

B.Sc. Part-I
Semester - I
Chemistry Paper - I : Inorganic Chemistry

Unit-I : 1. Atomic Structure :

Idea of de Broglie matter waves. Heisenberg's uncertainty principle, atomic orbital's, Schrodinger wave equation, significance of Ψ and Ψ^2 quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d, orbital's, Auf-bau and Pauli exclusion principles. Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge.

Unit-II : 2 Chemical Bonding :

Covalent Bond, valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3 , H_3^+O , SF_4 , ClF_3 , ICl_2 and H_2O , MO theory homonuclear and heteronuclear (CO) and (NO) diatomic molecules, multicenter bonding in electron deficient molecules bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Unit-III :

3. Ionic Solids-Lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids polarizing power and polarisability of ions, Fajan's rule, Metallic bond free electron, valence bond and band theories.

Unit-IV :

- (a) Chemistry of Noble gases :
 - (i) Chemistry of Xenon
 - (ii) Structure and bonding in Xenon compounds
- (b) Oxyacids of group 13-16 :
General chemical properties and structures.
- (c) Silicates : Structural principles.

B.Sc. Part-I
Semester - II
Chemistry
Paper - I : Inorganic Chemistry

Unit-I : 1. Vertical Trends for s and p block elements :

- (a) Properties of isolated atoms :
 - (i) Relative orbital energies and overlaps
- (b) Physical properties of elements :
 - Melting point and enthalpies of atomisation
- (c) Chemical properties of elements :
 - (i) Standard reduction potentials
 - (ii) Standard enthalpies of formation of compounds
 - (iii) Reaction of elements with air.

Unit-II : Vertical Trends for s & p block-compounds :

- (a) Structural and bonding aspects of compounds :
 - (i) Ionic-covalent transition (polarizing power, polarisability of ions, Fajan's rule)
 - (ii) Range of oxidation states
 - (iii) Inert pair and alternation effect
- (b) Physical properties of Compounds :
 - (i) Solubilities of salts (solvation energy and its effect)

Unit-III

Horizontal Trends for s and p block elements :

- (a) Physical properties of elements :
 - (i) Metallic character
 - (ii) Metallic radius
- (b) Chemical properties of elements :
 - (i) Oxidation states and valencies
 - (ii) Standard reduction potentials
- (c) Properties of Compounds :
 - (i) Ionic-covalent transition

Unit-IV : Periodic Properties :

Atomic and ionic radii, ionization energy, electron affinity and electro negativity - definition, methods of determination or evaluation trends in periodic table and applications in predicting and explaining the chemical behaviour.

B.Sc. Part-II
Semester - III
Chemistry
Paper - II : Organic Chemistry

Unit-I : 1. Electromagnetic spectrum :

Absorption spectra, ultraviolet absorption spectroscopy, absorption laws (Beer-Lambert's Law), molar absorptivity, presentation and analysis of U.V. spectra, types of electronic transitions, effect of conjugation, concept of chromophore and auxochrome, Bathochromic, hypsochromic and hypochromic shifts, U.V. spectra of conjugated enes.

Unit-II : Alcohols :

Classification and nomenclature :

Monohydric alcohols : nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols.

Dihydric alcohols : nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$\text{Pb}(\text{OAc})_4$; HIO_4] and pinacol-pinacolone rearrangement (mechanism only).

Trihydric alcohols : nomenclature, methods of formation, chemical reactions of glycerol.

Unit-III : Phenol :

Nomenclature, methods of formation, structure and bonding, physical properties and acidic characters, comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reaction of phenols- electrophilic aromatic substitution, acylation and carboxylation, Mechanism of Fries rearrangement, Claisen rearrangement, Gatterman synthesis. Leanderer-Manasse reaction and Reimer-Tiemann reaction. Picric acid (synthesis and acidity only).

Unit-IV : IR Spectroscopy :

Infrared absorption spectroscopy, molecular vibrations. Hook's Law, selection rules. Intensity and position of IR bands. Measurements of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

B.Sc. Part-II
Semester - IV
Chemistry

Paper - II : Organic Chemistry

Unit-I : Ethers and Epoxides :

Nomenclature of ethers and methods of their formation, physical properties. chemical reactions-cleavage and autoxidation, Ziesel's method.

Synthesis of epoxides. Acid and base - catalyzed ring opening of epoxides, orientation of epoxide ring opening , reaction of Grignard and organolithium reagents with epoxides.

Unit-II: Aldehyde and Ketone :

Nomenclature and structure of carbonyl group, synthesis of aldehyde and ketone with particular reference to the synthesis of aldehydes from acid chlorides, Synthesis of aldehydes and ketones, synthesis of ketones from nitriles and from carboxylic acid, physical properties.

Mechanism of nucleophilic addition to carbonyl group with particular emphasis on benzoin, aldol, Perkin, and Knoevenagel condensations. Condensation with NH_3 and its derivations. Writting reaction, Mannich reaction.

Use of acetals as protecting groups : oxidation of aldehydes. Bacyer Villiger oxidation of ketones, Cannizzaro reaction. MPV, Clemmensen. Wolf-Kishner equation, LiAlH_4 reduction.

Unit-III : Carboxylic Acids :

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acid, effect of substituents on acidic strength, Preparation of carboxylic acid, Reaction of carboxylic acid.

Hell-Volhard-Zenlinsky reaction, Mechanism of decarboxylation, effect of heat on dicarboxylic acid.

Unit-IV : (a) Carboxylic acids and derivatives :

Structure and nomenclature, Relative reactivity of acid derivatives towards nucleophiles Mechanism of esterification and hydrolysis (acidic and basic both), Reactions of urea.

(b) Organic Compounds of Nitrogen : Preparation and properties of nitroalkanes. General methods of preparation of nitroarenes, reduction of nitrobenzene in different conditions.

Preparation of primary, secondary and tertiary amines, Gabriel-phthalimide reaction, Hoffmann bromamide reaction, Basicity of amines (aromatic and aliphatic both). Reactions of primary amines with special reference to aniline, Synthetic application of aryl diazonium salts.

B.Sc. Part-II
Semester - IV
Chemistry

Paper - III : Physical Chemistry

Unit-I : Chemical Equilibrium :

Equilibrium constant & free energy, Thermodynamic derivation law of mass action, Le chatelier's principle & its application, Recatio isotherm & reaction isochore (Van't Hoffequation), Clapeyron equation and Clausius-Clapeyron equation, application.

Unit-II : Phase Equilibrium :

Statement & meaning of terms phase, Component and degree of freedom, derivation of Gibb's phase rule, phase equilibria of one component system (Water and sulphur systems), Phase equilibria of two component system-simple eutectic (Pb-Ag system) and compound formation with congruent melting point (Mg-Zn) and incongruent melting compound (NaCl-H₂O), Freezing mixture (acetone and dry ice).

Unit-III : Electrochemistry-I Electrical transport :

Conductance of electrolytic solutions, specific conductance and equivalent conductance, measurement of equivalent conductance (Wheat stone bridge principle), Variation of equivalent and specific conductance with dilution.

- ♣ Migration of ions and Kohlrausch law
- ♣ Ostwald's dilution law and its uses and limitations.
- ♣ Debye Huckel Onsager's equation for strong electrolyte (Elementary treatment only)
- ♣ Transport number, determination by Hittorff's method and moving boundary method.
- ♣ Applications of conductivity measurement, Determination of degree of dissociation. determination of solubility product of a sparingly soluble salt and conductometric titrations (acid-base and precipitation type only).

Unit -IV Electrochemistry-II :

Types of reversible electrodes gas metal ion, metal-metal ion, metal-insoluble, salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation of cell E.M.F and single electrode potential, standard hydrogen electrode and standard electrode potential, sign conventions. Concentration cell with and without transference, Liquid junction potential, applications of concentration cell, valency of ions, solubility product and activity coefficient and potentiometric titrations.

B.Sc. Part-III
Semester - V
Chemistry
Paper - II : Organic Chemistry

Unit-I : 1. Elimination Reaction :

β -elimination, E1, E2 and E1cB, stereoselectivity, orientation in E2, Saytzev and Hoffmann's rule, elimination vs substitution.

Unit-II :2. Basic Concept of NMR Spectroscopy :

NMR : (Nuclear Magnetic Resonance) spectroscopy, proton magnetic resonance (^1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, Spin-spin splitting & coupling constant area of signals.

3. Application of NMR Spectroscopy :

Interpretation of PMR, Spectra of simple organic molecules such as ethyl bromides, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenones.

Unit-III : 4. Heterocyclic Compounds (Bonding and Structure):

Introduction, molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, comparison of basicity of pyridine, piperidine and pyrrole.

5. Heterocyclic Compounds (Synthesis):

Synthesis and chemical reactions of monocyclic system, methods of synthesis and chemical reaction with particular emphasis on the mechanism of electrophilic substitution, mechanism of nucleophilic substitution.

Unit-IV : 6. Heterocyclic Compounds (Condensed System) :

Introduction to condensed five and six membered heterocyclics. Preparation and reactions of indole, Quinoline, isoquinoline, Electrophilic Substitution reactions of indole, Quinoline and isoquinoline.

7. Important Name reaction related to Heterocyclic Reaction :

Fischer - indole synthesis, Skraup Synthesis and Bischler - Napieralski Synthesis.

B.Sc. Part-III
Semester - V
Chemistry
Paper - III : Physical Chemistry

Unit-I : Elementary Quantum Mechanics :

De Broglie hypothesis, Heisenberg's uncertainty principle, sinusoidal wave equation, Hamiltonian Operator, Schrodinger wave equation and its importance, Physical interpretation of wave function, postulates of quantum mechanics, particle in a one dimensional box.

Unit-II : Molecular orbital theory :

Basic ideas-criteria of forming MOs from AOs, construction of MOs by LCAO, H_2^+ ion, calculation of energy levels from wave functions, physical picture of bonding and Anti bonding wave functions, concept of σ , σ^* , Π , Π^* orbitals and their characteristics, Hybrid orbitals ; sp , sp^2 , sp^3 , calculation of coefficients of AOs used in these hybrid orbital's Introduction to VB model of H_2 , Comparison of MO & VB models.

Unit-III : Photochemistry :

Interaction of radiation with matter, difference between thermal and photochemical processes, Laws of photochemistry , Grothus-Draper's law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state qualitative description of fluorescence, Phosphorescence, non-radiative process (IC,ISC), quantum yield, photo -sensitized reactions, energy transfer processes (Simple examples).

Unit-IV : Spectroscopy :

Introduction of Electromagnetic radiation, regions of spectrum, basic features of different spectrophotometers, Statement of Born-oppieheimer approximation, degrees of freedom.

Rotational Spectrum : Diatomic molecules, Energy levels of a rigid rotor (Semi-classical principles), Selection rules, Spectral intensity, distribution using population distribution, (Maxwell-Boltzmann distribution), determination of bond length, qualitative description of non-rigidrotor, isotopic effect.

B.Sc. Part-III
Semester - VI
Chemistry
Paper - III : Physical Chemistry

Unit-I : Vibrational spectrum :

Infra-rd spectrum, energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, and determination of force constant & qualitative relation of force constant and bond energies effect of an harmonic motion and isotopic substitution on the spectrum, ideas of vibrational frequencies of different functional groups.

Raman Spectrum : Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules. Selection rules.

Unit-II Electronic spectrum :

Concept of potential energy curves for bonding and non-bonding molecular orbital's, qualitative description of selection rules and Frank Condon principle.

Qualitative description of σ π and nMOs, their energy levels and their respective transitions.

Unit-III : Electrochemistry :

Activity and activity coefficient, physical significance of activity, mean ionic activity of electrolytes, Debye-Huckel limiting law, Experimental determination of activity coefficient (solubility and emf method only) Ionic mobility and its experimental determination (moving boundary method). The Einstein relation between absolute mobility and diffusion coefficients, ionic strength and its calculation.

Unit-IV : Dilute Solution and Colligative Properties :

Dilute solution colligative properties, Raoult's law, relative lowering of vapour pressure. Molecular weight determination. Osmosis law of osmotic pressure and its measurement determination of molecular weight from osmotic pressure, Elevation of B.P. and depression of Freezing point. Thermodynamic derivation of relation between molecular weigh & elevation in boiling point depression in Freezing point. Abnormal molar mass degree of dissociation and Association of solutes.

B.Sc. Part-III
Semester - VI
Chemistry
Paper - III : Organic Chemistry

Unit-I : 1. Soaps and Detergents : Soaps, Synthetic detergents, alkyl and aryl sulphonates.

2. Organolithium & organocopper compounds.

Unit-II : 3. Polymerization and its Mechanism :

Addition or chain growth polymerization, free radical vinyl polymerization, ionic vinyl polymerization condensation or step growth polymerization, Ziegler-Natta polymerization and vinyl polymers.

4. Preparation of Synthetic Polymers : Polyester, polyamides, Phenol-Formaldehyde resins, epoxy resins and polyurethane, natural and synthetic rubbers.

Unit-III : 5. Organic Synthesis via Enolates :

Acidity of α -hydrogen, alkylation of diethyl malonate and ethyl acetoacetate. Alkylation of 1,3 dithianes, Alkylation and acylation of enamines.

6. The Claisen condensation, keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1,3 dithianes, Alkylation and acylation of enamines.

Unit-IV : 7. Synthetic Dyes :

Colour and constitution (electronic concept), Classification of Dyes, Chemistry and synthesis of methyl orange, congo red, Malachite green, crystal violet, phenolphthalein, Fluorescein, Alizarin and Indigo.