Chemistry Syllabus

Inorganic Chemistry

Chemicalperiodicity, Structure and bonding (homo- and hetero-nuclear molecules), VSEPRTheory.Hard-soft acid base concept, non-aqueoussolvents. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of thecompounds.Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reactionmechanisms.Inner transition elements: spectral and magnetic properties, redox chemistry, analyticalapplications. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneouscatalysis.Cages and metalclusters. Bioinorganic chemistry: photosystems, porphyrins, metallo-enzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine. Nuclear reactions, fusion fission and radio-analytical techniques.

Analytical Chemistry

Separation techniques, Chromatography, HPLC, Analytical spectroscopy, electro-and thermo-analytical methods. Characterization of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopictechniques. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Physical Chemistry:

Quantum mechanics: Basic Principle and Postulates; operator; exactly- solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta;tunneling.Approximate methods of quantum mechanics: Variation principle;perturbation theory up to second order in energy;applications.
Atomic structure and spectroscopy; term symbols; many-electron systems and anti-symmetryprinciple.Elementary concepts of MO and VBtheories; Huckel theory for conjugated π-electronsystems.Chemical applications of Group theory; symmetry elements; pointgroups; character tables; selectionrules.

Basic Principles of molecular spectroscopy, Rotational and vibrational IR and Raman activities – selection rules, electronic spectra; basic principles of magneticresonance.

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; uni-molecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemicalreactions. Thermodynamics Laws, description of various types of thermodynamic processes; Maxwell's relations; spontaneity and equilibria; temperature and

pressure dependence of thermodynamic quantities; LeChatelier principle; Phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, andsolutions. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities –calculations for modelsystems. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye- Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conduct metric and potentiometrictitrations.

Organic Chemistry

IUPAC nomenclature of organic molecules including regio- andstereo-isomers.Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereo-genicity, stereo-selectivity,enantio-selectivity, diastereo-selectivity and asymmetricinduction.Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions. Named reactions, Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereo-selectivetransformations. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination ofenantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and related concerted reactions. Principles and applications of photochemical reactions in organicchemistry. Synthesis and reactivity of common heterocyclic compounds containing oneor two heteroatoms (O, N,S). Chemistry of natural products: Carbohydrates, proteins and peptides, fattyacids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids. Structure determination of organic compounds by IR, UV-Vis, ^{1}H&^{13}C NMR and Mass spectroscopic techniques.