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FUNDAMENTAL CHEMISTRY

(Food Technology & allied branches)

Course Objectives:

- To familiarize engineering chemistry and its applications.
- To train the students on the principles and applications of electrochemistry and polymers.
- To introduce instrumental methods, molecular machines and switches.

Course Outcomes: At the end of the course, the students will be able to

CO1: Compare the materials of construction for battery and electrochemical sensors.

CO2: Explain the preparation, properties, and applications of thermoplastics &thermosetting, elastomers & conducting polymers.

CO3: Distinguish the principles of spectrometry, solid liquid chromatography in separation of solids and liquid mixtures.

CO4: Apply the principle of Beer Lambert's Law.

CO5: Illustrate conductometric and pH metric titrations.

UNIT I Structure and Bonding Models

Planck's quantum theory, dual nature of matter, Schrodinger wave equation, significance of Ψ and Ψ^2 , applications to hydrogen, Molecular Orbital Theory – bonding in homo- and heteronuclear diatomic molecules – Energy level diagrams of O₂ and CO, etc. π -molecular orbitals of butadiene and benzene, calculation of bond order.

UNIT II Electrochemistry and Applications

Electrodes –reference electrodes (Calomel electrode, and glass electrode) electrochemical cell, Nernst equation, numerical problems based on cell potential calculations, pH meter and applications of pH metry (acid-base titrations), conductivity, conductivity cell, conductometric titrations (acid-base titrations).

Electrochemical sensors – potentiometric sensors with example.

Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium and lithium ion batteries-working principle of the batteries including cell reactions; Fuel cells- hydrogen-oxygen fuel cells – basic principle, working, and applications.

UNIT III Polymer Chemistry

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, with specific examples and mechanisms of polymer formation.

Plastics - Thermoplastics and Thermo settings, Preparation, properties and applications of – PVC, Bakelite, Nylon-6,6, carbon fibres. Elastomers–Buna-S, Buna-N–preparation, properties and applications.

Bio degradable polymers: Poly β -hydroxybutyrate-co- β -hydroxyvalerate(PHBV), poly hydroxyl butyrate(PHB) and applications.

UNIT IV Instrumental Methods and Applications

Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. UV-Visible Spectroscopy, electronic transition, Instrumentation, IR spectroscopies, fundamental modes and selection rules, Instrumentation. Chromatography: Basic principle-Classification of Chromatography-HPLC-principle, Instrumentation, Thin Layer Chromatography (TLC) and applications

UNIT V Surface Chemistry and Nano Materials

Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, synthesis of colloids (Braggs Method), chemical and biological methods of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, adsorption isotherm (Freundlich and Longmuir), BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors, etc.

Textbooks:

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
2. D.J. Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heineman, 1992.
3. J.D. Lee, Concise Inorganic Chemistry, 5th Edition, Wiley Publications, Feb.2008