrial applications. Carbon-fiber - Preparation from Polyacrylonitrile (PAN), properties and industrial applications. **09 Hrs**

Unit-V

Lubricants: Introduction, types, ideal properties and applications. Lubricant testing; experimental determination of viscosity using Ostwald's viscometer.

Industrial Coolants: Introduction, types - water and oil-based coolants, properties and industrial applications.

Sensors: Potentiometric sensors: Principle, instrumentation and application in the estimation of iron in industrial effluents. Conductometric sensors: Principle, instrumentation and application in the determination of acid mixture in industrial effluents. Colorimetric sensor: Principle, instrumentation and application in the estimation of copper in brass alloy. pH sensor: Glass electrode, principle, working and determination pH by using glass electrode. Mentions its advantages and limitations.

Self-learning: Functions of Industrial Coolants. pH sensor -Its application in the estimation of pKa of acid electrolyte. **8Hrs**

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. Wiley Engineering Chemistry, Wiley India Pvt. Ltd. New Delhi, 2013- 2nd Edition.

2. Shashi Chawla, Dhanpat Rai & Co. (P) Ltd., A Textbook of Engg. Chemistry.

3. R.V. Gadag and Nityananda Shetty, A Textbook of Engineering Chemistry, I. K. International Publishing house. 2nd Edition, 2016.

4. V R Gowariker, N V Viswanathan, Jayadev, Sreedhar, Newage, Polymer Science, Int. Publishers, 4th Edition, 2021.

5. G.A. Ozin & A.C., Nanotechnology A Chemical Approach to Nanomaterials, Arsenault, RSC Publishing, 2005.