M.Sc. (Chemistry)

Physical Chemistry

Theory of Gases: Kinetic theory of gases. Van der Waals equation and applications, Maxwell-Boltzmann distribution law, critical phenomena.

Chemical Thermodynamics: Reversible and irreversible processes, First law and its application to ideal and nonideal gases, Thermochemistry, Second law, Entropy and free energy, Criteria for spontaneity. Third law and its application.

Chemical and Phase Equilibria: Law of mass action, Kp , Kc, Kx and Kn , Effect of temperature on K, Ionic equilibria in solutions, pH and buffer solutions, Hydrolysis, Solubility product, Clausius-Clapeyron Equation, Phase equilibria–Phase rule and its application to one-component and two-component systems, Colligative properties.

Electrochemistry: Conductance and its applications, Transport number, Galvanic cells, EMF and Free energy, Concentration cells with and without transport. Conductometric and potentiometric titration.

Chemical Kinetics: Reactions of zero, 1^{st}, 2^{nd} and 3^{rd} order, Arrhenius equation, Collision theory, Theory of absolute reaction rate, Enzyme kinetics.

Quantum Mechanics: Black-body radiation, Plank's radiation law, photoelectric effect, heat capacity of solids, Compton effect, Schrodinger Equation, wave function and its significance, postulates of quantum mechanics, quantum mechanical operators, commutation relations, Role of operators in quantum mechanics, Particle in one dimensional box.

Molecular Spectroscopy: Electromagnetic radiation, regions of spectrum, basic features of spectroscopy, statement of Born-oppenheimer approximation, Degrees of freedom. Elementary idea of Rotational (rigid rotor), Vibrational (harmonic & anharmonic oscillator) and Raman Spectra of simple diatomic molecules.

Inorganic Chemistry

Atomic Structure: Fundamental particles. Bohr's theory of hydrogen atom, Wave-particle duality, Uncertainty principles, Schrodinger's wave equation, Quantum numbers, shapes of orbitals, Hund's rule and Pauli's exclusion principle.

Periodic Properties: Periodic classification of elements and periodicity in properties, Atomic and ionic radii, ionization energy, electron affinity and electronegativity – definition, methods of determination or evaluation, trends in periodic table (in s & p block elements).

Chemical Bonding and Shapes of Compounds: Types of bonding, Valence Bond Theory and Molecular Orbital theory of diatomic molecules, VSEPR theory and shapes of molecules, hybridization, dipole moment.

Solid State: Ionic structures (NaCl, CsCl, ZnS (Zinc Blende), CaF_2, diamond, graphite etc.) radius ratio rule, lattice defects, lattice energy and Born-Haber cycle.

Hard and Soft Acids and Bases: Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness, Symbiosis,Liquid NH_3 as non-aquesous solvent.

Main Group Elements (s and p blocks): Chemistry with emphasis on group relationship and gradation in properties, structure of electron deficient compounds of main group elements and application of main group elements (s & p-block including noble gases).

Chemistry of d & f-block elements: Characteristics of 3d elements, oxide, hydroxide and salts of first row transition metals, General properties of lanthanides and actinides.

Coordination Chemistry: Nomenclature and stereochemistry, VB and Crystal Field theoretical approaches for structure & bonding, colour (electronic spectra) and magnetic properties of transition metal complexes. Thermodynamic and Kinetic Aspects of Metal Complexes

Organometallic Chemistry: Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, AI,

Hg, Sn and Ti, metal-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls. Organomagnesium compounds: the Grignard reagents - formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions.

Bioinorganic Chemistry: Essential and trace elements in biological processes, metallo-porphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}. Nitrogen Fixation.

Qualitative and quantitative Analysis: Basic theory of volumetric titrations (acid-base, redox, complexometric, precipitation), Salt analysis (detection of acid and basic radicals)

Organic Chemistry

Basic Concepts in Organic Chemistry and Stereochemistry : Isomerism and nomenclature, electronic (resonance and inductive) effects. Optical isomerism in compounds containing one and two asymmetric centers, designation of absolute configuration, conformations of cyclohexanes.

Organic Reaction Mechanism and Synthetic Applications: Methods of preparation and reactions of alkanes, alkenes, alkynes, arenes and their simple functional derivatives, alcohols, ethers , phenols, aldehydes , ketones, carboxylic acid and carboxylic acid derivatives. Mechanism and synthetic applications of electrophilic aromatic substitution. Stereochemistry and mechanism of aliphatic nucleophilic substitution and elimination reactions.Diels – Alder reactions, Wittig Reactions, Mechanism of aldol condensation, Claisen condensation, esterification and ester hydrolysis, Cannizzaro reaction, benzoin condensation. Perkin reaction, Claisen rearrangement, Beckmann rearrangement and Wagner – Meerwein rearrangement.

Introduction to the following classes of compounds – Carbohydrates, Amino Acids, Peptides, Proteins and Nucleic Acids, Fats, Oils and Detergents

Heterocyclic Chemistry : Furans, thiophenes, pyrrols and pyridines.

Qualitative Organic Analysis : Functional group interconversions, structural problems using chemical reactions, identification of functional groups by chemical tests. Spectroscopy-IR,NMR,UV.