

CHEMISTRY-I (PHYSICAL CHEMISTRY)

CREDIT HOURS: 3

COURSE OBJECTIVES

The objective of the course is for students

1. Understand and apply the laws of thermodynamics and kinetics.
2. Understand the role that thermodynamics and kinetics play in chemical equilibrium.
3. Understand how mathematics, models and approximations are used to explain chemical phenomena and fundamental properties of matter.
4. Use concepts of thermodynamics/kinetics/equilibrium to make predictions and give explanations about chemical systems and fundamental properties of matter.
5. Develop skills in making decisions in the lab, in data acquisition, and critical evaluation of data.
6. Appreciate the role physical chemistry plays in chemical (physical, biological, etc. systems).

COURSE CONTENT:

1. STATES OF MATTER

A. Gases:

Law of equipartition of energy, Collision diameter, collision number, collision frequency and mean free path; Viscosities of gases, measurements, effect of temperature and pressure on viscosities of gasses; Critical phenomenon of gases and experimental determination of P_c , V_c and T_c ; Concept of molecular velocities of gasses according to Maxwell's distribution law and comparison of various velocities.

B. Liquids:

The properties of liquids like surface tension, viscosity, refractive index and dipole moment; Parachor, rehochor and molar refraction as additive and constitutive properties; Measurement of refractive index and dipole moment; Magnetic susceptibility and its measurement by Gouys balance.

C. Solids:

Symmetry operations and Bravis lattices; Concept of X-Ray diffraction, Bragg's equation and crystal structure analysis; Powder method of crystal structure analysis; X-ray crystallography of sodium chloride crystal; Heat capacities of solids.

2. CHEMICAL THERMODYNAMICS:

Heat capacity as C_p and V_c ; Difference in C_p and C_v and ration of C_p and C_v towards atomicity; Temperature dependence of heat capacities; Quantitative effect of temperature over enthalpy change and internal energy change; Types of thermodynamical processes; Isothermal reversible expansion of ideal gases; Adiabatic process of ideal gasses; Second law of thermodynamics, Carnot cycle, efficiency of

heat engine and concept of entropy; Thermodynamics scale of temperature entropy for phase transition, spontaneity and reversibility; Entropy change in reversible and irreversible processes; Temperature dependence of entropy, Variation of entropy with pressure and volume; Concept of free energy; Derivation of Gibbs and Helmholtz equation; standard free energy of formation; Partial molar quantities, Chemical potential, variation of chemical potential with pressure and temperature fugacity; Thermodynamic of equilibrium, Reaction isohore; Calusius-Clapeyron equation; Molecular basis of entropy and probability.

3. CHEMICAL KINETICS:

Derivation of kinetic expression of zero order, first order, second order (with same and different concentration) and third order reactions (with same concentrations) with suitable examples; Equation for half life periods and determination of rate constants; Methods of measurements of order of reactions giving examples with different techniques; Derivation of Arrhenius equation and measurements of Arrhenius parameters, Measurement of slopes of Arrhenius plots for some important reactions Bimolecular collision theory of reaction rates and its failures; Collision theory of uni-molecular, gas phase reactions (Lindeman mechanism); Introduction transition state theory of reaction rates.

4. SOLUTION:

Thermodynamics derivation of colligates properties as lowering of vapor pressure, elevation of boiling point, depression of freezing point; Relationship between lowering of vapor pressure with ΔT_b and ΔT_f ; Osmotic pressure an their determination; Concept of semi permeable membrane, Isotonic solution, theory of osmotic pressure, relationship between vapor pressure and osmotic pressure, Abnormal colligative properties describing association and disassociation of solutes; Fractional distillation and idea of azotropes in detail; Concept of colloids; Classification of Colloids; their properties with reference to dialysis, electro dialysis, sedimentation, precipitation, ultra filtrations, Suspensions and gels; Tyndal cone effect; Macromolecules and micelles.

5. SURFACE CHEMISTRY:

Introduction to adsorption; Difference between physical and chemical adsorption; Adsorption of gases by solids; Different types of adsorption isotherms with special reference to Langmuir adsorption isotherm and its applications; Freundlich adsorption isotherm giving some important applications; Brief introduction to catalysis; Theories of Catalysis; Activation energy for catalyzed reactions; Kinetics of enzyme catalysis; Theories of catalysis; Activation energy for catalyzed reactions; Kinetics of enzyme catalysis.

Evaluation Criteria

Examination	Type	Marks
Internal Examination	Sessional Work	15%
	Mid-Semester	25%
External Examination	Final Semester	60%

Recommended Books:

1. Adamson A. W. "Understanding Physical Chemistry" 3rd Ed., Benjamin Cummings Publishing Company Inc.
2. Akhtar M.N.& Ghulam Nabi, "Textbook of Physical Chemistry", ilmi Kutab Khana, Lahore.
3. Bhatti H.N. and K.Hussain, "Principles of Physical Chemistry"; Carwan Book House, Lahore.
4. Maron S.H. & B. Jerome, "Fundamentals of Physical Chemistry", Macruthan Publishing Co., Inc. New York. (Also published by National Book Foundation).
5. Atikins P.W.& M.J.Clugston, "Principles of Physical Chemistry" Pitman Publishing Company (1988).
6. Moore W.J. "Physical Chemistry", 5th Ed. Longmans Publishers.
7. Jones M. "Elements of Physical Chemistry" Addison-Sesky Publishing Company.
8. G.M.Barrow, International six Edition "Physical Chemistry".
9. IRA. N. Levine fourth edition "Physical Chemistry"
10. Alberty and Danials, "Physical Chemistry"
11. Castallon, "Physical Chemistry"
12. Laidler & Meiser "Physical Chemistry"
13. Friemental "Chemistry in Action"

CHEMISTRY LAB-I (PHYSICAL CHEMISTRY)

CREDIT HOURS: 1

1. Determination of percentage composition by surface tension, viscosity and refractive index method.
2. Determination of heat of solution for solids and liquids.
3. Quantitative measurement of colored salt of KMnO_4 , $\text{K}_2\text{Cr}_2\text{O}_7$ in colorimeter.
4. Study of first order reaction:
 - a) Study of hydrolysis of methylacetate
 - b) Measurement of rate constant
5. Measurement of molecular weight by; Depression of freezing point.
6. Determination of transition temperature of $\text{Na}_2\text{SO}_4 \cdot 10 \text{H}_2\text{O}$; $\text{Na}_2\text{CO}_3 \cdot 10 \text{H}_2\text{O}$; $\text{MgSO}_4 \cdot 7 \text{H}_2\text{O}$

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Recommended Books:

1. Crocleford H.D., H.W.Biard, F.W. Getzen & J.W. Nowell, "Laboratory Manual of Physical Chemistry", 2nd Ed., John Wiley & Sons London.
2. Das R.C. and B. Behera, "Experimental Physical Chemistry", Tata McGraw Hill Publishing Company Limited.
3. Levitt B.P., "Findlay's Practical Physical Chemistry", 9th Ed., Longman Group Limited.