IIT-JAM Chemistry-CY

PHYSICAL CHEMISTRY

Basic Mathematical Concepts: Functions, maxima and minima, integrals, ordinary differential equations, vectors and matrices, determinants, elementary statistics and probability theory.
Atomic and Molecular Structure: Fundamental particles, Bohr's theory of hydrogen-like atom; wave-particle duality; Uncertainty principle; Schrödinger's wave equation; Quantum numbers, shapes of orbitals; Hund's rule and Pauli's exclusion principle, electronic configuration of simple homonuclear diatomic molecules.
Theory of Gases: Equation of state of ideal and non-ideal (van der Waals) gases, Kinetic theory of gases. Maxwell-Boltzmann distribution law; equipartition of energy.
Solid state: Crystals, crystal systems, X-rays, NaCl and KCl structures, close packing, atomic and ionic radii, radius ratio rules, lattice energy, Born-Haber cycle, isomorphism, heat capacity of solids.
Chemical Thermodynamics: Reversible and irreversible processes; First law and its application to ideal and non-ideal gases; Thermochemistry; Second law; Entropy and free energy, Criteria for spontaneity.
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; 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; Polarography; Concentration cells with and without transport; Debey-Huckel-Onsagar theory of strong electrolytes.
Chemical Kinetics: Reactions of various order, Arrhenius equation, Collision theory; Theory of absolute reaction rate; Chain reactions – Normal and branched chain reactions; Enzyme kinetics; photochemical processes; Catalysis.
Adsorption: Gibbs adsorption equation, adsorption isotherm, types of adsorption, surface area of adsorbents, surface films on liquids.

ORGANIC CHEMISTRY

Basic Concepts in Organic Chemistry and Stereochemistry: Electronic effect (resonance, inductive, hyperconjugation) and steric effects and its applications (acid/base property). Optical isomerism in compounds without any stereocenters (allenes, biphenyls), conformation of acyclic systems (substituted ethane/n-propane/n-butane) and cyclic systems (mono and di substituted cyclohexanes).
Organic Reaction Mechanism and Synthetic Applications: Chemistry reactive intermediates, carbine, nitrene, benzyne, Hofmann-Curtius-Lossen rearrangement, Wolf rearrangement, Simmons-Smith reaction, Reimer-Tiemann reaction, Michael reaction, Darzens reaction, Witting reaction, McMurry reaction. Pinacol-pinacolone, Favorskii, benzilic acid rearrangement, dienonc-phenol rearrangement, Bayer-Villeger reaction. Oxidation and reduction reactions in organic chemistry. Organometallic reagents in organic synthesis (Grignard and organocopper). Diels-Alder reaction, Sigmatropic reactions.

Qualitative Organic Analysis: Functional group interconversions, structural problems using chemical reactions, identification of functional groups by chemical tests, elementary ^{1}H NMR and IR spectroscopy as a tool for structural elucidation.
Natural Products Chemistry: Introductory chemistry of alkaloids, terpenes, carbohydrates, amino acids, peptides and nucleic acids.
Heterocyclic Chemistry: Monocyclic compounds with one hetero atom.

INORGANIC CHEMISTRY
Periodic Table: Periodic classification of elements and periodicity in properties; general methods of isolation and purification of elements.
Chemical Bonding and Shapes of Compounds: Types of bonding; VSEPR theory and shapes of molecules; hybridization; dipole moment; ionic solids; structure of NaCl, CsCl, diamond and graphite; lattice energy.
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.
Transition Metals (d block): Characteristics of 3d elements; oxide, hydroxide and salts of first row metals; coordination complexes; VB and Crystal Field theoretical approaches for structure, color and magnetic properties of metal complexes. Organometallic compounds, metal carnonyls, nitrosyls and metallocenes, ligands with back bonding capabilities; MO theory approaches to explain bonding in metal-carbonyl, metal-nitrosyl and metal-phosphine complexes.
Bioinorganic Chemistry: Essentials and trace elements of life, basic reactions in the biological systems and the role of metal ions especially Fe^{2+}, Fe^{3+}, Cu^{2+} and Zn^{2+}, function of hemoglobin and myoglobin.
Instrumental Methods of Analysis: Basic principles, instrumentations and simple applications of conductometry, potentiometry, UV-vis spectro-photometry, analysis of water, air and soil samples.
Analytical Chemistry: Principles of qualitative and quantitative analysis; acid-base, oxidation-reduction and EDTA and precipitation reactions; use of indicators; use of organic reagents in inorganic analysis; radioactivity; nuclear reactions; applications of isotopes.