

Programme Outcome

After completion of degree, students gained the theoretical as well as practical knowledge of handling chemicals. Also they expand the knowledge available opportunities related to chemistry in the government services through public service commission particularly in the field of food safety, health inspector, pharmacist etc. Afford a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective. Achieve the skills required to succeed in graduate school, professional school and the chemical industry like cement industries, agro product, Paint industries, Rubber industries, Petrochemical industries, Food processing industries, Fertilizer industries etc. Got exposures of a breadth of experimental techniques using modern instrumentation. Understand the importance of the elements in the periodic table including their physical and chemical nature and role in the daily life. Understand the concept of chemistry to inter relate and interact to the other subject like mathematics, physics, biological science etc. Learn the laboratory skills and safely to transfer and interpret knowledge entirely in the working environment.

Course Outcome

- to study about the different field of science.
- to develop skill in different laboratories.
- to understand various technologies.
- to develop various knowledge.
- to familiarise the student with the important role played by chemistry in their daily life.
- have sound knowledge about the fundamentals and application of scientific theories
- to develop scientific attitude to make student open-minded and curious to develop skill in practical works experiment equipment and laboratory, etc

B.Sc. Part I
PAPER I
INORGANIC CHEMISTRY

Course specific Outcome -

- Atomic theory and its evolution.
- Learning scientific theory of atoms, concept of wave function.
- Elements in periodic table; physical and chemical characteristics, periodicity.
- To predict the atomic structure, chemical bonding, and molecular geometry based on accepted models
- To understand atomic theory of matter, composition of atom
- Identity of given element, relative size, charges of proton, neutron and electrons, and their assembly to form different atoms.
- Defining isotopes, isobar and isotone
- Physical and chemical characteristics of elements in various groups and periods according to ionic size, charge, etc. and position in periodic table.
- Characterize bonding between atoms, molecules, interaction and energetics (ii) hybridization and shapes of atomic, molecular orbitals, bond parameters, bond- distances and energies.

UNIT-I

A. ATOMIC STRUCTURE

Bohr's theory, its limitation and atomic spectrum of hydrogen atom. General idea of de-Broglie matter-waves, Heisenberg uncertainty principle, Schrödinger wave equation, significance of Ψ and Ψ^2 , radial & angular wave functions and probability distribution curves, quantum numbers, Atomic orbital and shapes of s, p, d orbitals, Aufbau and Pauli exclusion principles, Hund's Multiplicity rule, electronic configuration of the elements.

B. PERIODIC PROPERTIES

Detailed discussion of the following periodic properties of the elements, with reference to s and p-block. Trends in periodic table and applications in predicting and explaining the chemical behavior.

- a) Atomic and ionic radii,
- b) Ionization enthalpy,
- c) Electron gain enthalpy,
- d) Electronegativity, Pauling's, Mulliken's, Allred Rochow's scales.
- e) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

UNIT-II

CHEMICAL BONDING I

Ionic bond: Ionic Solids - Ionic structures, radius ratio & co-ordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy Born- Haber cycle, Solvation energy and solubility of ionic solids, polarising power & polarisability of ions, Fajans rule, Ionic character in covalent compounds: Bond moment and dipole moment, Percentage ionic character from dipole moment and electronegativity difference, Metallic bond-free electron, Valence bond & band theories.

UNIT-III

CHEMICAL BONDING II

Covalent bond: Lewis structure, Valence bond theory and its limitations, Concept of hybridization, Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H₂O, NH₃, PCl₃, PCl₅, SF₆, H₃O⁺, SF₄, ClF₃, and ICl₂ - Molecular orbital theory. Bond order and bond strength, Molecular orbital diagrams of diatomic and simple polyatomic molecules N₂, O₂, F₂, CO, NO.

UNIT-IV

A. s-BLOCK ELEMENTS

General concepts on group relationships and gradation properties, Comparative study, salient features of hydrides, solvation & complexation tendencies including their function in biosystems and introduction to alkyl & aryls, Derivatives of alkali and alkaline earth metals

B. p-BLOCK ELEMENTS

General concepts on group relationships and gradation properties. Halides, hydrides, oxides and oxyacids of Boron, Aluminum, Nitrogen and Phosphorus. Boranes, borazines, fullerenes, graphene and silicates, interhalogens and pseudohalogens.

UNIT-V

A CHEMISTRY OF NOBLE GASES

Chemical properties of the noble gases, chemistry of xenon, structure, bonding in xenon compounds

B. THEORETICAL PRINCIPLES IN QUALITATIVE ANALYSIS (H₂S SCHEME)

Basic principles involved in the analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

B.Sc. Part I

PAPER: II

ORGANIC CHEMISTRY

Course specific Outcome -

- Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms.
- Stereochemistry of organic molecules – conformation and configuration, asymmetric molecules and nomenclature.
- Aromatic compounds and aromaticity, mechanism of aromatic reactions.
- Understanding hybridization and geometry of atoms, 3-D structure of organic molecules, identifying chiral centers.
- Reactivity, stability of organic molecules, structure, stereochemistry.
- Electrophile, nucleophiles, free radicals, electronegativity, resonance, and intermediates along the reaction pathways.
- Mechanism of organic reactions (effect of nucleophile/leaving group, solvent), substitution vs. elimination

UNIT-I BASICS OF ORGANIC CHEMISTRY

Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment. Electrophiles and Nucleophiles; Nucleophilicity and basicity; Homolytic and Heterolytic cleavage, Generation, shape and relative stability of Carbocations, Carbanions, Free radicals, Carbenes and Nitrenes. Introduction to types of organic reactions: Addition, Elimination and Substitution reactions.

UNIT-II INTRODUCTION TO STEREOCHEMISTRY

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Diastereoisomers, meso compounds, Relative and absolute configuration: Fischer, Newmann and Sawhorse Projection formulae and their interconversions; Erythrose and threose, D/L, d/l system of nomenclature, Cahn-Ingold-Prelog system of nomenclature (C.I.P rules), R/S nomenclature. Geometrical isomerism: cis-trans, synanti and E/Z notations.

UNIT-III CONFORMATIONAL ANALYSIS OF ALKANES

Conformational analysis of alkanes, ethane, butane, cyclohexane and sugars. Relative stability and Energy diagrams. Types of cycloalkanes and their relative stability, Baeyer strain theory: Theory of strainless rings, Chair, Boat and Twist boat conformation of cyclohexane with energy diagrams; Relative stability of mono-substituted cycloalkanes and disubstituted cyclohexane.

UNIT-IV CHEMISTRY OF ALIPHATIC HYDROCARBONS

A. Carbon-Carbon sigma (σ) bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reaction, Free radical substitutions: Halogenation-relative reactivity and selectivity.

B. Carbon-Carbon Pi (π) bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions and mechanisms (Markownikoff/ Anti - Markownikoff addition), mechanism of oxymercuration-demercuration, hydroborationoxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl

benzene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

UNIT-V AROMATIC HYDROCARBONS

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/ carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directive effects of the groups.

B.Sc. Part I

PAPER - III

PHYSICAL CHEMISTRY

Course specific Outcome -

- Familiarization with various states of matter.
- Physical properties of each state of matter and laws related to describe the states.
- Calculation of lattice parameters.
- Electrolytes and electrolytic dissociation, salt hydrolysis and acid-base equilibria.
- Understanding Kinetic model of gas and its properties.
- Maxwell distribution, mean-free path, kinetic energies.
- Behavior of real gases, its deviation from ideal behavior, equation of state, isotherm, and law of corresponding states.
- Solids, lattice parameters – its calculation, application of symmetry, solid characteristics of simple salts.
- Ionic equilibria – electrolyte, ionization, dissociation. 12. Salt hydrolysis (acid-base hydrolysis) and its application in chemistry.

UNIT-I

MATHEMATICAL CONCEPTS FOR CHEMIST

Basic Mathematical Concepts: Logarithmic relations, curve sketching, linear graphs, Properties of straight line, slope and intercept, Functions, Differentiation of functions, maxima and minima;

integrals; ordinary differential equations; vectors and matrices; determinants; Permutation and combination and probability theory, Significant figures and their applications.

UNIT-II

GASEOUS STATE CHEMISTRY

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path; Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Joule Thompson effect, Liquification of Gases. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor (Z), and its variation with pressure and temperature for different gases. Causes of deviation from ideal behaviour. van der Waals equation of state, its derivation and application in explaining real gas behaviour, calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

UNIT-III

A. LIQUID STATE CHEMISTRY

Intermolecular forces, magnitude of intermolecular force, structure of liquids, Properties of liquids, viscosity and surface tension.

B. COLLOIDS and SURFACE CHEMISTRY Classification, Optical, Kinetic and Electrical Properties of colloids, Coagulation, Hardy Schulze law, flocculation value, Protection, Gold number, Emulsion, micelles and types, Gel, Syneresis and thixotrophy, Application of colloids. Physical adsorption, chemisorption, adsorption isotherms (Langmuir and Freundlich). Nature of adsorbed state. Qualitative discussion of BET.

UNIT-IV

SOLID STATE CHEMISTRY

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Crystal defects.

UNIT-V

A. CHEMICAL KINETICS

Rate of reaction, Factors influencing rate of reaction, rate law, rate constant, Order and molecularity of reactions, rate determining step, Zero, First and Second order reactions, Rate and Rate Law, methods of determining order of reaction, Chain reactions. Temperature dependence of reaction rate, Arrhenius theory, Physical significance of Activation energy, collision theory, demerits of collision theory, non mathematical concept of transition state theory.

B. CATALYSIS

Homogeneous and Heterogeneous Catalysis, types of catalyst, characteristic of catalyst, Enzyme catalysed reactions, Micellar catalysed reactions, Industrial applications of Catalysis.

B.Sc. Part II

PAPER - I

INORGANIC CHEMISTRY

(Paper Code - 0845)

PHYSICAL CHEMISTRY

Course specific Outcome

- Oxidation-Reductions and their use in metallurgy.
- Chemistry of s and p-block elements.
- Chemistry of noble gases.
- Inorganic polymers and their use.
- Understanding redox reactions in hydrometallurgy processes.
- Structure, bonding of s and p block materials and their oxides/compounds.
- Understanding chemistry of boron compounds and their structures.
- Chemistry of noble gases and their compounds; application of VSEPR theory in explaining structure and bonding.
- Understanding chemistry of inorganic polymers, their structures and uses.

UNIT-I CHEMISTRY OF ELEMENTS OF FIRST TRANSITION SERIES

Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.

UNIT-II CHEMISTRY OF ELEMENTS OF SECOND & THIRD TRANSITION SERIES

General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.

UNIT-III A. OXIDATION AND REDUCTION

Use of redox potential data analysis of redox cycle, redox stability in water- Frost, Latimer & Pourbaix diagrams. Principles involved in the extraction of the elements.

B. COORDINATION COMPOUNDS

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

UNIT-IV A. CHEMISTRY OF LANTHANIDE ELEMENTS

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

B. CHEMISTRY OF ACTINIDES

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from uranium, similarities between the later actinides and the later lanthanides.

UNIT-V A. ACID AND BASES

Arrhenius, Bronsted-Lowry, the Lux-flood, solvent system and Lewis concepts of acids and bases.

N. NON-AQUEOUS SOLVENTS Physical properties of a solvent, types of solvents and their general characteristics, reaction in non-aqueous solvents with reference to liquid ammonia and liquid sulphur dioxide.

B.Sc. Part II

PAPER - II

ORGANIC CHEMISTRY

(Paper Code - 0846)

Course specific Outcome

- Familiarization about classes of organic compounds and their methods of preparation.
- Basic uses of reaction mechanisms.
- Name reactions, uses of various reagents and the mechanism of their action.
- Preparation and uses of various classes of organic compounds.
- Organometallic compounds and their uses.
- Organic chemistry reactions and reaction mechanisms. 7. Use of reagents in various organic transformation reactions.

UNIT-I ALCOHOLS

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

B. Trihydric alcohols - nomenclature and methods of formation, chemical reactions of glycerol.

PHENOLS

A. Structure and bonding, in phenols, physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, acylation and carboxylation.

B. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben - Hoesch reaction, Lederer - Manasse reaction and Reimer- Tiemann reaction.

EPOXIDES

Synthesis of epoxides. Catalysed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. Anti 1,2 dihydroxylation of alkenes via epoxides. Crown ethers.

UNIT-II ALDEHYDES AND KETONES

A. Nomenclature and Structure of the carbonyl group. Synthesis of aldehydes and ketones using 1,3 - dithianes, synthesis of ketones from nitriles. Mechanism of nucleophilic additions to carbonyl group Benzoin, Aldol, Perkin and Knoevenagel condensations. Condensations with ammonia and its derivatives, Wittig reaction, Mannich reaction B. Use of acetate as protecting group, Oxidation of aldehydes, Baeyer – Villiger oxidation of ketones, Cannizzaro reaction, MPV,

Clemmensen Condensation, Wolff-Kishner reaction, LiAlH_4 and NaBH_4 reduction. Halogenation of enolizable ketones. An introduction to α,β unsaturated aldehydes and ketones.

UNIT-III A. CARBOXYLIC ACIDS

Structure and bonding, Physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Hell-Volhard Zeilinsky reaction. Reduction of carboxylic acids. Mechanism of Decarboxylation. Methods of formation and chemical reactions of unsaturated mono carboxylic acids. Di carboxylic acids : methods of formation and effect of heat and dehydrating agents.

B. SUBSTITUTED CARBOXYLIC ACIDS Hydroxy and Halo-substituted Acids.

C. CARBOXYLIC ACID DERIVATIVES

Structure of acid chlorides, esters, amides and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of acid and base catalyzed esterification and hydrolysis.

UNIT-IV ORGANIC COMPOUNDS OF NITROGEN

A. Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline medium.

B. Reactivity, Structure and nomenclature of amines, physical properties. Stereochemistry of amines. Separation of mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel - phthalimide reaction, Hofmann bromamide reaction, Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

UNIT-V HETEROCYCLIC COMPOUNDS

A. Introduction

Molecular orbital picture and aromatic character of pyrrole, furan, thiophene and pyridine, methods of synthesis and chemical reactions with emphasis on the mechanism of electrophilic substitution. Mechanism and nucleophilic substitution reaction in pyridine derivatives. Comparison of basicity of pyridine. Piperidine and pyrrole.

B. Preparation and reaction of Indole, quinoline and isoquinoline and with special reference to Fisher Indole synthesis and Skraup synthesis and Bischer-Napieralski synthesis, Mechanism of

electrophilic substitution reactions of indole, quinoline and isoquinoline. Amino acids and Peptides
:

A. Classification, Structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reaction of α -amino acids.

B. Structure and nomenclature of peptides. Peptide synthesis, solid – phase peptide synthesis.

B.Sc. Part II
PAPER - III
PHYSICAL CHEMISTRY
(Paper Code - 0847)

Course specific Outcome

- Laws of thermodynamics and concepts.
- Partial molar quantities and its attributes.
- Dilute solution and its properties.
- Understanding the concept of system, variables, heat, work, and laws of thermodynamics.
- Understanding the concept of heat of reactions and use of equations in calculations of bond energy, enthalpy, etc.
- Understanding the concept of entropy; reversible, irreversible processes. Calculation of entropy using 3rd law of thermodynamics.
- Understanding the application of thermodynamics: Joule Thompson effects, partial molar quantities. 8. Understanding theories/thermodynamics of dilute solutions.

UNIT-I A. Thermodynamics - I

Fundamental of thermodynamics system, surroundings etc. Types of systems, intensive and extensive properties, state and path functions thermodynamic operations Internal energy, enthalpy, Heat capacity of gases at constant volume and at constant pressure and their relationship. First Law of Thermodynamics limitation of first law. Joule-Thompson expansion, inversion temperature of gases. Calculation of w, q, dU & dH for the liquification expansion of ideal gases under isothermal and adiabatic conditions.

B. Thermo chemistry

Standard state,- Hess's law of heat summation. Enthalpy of reaction at constant pressure and constant volume. Enthalpy of neutralizations. Enthalpy of combustion, Enthalpy of formation, Calculation of Bond enthalpy. Elirchhoff's equation.

UNIT-II A. Thermodynamics-II

Second Law of Thermodynamics : Spontaneous process need of second law, statements of Carnot cycle and efficiency of heat engine, Carnot theorem. Thermodynamic state of temperature. Concept of entropy : entropy change in a reversible and irreversible process, Entropy change in isothermal reversible expansion of an ideal gas, Entropy change in isothermal mixing of ideal gases, physical signification of entropy.

B. Gibbs and Helmholtz free energy variation of G and A with pressure, volume temperature, Gibbs Helmholtz equation.

UNIT-III PHASE EQUILIBRIUM

A. Gibbs Phase rule, Phase components and degree of freedom, Limitation of phase rule. Applications of phase rule to one component system - water system, sulphur system. Application of phase rule to two component systems : pb-Ag system, Zn, Mg system, ferric chloride-water system, desilverization of ____ congruent and incongruent, melting point, eutectic point. Three component systems : solid solution liquid pairs. Liquid liquid mixture : (Partially miscible liquids) : phenol-water, trimethylaminewater nicotine systems, constant temperature, azeotropes.

B. Nerst distribution law, Henry's law, application, solvent extraction.

UNIT-IV ELECTROCHEMISTRY-I A. Electrolytic Conductance : Specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, Kohlrausch's law; application of Kohlrausch's law in determination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titration.

B. Theories of strong electrolytes : limitations of Ostwald dilution law, weak and strong electrolyte, Debye-Huckel- Onsager (DHO) equation for strong electrolyte, relaxation and electrophoretic effect.

C. Migration of ions : Transport number, definition and determination by Hittorf method and moving boundary method.

UNIT-V ELECTROCHEMISTRY-II

A. Electrochemical cell or Galvanic cell : reversible and irreversible cells conventional representation of electrochemical cells, EMF of the cell, effect of temperature on EMF of the cell, Nernst equation, calculation of G , ΔH and ΔS for cell reaction.

B. Single electrode potential : standard hydrogen electrode, calomel electrode quinhydrone electrode, redox electrodes, electrochemical series.

C. Concentration cells with & without transport, liquid junction potential, application of concentration cell in determining valency of ions, solubility product, activity coefficient. D. Determination of pH and pka using hydrogen and quinhydrone electrode potentiometric titrations, buffer solutions; Henderson-Hassel Equation, Hydrolysis of salts, Corrosion : type theories and prevention.

B.Sc. Part III

PAPER - I (Paper Code-0895)

INORGANIC CHEMISTRY

Course specific Outcome

- Coordination compounds – its nomenclature, theories, d-orbital splitting in complexes, chelate.
- Transition metals, its stability, color, oxidation states and complexes.
- Lanthanides, Actinides – separation, color, spectra and magnetic behavior
- Bioinorganic chemistry – metal ions in biological system, its toxicity; hemoglobin.
- Understanding the nomenclature of coordination compounds/complexes, Molecular orbital theory, d-orbital splitting in tetrahedral, octahedral, square planar complexes, chelate effects.
- Understanding the transition metals stability in reactions, origin of colour and magnetic properties.
- Understanding the separation of Lanthanoids and Actinoids, its color, spectra and magnetic behavior.
- Understanding the bioinorganic chemistry of metals in biological systems.
- Hemoglobin and its importance in biological systems.

UNIT-I METAL-LIGAND BONDING IN TRANSITION METAL COMPLEXES

Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal field parameters. Thermodynamic and kinetic aspects of metal complexes. A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.

UNIT-II MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES

Types of magnetic behaviour, methods of determining magnetic susceptibility, spin only formula, L-S coupling, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes. Electronic spectra of Transition Metal Complexes. Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectro-chemical series. Orgel-energy level diagram for d1 and d2 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.

UNIT-III ORGANOMETALLIC CHEMISTRY

Definition, nomenclature and classification of organo metallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn, & Ti, A brief account of metal-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and nature of bonding in metal carbonyls.

UNIT-IV BIOINORGANIC CHEMISTRY

Essential and trace elements in biological processes, metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metals with special reference to Ca²⁺, nitrogen fixation.

UNIT-V HARD AND SOFT ACIDS AND BASES

Classification of acids and bases as hard and soft. Pearson's HSAB concept, acidbase strength and hardness and softness. Silicones and Phosphazenes Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

B.Sc. Part III

PAPER - II (Paper Code-0896)

ORGANIC CHEMISTRY

Course specific Outcome

- Student are able to understand Nitrogen containing functional groups and their reactions.
- Familiarization with polynuclear hydrocarbons and their reactions.
- Heterocyclic compounds and their reactions.
- Alkaloids and Terpenes
- Understanding Biomolecule structure and function.
- Understanding the structure and their mechanism of reactions of selected polynuclear hydrocarbons.
- Understanding the various Spectroscopic technique.

UNIT-I A. ORGANOMETALLIC COMPOUNDS

Organomagnesium compounds : Grignard reagents-formation, structure and chemical reactions.
Organozinc compounds : formation and chemical reactions. Organolithium compounds : formation and chemical reactions.

B. Organosulphur Compounds Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine.
Organic Synthesis via Enolates Active methylene group alkylation of diethylmalonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate : the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate.

UNIT-II BIOMOLECULES

A. Carbohydrates :

Configuration of monosaccharides, threo and erythro diastereomers. Formation of glycosides ethers and esters Determination of ring size of monosaccharides. Cyclic structure of D(+) glucose. Structure of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

B. Proteins and Nucleic acids Classification and structure of protein levels of protein structure, protein denaturation / renaturation, Constituents of amino acids Ribonucleosides and ribonucleotides, double helical structure of DNA.

UNIT-III A. Synthetic Polymers Addition or chain growth polymerization. Free radical vinyl polymerization, Ziegler-Natta polymerization, Condensation or Step growth polymerization,

Polyesters, polyamides, phenols- formaldehyde resins, urea- formaldehyde resins, epoxy resins and polyurethanes, natural and synthetic rubbers.

B. Synthetic Dyes

Colour and constitution (Electronic Concept). Classification of Dyes. Chemistry of dyes. Chemistry and synthesis of Methyl Orange, Congo Red, Malachite Green, Crystal Violet, Phenolphthalein, fluorescein, Alizarine and Indigo.

UNIT-IV SPECTROSCOPY

A. Mass spectroscopy : mass spectrum fragmentation of functional groups.

B. InfraRed Spectroscopy : IR absorption Band their position and intensity, Identification of IR spectra.

C. UV-Visible Spectroscopy : Beer Lambert's law, effect of Conjugation λ_{max} Visible spectrum and colour.

D. Anthocyanin as natural colouring matter (Introduction only)

E. Application of Mass, IR, UV-Visible Spectroscopy to organic molecules.

UNIT-V A. NMR Spectroscopy : Introduction to NMR. Shielding and Number of signal in PMR, Chemical shift and characteristic values, splitting of Signals and Coupling constant. Application to organic molecules.

B. ^{13}C MR Spectroscopy : Principal & Application.

C. Magnetic Resonance Imaging (MRI)- Introductory idea.

B.Sc. Part III

PAPER – III

(Paper Code-0897)

PHYSICAL CHEMISTRY

Course specific Outcome

- Understand the various spectroscopic technique
- Thermodynamic process.
- Understanding the molecular orbital theory and valence bond theory
- Understanding the principle of quantum mechanics
- Study different type of spectra
- Understanding the behavior of different types of magnetic properties

UNIT-I QUANTUM MECHANICS

Black body radiation, Plank's radiation law, photoelectric effect, Compton effect. DeBroglie's idea of matter waves, experimental verification Heisenberg's uncertainty principle, Sinusoidal wave equation, Operators : Hamiltonian operator, angular momentum operator, laplacian operators postulate of quantum mechanics Eigen values, Eigen function. Schrodinger time independent wave equation physical significance of Ψ And Ψ^2 . Applications of schrodinger wave equation : particle in one dimensional box Hydrogenation (separation into three equation's) radial wave function and angular wave function.

UNIT-II QUANTUM MECHANICS-II

Quantum mechanical approach of molecular orbit theory; basic idea criteria for forming M.O and A.O, LCAO approximation, formation of H_2^+ ion, calculation of energy levels from wave functions bonding and antibonding wave functions concept of σ , σ^* , π and orbitals and their characteristics, Hybrid orbital : SP, SP², SP³, Calculation of coefficients Ads used in these hybrid orbitals. Introduction to valence bond model of H_2 , Comparison of M.O. and V.B. model, Huckel theory, application of huckel theory to ethane propene etc.

UNIT-III SPECTROSCOPY-I

A. Introduction, characterization of electromagnetic radiation, regions of the spectrum, representation of spectra width and intensity of spectral transition, rotational spectra of calculated diatomic molecules, energy level of rigid rotator, selection rule, determination of bond length qualitative description of non – rigid rotator isotopic effect.

B. Vibrational spectra - Fundamental vibrational and their symmetry, vibrating diatomic molecules, energy levels of simple harmonic oscillator. Selection Rule, Pure vibrational Spectrum, determination of force constant, diatomic vibrating operator. Anharmonic Oscillator.

C. Raman Spectra : Concept of polarizability, quantum theory of Raman spectra stokes and anti stokes lines pure rotational and vibrational Raman spectra, Application of Raman spectra stokes

and anti stokes lines, pure rotational and vibrational Raman spectra, Applications of Raman spectra.

UNIT-IV SPECTROSCOPY-II

A. Electronic Spectra : Electronic Spectra of diatomic molecule, Frank London principle, types of electronic transitions. Applications of electronic spectra. B. Photo-chemistry : Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry. Grothus-Draper law, Stark-Einstein law, Jablonski diagram depicting various process occurring in the excited state, qualitative description of fluorescence, occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield photosensitized reactions energy transfer processes (simple examples).

UNIT-V A. Thermodynamics Energy referred to absolute zero, third law of thermodynamics Test of III law of thermodynamics Nerst heat theorem application and limitation of Nerst heat theorem.

B. Physical properties and molecular structure : polarization of molecules, {Classius-Mosotti equation. orientation of dipoles in an electric field. Dipole moment, induced dipole moment, measurement of dipole moment. Temperature methods and refractivity methods. Dipole moment and molecular structure.

C. Magnetic Properties : Paramagnetism diamagnetism, ferromagnetism. Determination of magnetic susceptibility, elucidation of molecular structure.