

DEPARTMENT OF CHEMISTRY

CHEMISTRY SYLLABUS FOR Ph. D. ENTRANCE EXAM

Inorganic Chemistry

Chemical periodicity, Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis,

Analytical chemistry- separation, spectroscopic, thermoanalytical methods, Gravimetric and Volumetric methods,

Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; metal complexes in medicine, Laser Action, Mutagenic affect of radiation,

Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.

Physical Chemistry:

Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling, Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle, Chemical bonding in diatomics; elementary concepts of MO and VB theories, Huckel theory for conjugated π -electron systems, Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules, Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR – selection rules; basic principles of magnetic resonance, Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions, Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations, Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.

Organic Chemistry

IUPAC nomenclature of organic molecules including regio- and stereoisomers, Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction, Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions, Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzyne and nitrenes, Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways, Common named reactions and rearrangements – applications in organic synthesis, Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups, Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic, Pericyclic reactions – electrocycloisatation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry, Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S), Structure determination of organic compounds by IR, UV-Vis, ^1H & ^{13}C NMR and Mass spectroscopic techniques.

Reference Books-

1. Inorganic Chemistry by J. E. Huheey
2. Finar, I.L., Organic Chemistry, vol. I & II (ELBS)
3. Advance Physical Chemistry- D.N.Bajpai
4. Analytical Chemistry by S.M. Khopkar
5. Fundamentals of Molecular Spectroscopy – C.N. Banwell and E.N. McCash