

Syllabus Science

Theories of Chemical Bonding: LCAO, types of molecular orbitals, molecular orbital diagrams of homo and heteronuclear (diatomic and polyatomic) molecules.

Transition Metal Chemistry: Electronic configuration, variable oxidation states, magnetic properties, charge transfer spectra, stereochemistry of co-ordination compounds, their IUPAC names, metal-ligand bonding, ligand field theory of complexes, high and low spin complexes, CFSE, Jahn-Teller effect, spectral and magnetic properties of complexes.

Lanthanides and Actinides: Electronic configuration, magnetic and spectral properties, lanthanide and actinide contraction, oxidation states, super heavy elements.

Chemistry of Non-transition Elements: Preparation, properties and bonding in diborane and higher boranes, polyhedral borane anions and carboranes, borazines, silicates, interhalogen compounds, compounds of xenon and their structures.

Non-aqueous Solvents: Reactions in liquid sulphur dioxide, liquid ammonia and hydrogen fluoride, uses of solvents like DMSO, THF and DMF.

Organometallic Chemistry of Transition Elements: Synthesis, structure and bonding, homogeneous catalytic reactions, hydrogenation, hydroformylation, isomerisation, polymerization.

Solid State: Bragg's equation, determination of dimensions of a unit cell, number of atoms and molecules per unit cell, lattice energy, line and plane defects, electrical properties of solids, insulators and semiconductors.

Electronic Displacements and Aromaticity: Inductive, electromeric, mesomeric and hyperconjugation effects, electrophiles, nucleophiles, free radicals. Resonance and its applications to organic compounds, effect of structure on the dissociation constants of organic acids and bases, hydrogen bond and its effects on the properties of organic compounds, aromaticity, Huckel's rule and its applications, annulenes and heteroannulenes.

Reaction Mechanisms: Addition, substitution, elimination and rearrangements, reactive intermediates like benzynes, carbenes and nitrenes, non-classical carbonium ion, neighbouring group participation, some name reactions: Aldol, Perkin, Stobbe, Dieckmann condensations, Hofmann, Schmidt, Lossen, Curtins, Beckmann and Fries rearrangement, Reformatsky, Wittig, Favorskii, Shapiro and Baeyer-Villiger reaction, Michael addition.

Synthetic Uses of: (i) Acetoacetic and malonic esters(ii) Grignard and organolithium reagents, their preparation, identification, estimation and important applications in organic synthesis.

Aromatics, Heteroaromatics and Dyes: Synthesis and important reactions of anthracene, phenanthrene, biphenyl, furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline and indole. Modern theories of colour and constitution.

Pericyclic Reactions: Selection rules and stereochemistry of electrocyclic reactions, cycloaddition and sigmatropic shifts, Sommelet – Hauser, Cope and Claisen rearrangements.

Stereochemistry and Conformational Analysis: Optical and geometrical isomerism. E, Z and R, S notations, conformations of alkanes and cycloalkanes and their effect on reactivity, asymmetric synthesis, Stereoselective and stereospecific synthesis.

Organic Photochemistry: Jablonskii diagram, photochemistry of alkenes, carbonyl compounds and aromatic compounds, photochemistry of vision, photodegradation of polymers, photochemical formation of smog, singlet molecular oxygen reactions. Paterno-Buchi reaction, Norrish Type I & II reactions and Barton reaction.

Spectroscopy-I: Principles of electronic, IR, NMR and Mass spectroscopy and their combined applications for structural elucidation of organic compounds.

Spectroscopy-II: Principles and applications of ESR, Raman, Mossbauer, photoacoustic and photoelectron spectroscopy.

Nuclear Chemistry: Radioactive decay, mass defect and binding energy, nuclear reactions, nuclear isomerism, fission and fusion, neutron activation analysis, applications of isotopes.

Analytical Chemistry: Principles and applications of AAS, DTA, TGA polarography, partition and adsorption chromatography.

Quantum Theory: Schrodinger equation, particle in a box, hydrogen atom, hydrogen molecule ion, hydrogen molecule, variation theorem, spin-spin orbital coupling scheme, term symbols and spectroscopic states.

Chemical Kinetics: Rates of chemical reactions, methods of determining rate laws, Arrhenius equation, collision theory of reaction rates, steric factor, theory of absolute reaction rates, salt effect, kinetics of photochemical and unimolecular reactions.

Thermodynamics: First law, relation between C_p and C_v , enthalpies of physical and chemical changes, temperature dependence of enthalpies, second law, entropy, Gibbs and Helmholtz functions, evaluation of entropy and Gibbs function, third law of thermodynamics, Gibbs-Helmholtz equation.

Electrochemistry and Ionic Equilibria: Theory of strong electrolytes, Debye-Huckel theory of activity coefficients, equilibria in electrochemical cells, cell reactions, Nernst equation, applications of cells, e.m.f. measurements, concentration cells, fuel cells, electrolysis, corrosion and its prevention.

Physical Chemistry of Polymers: Number-average and weight average molecular weights, group analysis, sedimentation, light scattering and viscosity methods for determination of molecular weights, stereochemistry and mechanism of polymerization.

Symmetry and Group Theory: Symmetry elements and symmetry operations, groups, classes, multiplication and character tables, applications of group theory in hybridization and molecular vibrations.

Newer Techniques of Synthesis: Brief idea and phase transfer catalysis, photocatalysis, microwave assisted reactions, disconnection approach, green chemical routes, sonochemical reactions.