Physical Chemistry
(Chemical Engineering)

Course Code: 22BC1105 **L T P C**

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Course Outcomes: At the end of the course the student shall be able to

CO1: Apply principles and applications of distribution law (L3)
CO2: Determine reaction rates and propose mechanisms (L3)
CO3: Predict the mechanism of catalytic reactions (L3).
CO4: Use the principles of reactions in equilibria (L3).
CO5: Apply the principles of electrochemistry (L3).

UNIT-I **10 Lectures**

DISTRIBUTION LAW

Statement-Nernst Distribution law, Explanation and limitations of law, Modified Distribution law for association or dissociation of the solute; Applications of Distribution law- Determination of equilibrium constant from distribution coefficient, solvent extraction, Desilverisation of lead, Distribution indicators, Partition chromatography.

Learning outcomes:
At the end of the module the student will be able to

1. explain the principles of distribution law (L2)
2. apply the principle of solvent extraction to extract the solute (L3)
3. determine the Equilibrium constant of an equilibrium (L3)

UNIT-II **10 Lectures**

CHEMICAL KINETICS

Basic Terms, Methods of determining order of reaction, Theories of reaction rates-Collision Theory, Arrhenius Equation and Absolute reaction rates; Simultaneous reactions- Consecutive reactions, Parallel reactions and opposing reactions. Fast reactions-Stopped flow and relaxation techniques

Learning outcomes:
At the end of the module the student will be able to

1. apply the methods to determine order of a reaction (L3)
2. describe various theories of reaction rates (L2)
3. interpret the mechanisms of complex reactions (L2)

UNIT-III: **8 lectures**

CATALYSIS

Definition, Types-Homogeneous and heterogeneous catalysis; Characteristics of catalysts, Promoters, Catalytic poisoning, Retardation, Autocatalysis, Activation energy and catalysis; Mechanism of Catalysis; Acid-base catalysis- Protolytic and Prototropic mechanism; Enzyme catalysis- Characteristics of enzyme catalysis, Mechanism of enzyme catalysis (Michaelis-Menten's Mechanism).

Learning outcomes:
At the end of the module the student will be able to

1. explain the general properties of catalysts (L2)
2. discuss the mechanism of acid- base catalysis (L2)
3. interpret the mechanism of enzyme catalysis (L3)

UNIT-IV: **10 Lectures**

CHEMICAL EQUILIBRIA

Chemical equilibrium, the law of mass action, factors affecting chemical reactions in solution, Le Chatelier's principle, solubility product. Acid-Base equilibria in water- Ostwald's dilution Law, Strengths of acids and bases, Dissociation of polyprotic acid, Titration curve of weak polyprotic acid (H_3PO_4); Common ion effect, ionic product of water, Hydrogen ion exponent, Hydrolysis of salts, Degree of hydrolysis, Buffer solutions.

Learning outcomes:

At the end of the module the student will be able to

1. determine the dissociation constant of acids and bases (L3)
2. interpret titration curve of polyprotic acids (L3)
3. explain the concepts of pH and buffer solutions (L2)

UNIT-V **12 Lectures**

ELECTROCHEMISTRY

Specific, molar and equivalence conductance-effect of dilution, Arrhenius theory of electrolytic dissociation, Ostwald's dilution Law-Limitations, Debye-Huckel–Onsagar theory of strong electrolytes (Interionic atmosphere Theory); Ionic Product and concepts of activity coefficient.

Electrode potential, Nernst equation, EMF of electrochemical cell, reference electrodes-standard hydrogen electrode, calomel electrode. Electrochemical series, Concentration cell, Construction of glass electrode, determination of pH of given solution using glass electrode. Sensors (Potentiometric and amperometric); Batteries-Classification, Primary Cells-Dry cell, Secondary Cell-Lithium ion cell, Fuel Cell-Alkaline H_2-O_2 Fuel cell.

Learning outcomes:

At the end of the module the student will be able to

1. calculate electrode and cell potentials (L3)
2. apply redox principles for construction of batteries (L3)
3. explain the significance of theories of electrolytes (L2)

Text Books:

1. Arun Bahl, B.S. Bahl and G.D.Tuli, *Essentials of Physical Chemistry*, 16th Edition, S. ChandPublications, 2006.
2. Puri, Sharma and Pathania, *Physical Chemistry*, 42nd Edition, Vishal Publishing Company, 2008.

Reference Books:

1. Glasston & Lewis, *Physical Chemistry*, 2nd Edition, MacMillan Publishers, 1973.
2. Atkins, *Physical Chemistry*, 9th Edition, W.H. Freeman Publishers, 2010.
3. G.H.Jeffery, J.Bassett, Mendham and R.C.Denney, *Vogels textbook of quantitative chemical Analysis*, 5th Edition, Longman Group,1989.