PHYSICAL AND ANALYTICAL CHEMISTRY
(For Chemical Engineering)

Course Code - Category: CHE 123 - BS **Credits:3**

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3	0	0	1	5

Sessional Marks:40

End Exam: 3 Hours

End Exam Marks:60

Course Objectives

- To understand the concept of Homogenous and heterogeneous chemical equilibriumwith its importance in industrial process.
- To get an idea about the Surface chemistry and its characterization.
- To give a knowledge on basic quantitative techniques of Titrimetry and Gravimetry.
- To inculcate the concept of various Electro-analytical techniques.
- To give an awareness on various Separation techniques.

Course Outcomes

By the end of the semester, the student will be able to:	
CO1	**Apply** the Homgeneous and heterogeneous Chemical equilibria laws in various systems and **Develop** Optimum conditions for these systems in Industrial Processes
CO2	**Familarize** in the concepts of surface characterisation by using X-Ray difraction and stabilization of colloids and nanomaterials.
CO3	Get **Knowledge** on the Quantitative determination of various samples either by using Titrimetry or gravimetry with least error.
CO4	Get adept in **Computing** pH, Potential and conductance by electro analytical methods
CO5	Separate impurities by **Applying** Solvent extraction and Gas chromotagraphy Techniques

SYLLABUS

UNIT- 1
12 periods

Chemical Equilibrium: Reversible and irreversible reactions, concept of equilibrium, Law of Mass action, Equilibrium constant, Factors influencing equilibrium constant, apply law of mass action tohomogeneous gaseous and liquid systems, Le-Chatelier principle- applications, Effect of temperature on equilibrium constant -derivation

Phase rule: Definition- explanation of terms- Derivation of Phase Rule- One component system (water system)- Two component system (Ag-Pb), Eutectic mixture- its significance.

Learning Outcomes:

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

- **list** the differences between Reversible and Irreversible reactions (L1)
- **Apply** the law of Mass action to different homogeneous and heterogeneous systems (L2)
- **State** Le- chatlier principle(L1)
- **Develop** Optimum conditions for few Industrial process reactions(L5)

UNIT- II **10 periods**

Surface Chemistry: Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, method of preparation of nanomaterialsby Chemical Vapour deposition methods, stabilization of colloids and nanomaterials by stabilizing agents.

Characterization of surfaces - X-ray diffraction- Principle & Instrumentation; Adsorption- B.E.T equation (no derivation), Surface area- importance and Determination by B.E.T method, Applications of colloids and nanomaterials.

Learning Outcomes:

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

- **Illustrate** the role of an stabilizing agents in stabilization of colloids and nano material (L2)
- **Explain** the principles and instrumentation of X – Ray Diffrection (L2)
- **Apply** BET equation in measuring surface area(L3)

UNIT- III
10 periods

Introduction to Chemical analysis –Quantitative analysis, classification of errors- accuracy, precission- minimization of errors; Titrimetric Analysis,

Classification of reactions in titrimetric analysis- Standard solutions- Primary and Secondary standards, Theory of Indicators(Acid Base, Redox, Complexometric & precipitation Titrations); Gravimetric analysis- process of precipitation, contamination of precipitates (co-precipitation & post precipitaion)

Learning Outcomes:

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

- **Describe** different ways of minimization of errors(L2)
- **Explain** the theories behind different types of indicators (L2)
- **Analyse** the amount of Nickel present in the given sample(L4)

UNIT- IV

10periods

Electro- analytical Methods : Potentiometry- introduction, instrumentation and potentiometric titration (Redox); introduction to pH, determination of pH, pH metric titrations. Conductometry- conductance and types of conductance, Conductmetric Titrations (Acid-base) **,** variation of conductance with temperature, Kohlrausch's law and applications- calculation of equivalent conductance and degree of dissociation of weak electrolytes.

Learning Outcomes:

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

- **Define** electrode potential (L1)
- **Explain** the Instrumentation of Potentiometry(L2)
- **Compute** the strength of Acids and basesby pH meter (L3)
- **Apply** the Kohlrausch's law in measurement of equivalent conductance of weak electrolytes (L4)

UNIT- V
10 periods

Basics of Industrial SeparationTechniques:
Distribution law- partition coefficient, Solvent extraction -multiple extractions; Chromotography- principle, RF value, resolution and retention time, types of chromotogaphy- Thin layer and gas chromotography- instrumentation.

Learning Outcomes:

At the end of ths unit the student will be able to

- **State** Distribution Law (L1)
- **Explain** the efficiency of multiple extractions (L2)
- **Separate** impurities from an analyte using Gas chromatography (L4)

Prescribed text books

1. **Arun Bhal, B.S.Bhal and G.D.Thuli** "*Essentials of Physical chemistry*" S.Chand and company ltd. 2009.
2. **Chatwal and Anand**; "*Instrumental Methods of Chemical Analysis*" 5th edition, Himalaya Publishing Company.

Reference books

1. **Peter Atkins & Julio de Paula** "*Physical Chemistry*" 7th edition, oxford university
2. **B.R.Puri and L.R.Sharma** "*Principles of Physical Chemistry*", 44th edition press vishal publishing company, New Delhi.
3. **Vogel** "*Text book of Quantitative Chemical Analysis*" 6th edition, Pearson, 2014.