M.Sc. (PREVIOUS) CHEMISTRY SYLLABUS
SEMESTER-I
PAPER-IV: PHYSICAL CHEMISTRY-I
(Effective from the admitted batch of 2022-2023)

Credits: 4		**Theory: 4 Hours**
Max Marks: 100	**External: 80**	**Internal: 20**

Course Outcomes (COs)/Course Specific Outcomes (CSOs):

CO 1: Explain the basic concepts of Thermodynamics and its applications.
CO 2: Understand the concepts of thermodynamics of solutions.
CO 3: To understand the principle of micellisation.
CO 4: Understand the various kinetic theories, measurements of reaction rates.
CO 5: Learn experimental techniques for measuring the kinetics of fast reactions and homogenous catalyzed reactions.

Course learning outcome (LOs):

Upon completion of the course the students should be able to:
LO 1: To apply the concepts of thermodynamics to various problems in chemistry.
LO 2: To predict various thermodynamics of mixing of liquids (ΔHmix, ΔGmix and ΔSmix) of ideal gases.
LO 3: Adsorption-Adsorption isotherms- Freundlich adsorption isotherm, Langmuir adsorption isotherm-limitations
LO 4: To determine the stereochemistry of different organic molecules and various possible conformations of organic compounds
LO 5: To understanding the effect of dielectric constant on reactions - Effect of substituent-linear free energy relationships-Hamett equation
LO 6: To apply the concept of micellization to various chemical reactions. Explain specific and general acid-base catalysis. Steady state approximation- Enzyme catalysis.

UNIT-I **[12 Hours]**

Basic concepts of second law of Thermodynamics-Entropy- Entropy changes accompanying different processes-Entropy changes in an ideal gas, entropy changes in the mixing of ideal gases, entropy as a function of V and T and entropy as a function of P and T- Entropy change in isolated systems-Helmholtz and Gibbs energy -Maxwell relations.

Criteria for spontaneity-variation of Gibbs energy with temperature and pressure for solids, liquids and gases-Concept of fugacity-determination of fugacity coefficient of gases.

UNIT-II **[12 Hours]**

Thermodynamics of mixtures -partial molar quantities-Gibbs-Duhem equation and Duhem-Margules equation-Thermodynamics of mixing of liquids (ΔHmix, ΔGmix and ΔSmix) - Thermodynamics of ideal solutions - Raoult's law.
Thermodynamics of colligative properties of dilute solutions - concept of activity and activity coefficient- Thermodynamic concept of equilibrium, Van't Hoff equation-Third law of thermodynamics-exceptions to third law of thermodynamics.

UNIT-III **[12 Hours]**

Surface tension- Adsorption-Adsorption isotherms- Freundlich adsorption isotherm, Langmuir adsorption isotherm-limitations - BET adsorption isotherm-estimation of surface area.
Surface active agents, classification of surface-active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants.

UNIT-IV **[12 Hours]**

Chemical Kinetics: Theories of reaction rates- Collision theory- Limitations, Transition state theory. Lindeman's theory of unimolecular reactions. Effect of ionic strength on rates of reactions- Primary and secondary salt effects.
Effect of dielectric constant on reactions - Effect of substituent-linear free energy relationships-Hamett equation -limitations- Taft equation. Kinetics of consecutive and parallel reactions, (Uni molecular steps only, no derivation).

UNIT-V **[12 Hours]**

Specific and general acid-base catalysis. Steady state approximation- Enzyme catalysis- Michaelis -Menten mechanism. Derivation of Kinetic rate equation.
Fast reactions- different methods of studying fast reactions- flow methods, relaxation methods- temperature jump and pressure jump methods.

Text Books:

1. Physical Chemistry by Peter Atkins and Julio de Paula, Oxford University Press.
2. Chemical Kinetics by K. J. Laidler, McGraw Hill Pub.
3. Physical chemistry by K.L. Kapoor

Reference Books:

1. Thermodynamics for Chemists, Samuel Glasstone
2. Physical chemistry by Puri, Sharma and Pathania
3. Micelles, Theoretical and applied aspects, V. Moroi, Plenum publisher

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