Semester IV

C10: Chemistry 2 (Theory MBTCR4102T; Practical MBTCR4102P)

Theory: CIA: 10 Marks; End-Sem: 50 Marks
Practical: 40 Marks

Theory:
Module A: (30 marks) **(2.5 classes per week)**

Unit I: Principles and Applications of Thermodynamics: Importance and scope of thermodynamics, Definitions of systems and surroundings, Types of systems (closed, isolated and open), Extensive properties and intensive properties, Steady state and equilibrium state, Concept of heat and work, Reversible and irreversible processes and work done.

First law of Thermodynamics- Internal energy as a state function, state and path functions, Exact and inexact differentials, Enthalpy as a state function, Specific heat at constant volume and pressure, relationship between them and their differences, Isothermal and adiabatic processes, Thermochemistry- heat changes during physicochemical processes at constant pressure/volume, Kirchoff's equations.

Second law of Thermodynamics- Importance of Second law, Statements of Second law of Thermodynamics, Carnot's cycle, Principle of refrigerator, Physical concept of entropy, Entropy as a state function, Clausius inequality, Entropy change of systems and surroundings for various processes, Entropy change during the isothermal mixing of ideal gases, Entropy and unavailable work, Combined first and second law, Helmholtz free energy and Gibbs free energy, Spontaneity and equilibrium, Gibbs Helmholtz equation and their simple applications, Clausius-Clapeyron relation and phase transition, Concept of chemical potential, Partial molar quantities, Donnan equilibrium, Concept of activity and activity coefficient, Thermodynamic requirements of reactions- ΔH, ΔS, ΔG dependence of reactants and products.

Unit II:Chemical Bonding II: Structure and bonding in co-ordination compounds- Valence Bond Theory and its drawbacks. Crystal Field Theory- splitting of d^n configurations in octahedral and tetrahedral fields, Crystal Field Stabilisation Energy (CFSE) in weak and strong fields, Pairing energy, Factors affecting the magnitude of 10Dq, Spectrochemical series, Comparison of CFSE for Oh and Td complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination. Molecular orbital theory (elementary idea)- σ- and π-bonding in octahedral complexes (qualitative pictorial approach).

Unit III: Bonding Features in Organic Molecules: Formation of σ- and π-bonds, Bond length (distance), Bond angles, Strains in organic molecules. Inductive effect, Electromeric effect, Steric effect, Resonance, Resonance energy, Steric inhibition of resonance, Hyperconjugation and their applications. Intermolecular and intramolecular forces- Dipole-dipole interaction, Induced-dipole interaction, London force, Hydrogen bonding force. Physical properties related to molecular structures, Solute solvent interaction.

Module B: (20 marks) **(1.5 classes per week)**

Unit IV: Elementary Quantum Mechanics: Wave and particle nature of the subatomic particles, Rutherford model, Bohr's postulates, wave particle duality, de Broglie's matter wave, Heisenberg's Uncertainty Principle, line spectrum of hydrogen- Rydberg constant, Schrodinger's equation (time independent) and particle in one-dimensional box, operators, Eigen function and Eigen values, Radial and angular distribution function, shapes of s, p, d orbitals.

Unit V: Chemical Kinetics: Concepts of rate, rate constant, Order and molecularity of a reaction, Rate equations (1st, 2nd and 3rd order reactions), Calculation of the Rate constants, Pseudo unimolecular reaction, Half value period and its significance, Determination of order of a reaction, Rate determining step, Zero and fractional orders, Steady state approximations,Collision and Transition state Theories, Kinetically controlled and thermodynamically controlled reactions, Temperature dependence on rate constant, Arrhenius equation, Activation energy, Enzyme kinetics, Catalysis- homogeneous and heterogeneous, Enzyme catalysis, Michelis- Menten equation.

Teachers involved: Dr. Sudipa Saha (Module A), Dr. Jhimli Dasgupta (Module B)

Practical:

Qualitative inorganic analysis of mixtures containing not more than 4 radicals (two acid Radicals and two basic radicals and excluding insoluble salts) out of the following:

Basic radicals: Pb^{+2}, Ag^{+}, Bi^{3+}, Cu^{+2}, Cd^{+2}, Sn^{+2}, Fe^{+3}, Al^{+3}, , Cr^{+3}, Co^{+2}, Ni^{+2}, Mn^{+2}, Zn^{+2} , Ca^{+2}, Sr^{+2}, Ba^{+2}, Na^{+}, K^{+}, NH_4^{+}

Acid Radicals: CO_3^{2-}, S^{2-}, $S_2O_3^{2-}$, SO_4^{2-}, F^{-}, Cl^{-}, Br^{-}, I^{-}, NO_2^{-}, NO_3^{-}, PO_4^{3-}, BO_3^{3-}/ H_3BO_3.

(Spot tests should be carried out wherever feasible)

Teachers involved:

Dr. Sudipa Saha

Dr. Jhimli Dasgupta

Texts & Reading/Reference Lists:

Theory:

Module A:

G.W. Castellan, Physical Chemistry, Narosa, 4th edition, 2004.

P. C. Rakshit, Physical Chemistry, Sarat Book House, Revised & enlarged 7th edition, 2014.

R. P. Sarkar, General and Inorganic Chemistry (Part-II), New Central Book Agency (P) Limited, 3rd Revised edition, 2011.

J. D. Lee, Concise Inorganic Chemistry, ELBS, 1991.

S. K. Ghosh, Advanced General Organic Chemistry- A Modern Approach, New Central Book Agency (P) Limited, 2010.

P. Sykes, A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).

Module B:

Physical Chemistry with Applications to the Life Sciences; David Eisenberg, Donald Crothers. The Benjamin/ Cummings Publishing Company. Inc.

P. C. Rakshit, Physical Chemistry, Sarat Book House, Revised & enlarged 7th edition, 2014.

Practical:

A. K. Nad, B. Mahapatra and *A.* Ghosal, An Advanced Course in Practical Chemistry, New Central Book Agency (P) Limited, 2014