B.Sc Part I

Paper I (Inorganic chemistry)

Unit-I

I. **Atomic structure** idea of de-Broglie Matter waves, Heisenberg Uncertainty principle, atomic orbital's, nodel surfaces, Schrodinger wave equation, significance of Ψ and Ψ^2,Quantum number, Radial and angular wave functions and probability distribution curves, shapes of s,p and d-orbital's, Aufbau and Pauli exclusion principles, Hund's multiplicity rule, electronic configuration of the elements, effective nuclear charge(Slater rule)

II. **Periodic Properties** Atomic and ionic radii, ionization energy, electron affinity and electronegativity-definition, method of determination, trends in periodic table and application in predicting and explaining the chemical behavior.

Unit-II

III. **Chemical bonding**

a) Covalent Bond: Valence bond theory and its limitations, directional characteristics of covalent bond, various type of hybridizations and shape of simple inorganic molecules and ions, VSEPR theory to NH_3 , H_3O^+, ICl_2^- and H_2O,MO theory, Homonuclear and heteronuclear(CO and NO) diatomic molecules, multicentre bonding in electron deficient molecules, bond length and bond energy, percentage ionic character from dipole moment and electronegativity difference.

b)Ionic solid : Lattice energy and Born-Haber cycle, salvation energy and solubility of ionic solids, polarizing power and polarisability of ions, fajan's rule, metallic bond-free electron, valence bond and band theories.

C)weak interaction-hydrogen bonding, vander wall's forces(Keesom forces,debye forces & London forces)

Unit-III

IV. **S-block elements :** Comparative study of stability of solubility & carbonate, sulphate and nitrate of Alkali metals and Alkaline earth metals, Diagonal relationship, Salient features of hydrides, solvation and complexation tendencies including their function in biosystems.

V. **Chemistry of noble gases** Occurrence and isolation of the noble gases, chemical properties of the nobles gases, chemistry of Xenon, structure and bonding in xenon compounds.

Unit-IV

VI. **P-block elements** Comparative Study(including diagonal relationship) of group 13-17 elements, Compound lika hydrides, oxides,oxyacids and halides of group 13-16, Hydrides of boron-diborane,borazine,borohydrides,fullrenes, carbides, fluorocarbons, silicates(structural principle),tetrasulphur tetra nitride, properties of halogens, interhalogen and polyhalides.

B.Sc I

Paper-II(Organic chemistry)

Unit-1

I.General Organic chemistry: Different notation of electron(s) movement, hemolysis and heterolysis bond fission, types of reagent, types of organic reactions, Intermediate and transition state with energy consideration, Inductive and field effect, resonance, hyperconjugation. Reactive intermediates- Carbocation, carbanion, free radical,carbenes and arynes(with examples),Method of determination of reaction mechanism(product analysis, intermediates, isotopic effect, kinetic and stereochemical studies)

II.Alkanes and cycloalkanes: Source method of formation(with special reference to Wurtz reaction, Kolbe reaction, Corey-House Reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes,Mechanism of free radical halogenations of alkanes, reactivity and selectivity. Cycloalkanes-method of formation, chemical reactions, Bayer's strain theory and its limitation, ring strain in small ring (cyclopropane & cyclobutane), strainless theory, banana bond in cyclopropne ring.

Unit-II

III.Stereochemistry of Organic compounds: Concept of isomerism, Types of isomerism;
Optical isomerism- elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, property of enanatiomers, chiral and achiral molecules with two stereogenic centers, diasteromers,thero and erythro diastereomers, meso compounds, resolution of of enantiomers, inversion , retention and racemisation,Realtive and absolute configuration,sequence rules, D &L and R & S systems of nomenclature.
Geometrical isomerism-determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicycylic compounds.
Conformational isomerism-conformational analyses of ethane and n-butane; conformation of cyclohexane,axial and equatorial bonds, conformation of monosubstituted cyclohexane derivative, Newman projecton and Sawhorse formulae, Fisher and flying wedge formula, Interconversion of Fischer into Newman and Newman into Fischer, Difference between configuration and conformation.

Unit-III

IV.Alkenes, Cycloalkenes, Dienes and Alkynes: Method of formation, mechanism of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration, The Saytzeff rule , Hoffmann elimination, physical properties and relative stabilities of alkenes. Chemical reaction of alkenes-mechanism involved in hydrogenation , electrophilic and free radical addition, Markownikoff's rule,hydroboration-oxidation , oxymercuration reduction, Epoxidation, ozonolyis,hydration,hydroxylation and oxidation with $KMnO_4$, Substitution at allylic and vinylic position of alkenes. Conformation and chemical reaction of cycloalkenes and method of formation, Nomenclature and classification of dienes: isolated , conjugated and cumulated dienes, Structure of allenes and butadiene, chemical

reaction -1,2 and 1,4 addition, Diels-alder reaction, Alkynes-method of formation, chemical reaction of alkynes , acidity of alkynes, mechanism of electrophilic and nucleophilic addition reaction, hydroboration –oxidation metal-ammonia reduction, oxidation.

Unit-IV

V. Arenes and Aromaticity: structure of Benzene, MO picture. **Aromaticity**: The Huckel rule, aromatic ions. Aromatic electrophilic substitution- general pattern of the mechanism, role of σ and π complexes, Mechanism of nitration , halogenations , sulphonation and Friedyl-Craft reaction. Energy profile diagram, Activating and deactivating substitutents, orientation and o/p ratio, Side chain reaction of benzene derivatives, Birch reduction; Method of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and Anthracene.

VI.Alkyl and Aryl Halides: Method of formation, chemical reactions,Mechanism of nucleophilic sudstitution reaction of alkyl halides, SN^2 and SN^1 reactions with energy profile diagrams; Polyhalogen compounds: Chloroform, carbon tetrachloride; methods of formation of aryl halides, nuclear and side chain reactions; the addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reaction;relative reactivities of alkyl halides vs. allyl , vinyl and aryl halides, Synthesis and uses of DDT and BHC.

B.Sc I

Paper-III(Physical chemistry)

Unit-1

1- Mathemathical concept and computers

A) **Mathemthical Concepts:** Logarithmic relation, curve sketching, linear graph and calculation of slopes, differentiation of simple function like e^x , X^n, SinX , logX; Maxima and minima, partial differentiation and exact differentiation and reciprocity relations, Integration of useful/relevant functions, permutations and combinations, factorials, probability.

B) **Computers:** general introduction to computers, different component of a computer, Hardware and software, input-output devices; Binary numbers and arithmetic; introduction to computer languages, programming, operating system.

Unit-II

2- Gaseous state Postulates of kinetic theory of gases, Compressibility factor, deviation from ideal behavior, vander Waals equation of state, Critical phenomenon: PV isotherm of real gases, continuity of states, the isotherm of vander Waal's equation, relationship between critical constant and vander Waals constant, the law of corresponding state, reduced equation of state, Molecular velocities: Root mean average, average and most probable velocities, Qualitative discussion of the Maxwell's distribution of molecular velocities. Collision number, mean free path and collision diameter, liquification of gases(Linde's and claude method).

3.liquid State Intermolecular forces, structure of liquids(a qualitative description), structural difference between solids, liquids and gases; Liquid Crystals: difference between liquid crystal, solid and liquid, classification, structure of nematic and cholestic phases

Unit-III

4-Solid States Definition of space lattice, Unit cell, law of crystallography: (i) Law of constancy of interfacial angles(ii) law of rationality of indices(iii)law of symmetry. Symmetry element in crystal.

Limiting radius ratio and coordination number, lattice defect, Weiss indices and Miller indices, Interplaner distance, X-ray diffraction and Bragg equation, Structure of sodium chloride crystal.

5.Colloidal state Defination of colloids, classification of colloids: solid in liqid(sols):Properties, Kinetic, optical and electrical; stability of colloids, protective action, hardy-Schulze law, Gold number.

Liquid in Liquid(gel): type of emulsions,preparation, emulsifier,Liquid in solid(gel): classification, preparation and properties, inbibition, general application of colloids, colloidal electrolytes.

Unit-IV

6.Chemical Kinetics and Catalysis Rate of a reaction, factors influencing the rate of a reaction-concentration,temperature,pressure, solvent, light catalyst, concentration dependence of rates, mathematical characteristics of simple chemical reactions-zero order, first order,second order and pseudo order, half life anf mean life, determination of the order of reaction-differeential method. Method of integration, method of half life period and isolation method.radioactive decay as a first order phenomenon:

Experimetal methods of Chemical kinetics: conductometric, potentiometric,optical method,polarimetry and spectrophotometer.

Theories of chemical kinetics: effect of temperature on the rate of reaction, Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis), Expression for rate constant based on equilibrium constant and thermodynamic aspects.

Catalysis: Characteristics of catalyzed reactions, Classification of catalysis, homogenous and heterogeneous catalysis, enzyme catalysis with examples.

B.Sc. – I (PRACTICAL) 180 hrs (6 Hrs/week)

Inorganic Chemistry :

Semi micro Analysis – cation analysis, separation and identification of ions from Grops I, II, III, IV, V and VI, Anion analysis

Organic Chemistry :

Laboratory techniques,

Calibration of Thermometer:

80-82^0 (Naphthalene), 113 5-114^0 (Acetanilide)

132 5-133^0 (Urea), 100^0 (Distilled Water)

Determination of melting point:

Naphthalene 80-82^0, Benzoic acid 121 5-122^0

Urea 132 5-133^0, Succinic acid 184 5-185^0

Cinnamic acid 132 5-133^0, Sallicylic acid 157 5-158^0

Acetanilide 113 5-114^0, m-Dinitrobenzene 90^0

p-Dichlorobenzene 52^0, Aspirin 135^0

Determination of boiling point:

Ethanol 78^0, Cyclohexane 81 4^0, Toluene 110 6^0, Benzene 80^0

Mixed melting point determination:

Urea-Cinnamic acid mixture of various compositions (1 4, 1 1, 4 1)

Distillation:

Simple distillation of ethanol-water mixture using water condenser,

Distillation of nitrobenzene and aniline using air condenser

Crystallization:

Concept of induction of crystallization,

Phthalic acid from hot water (using fluted filter paper and steamless funnel)

Acetanilide from boiling water

Naphthalene from ethanol

Benzoic acid from water

Decolorisation and crystallization using charcoal:

Decolorsation of brown sugar (sucrose) with animal charcoal using gravity filtration

Crystallization and decolonsation of impure naphthalene (100g of naphthalene mixes with 0 3 g of Congo Red using 1g decolorizing carbon) from ethanol

Sublimation (Siple and Vacuum):

Camphor, Naphtalene, Phthalic acid and succinic acid

Qualitative Analysis:

Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds

Physical Chemistry :

Chemical Kinetics:

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at rooms temperature.

2 To study the effect of acid strength on the hydrolysis of an ester
3 To compare the strengths of HCl and H_2SO_4 by studying the kinetics of hydrolysis of ethyl acetate.
4. To study kinetically the reaction rate of decomposition of iodide by H_2O_4

Distribution Law:

1 To study the distribution of iodine between water and CCl_4
2 To study the distribution of benzoic acid between benzene and water.

Colloids:

1. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi- and trivalent anions

Viscosity, Surface Tension:

1 To determine the percentage composition of a given mixture (non interacting systems) by viscosity method
2. To determine the viscosity of amyl alcohol in water at different concentration and calculate the excess viscosity of these solutions.
3. To determine the percentage composition of a given binary mixture by surface tension method (acetone & ethyl methyl ketone)

B.Sc Part II

Paper I (Inorganic chemistry)

Unit-I

I. **Chemistry of element of First Transtion Series**-Characteristic properties of d-block element.Binary compounds(hydrides, carbides and oxides) of the element of the first transition series and complex with respect to relative stability of their oxidation states, coordination number and geometry.

II. **Chemistry of the element of Second and Third Transition Series** General characteristics, comparative treatment of Zr/Hf , Nb/Ta, Mo/W in respect of ionic radii, oxidation state, magnetic behavior, special properties and stereochemistry.

Unit-II

III. **Coordination Compound**
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-III

IV. **Chemistry of Lanthanide Elements :** Electronic structure , oxidation states and ionic radii and lanthanide contraction, complex formation, occurrences and isolation, cerric ammonium sulphate and its analytical uses.

V. **Chemistry of Actinides** Electronic configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U

Unit-IV

VI. **Oxidation and Reduction** Electrode potential, electrochemical series and its application, principles involved in the extraction of the elements, Simple problems and concept involved in Latimer diagram,Ebsworth-Frost diagram & Pourbaix diagram

VII. **Acids and Bases** Arrhenius, Bronsted-lowry, the Lux-Flood,solvent system and Lewis concept of acids and bases..

VIII. **Non-aqueous Solvents:** Physical properties of a solvent, Types of solvents and their general characteristic with reference to liquid NH_3 and liquid SO_2

B.Sc Part II

Paper II (Organic chemistry)

Unit-I

I. **Electromagnetic Spectrum Absorption Spectra**-Ultraviolet(UV) absorption spectroscopy : absorption laws(Beer-Lambert law); molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation, concept of chromophore and auxochrome, bathochromic, hypsochromic and hypochromic shifts, UV spectra of conjugated enes and enones.

Infrared (IR) absorption spectroscopy-molecular vibrations, Hooke's law, selection rules, intensity and positions of IR bands, measurement of IR spectrum,fingerprint region, characteristic absorptions of various functional group and interpretation of IR spectra of simple organic compounds.

Problems based on UV and IR.

Unit-II

II. **Alcohols**

Monohydric alcohols:-nomenclature, method of formation by reduction of Aldehydes , ketones, Carboxylic acids and Esters, Hydrogen bonding, Acidic nature, Reaction of alcohol due to breaking of O-H bond and C-O bond, oxidation and reduction.

Dihydric alcohols: Method of formation, chemicals reaction of vicinal glycols, oxidative cleavage by HIO_4 and Pinacol-pinacolone rearrangement

Trihydic alcohols-nomenclature, method of formation, chemical reactions of glycerol(reaction with oxalic acid, $KHSO_4$,PX_3,HI and oxidation)

III. **Phenols**

Preparation of phenols, acidic character, 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, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

Unit-III

IV. **Ethers and Epoxides :** Nomenclature of ethers and method of their formation, physical properties, chemical reactions-cleavage and autoxidation, Ziesel's method.

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

V. **Aldehydes and Ketones:** Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehyde and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids.

Mechanism of nucleophilic addition to carbonyl groupwith mechanism of Benzoin, aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivative, wittig reaction, Mannich reaction

Use of acetals as protecting group, Oxidation of aldehydes, Baeyer-villiger oxidation of ketones, . cannizzaro reaction, MPV, Clemenson, Wolf-kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones. An introduction to α,β unsaturated aldehyde and ketones with special reference to Michael addition reaction.

Unit-IV

VI. **Carboxylic Acids** Acidity of carboxylic acids, effect of substitutents on acidic strength, preparation of carboxylic acids, reaction of carboxylic acids, Hell-Vohlard-Zelinsky reaction, Synthesis of acid chlorides, esters and amides, reduction of carboxylic acids, Mechanism of decarboxylation, method of formation and chemical reaction of halo acids, method of formation and chemical reaction of unsaturated monocarboxylic acids , Dicarboxylic acids: method of formation and effect of heat and dehydrating agents.

VII. **Carboxylic Acid Derivatives** Relative stability of acyl derivatives, interconversion of acid derivatives by nucleophilic acyl substitution, Preparation of carboxylic derivatives, chemical reaction and hydrolysis(acidic and basic)

VIII. **Organic compounds of Nitrogen:**

Preparation of nitroalkanes and nitroarenes, Chemical reactions of nitroalkanes, Mechanism of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline, Picric acid.

Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties, Stereochemistry of amines, separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalyst, 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.

B.Sc Part II

Paper III (Physical chemistry)

Unit-I

I. **Thermodynamic-1**

Definition of thermodynamic terms: System,surrounding etc., Types of systems. Intensive and Extensive properties, State and path function and their differentials, Thermodynamics process, Concept of heat and work.

First Law of Thermodynamics: Statement, definition of internal energy and enthalpy, Heat capacity, Heat capacity at constant volume and pressure and their relationship. Joule's law–Joule -Thomson coefficient and inversion temperature. Calculation of w,q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Thermochemistry: Standard state, standard enthalpy of formation-Hess's law of constant heat summation and its application, Heat of reaction at constant pressure and at constant volume, enthalpy of neutralization, Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy, Kirchhoff's equation.

II. **Chemical Equilibrium**

Equilibrium constant and free energy, Thermodynamic derivation of law of mass action, Le-Chatelies's principle.

Reaction isotherm and reaction isochore- Clapeyron-clausius equation and its applications.

Unit-II

III. **Thermodynamic-II**

Second law of thermodynamics: Different statement of the law, Carnot's cycle and its efficiency, Carnot's theorem, Thermodynamic scale of temperature.

Concept of entropy : Entropy as a state function, entropy as a function of V & T. Entropy as a function of P &T, Entropy change in physical change.

Gibbs and Helmholtz functions: Gibbs function(G) and Helmholtz function(A) as thermodynamic quantities. A & G as criteria for thermodynamic equilibrium and spontaneity , their advantage over entropy change. Variation of G and A with P , V and T.

Third law of thermodynamics:

Nernst heat theorem, statement and concept of residual entropy.

Unit-III

IV. **Electrochemistry-I :**

Electrical transport-conduction in metals and in electrolytic solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution.

Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolyte, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number: definition and determination by Hittorf's method and moving boundary method.

Applications of conductivity measurements, determination of degree of dissociation, determination of Ka of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

Unit-IV

V. **Electrochemistry-II :**

Types of reversible electrode- gas-metal ion, metal ion, metal-insoluble salt-anion and redox electrode. Electrode reaction, derivation of cell EMF and single electrode potential, standard hydrogen electrode-reference electrode-standard electrode potential, sign conventions, electrochemical series and its significance.

Electrolytic and Galvanic cells- reversible and irreversible cells, conventional representation of electrochemical cell.

EMF of a cell and its measurements, Computation of cell EMF, calculation of thermodynamic quantities of cell reactions(ΔG , ΔH and K)

Concentration cell with and without transference, liquid junction potential, application of concentration cell s, valency of ions, solubility product and activity coefficient, potentiometric titrations.

Definition of pH and pKa, determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods.

Buffers-mechanism of buffer action, Henderson-Hazel equation. Hydrolysis of salt

VI. **Phase Equilibrium:**

Staement and meaning of the terms-phase, component and degree of freedom, derivation of Gibb's phase rule, phase equilibria of one component system-water, Sulphur and He system.

Phase equilibria of two component system-solid liquid equilibria, simple eutectic- Bi-Cd, Pb-Ag systems, desilverisation of lead.

Solid solutions- compound formation with congruent melting point melting point(Mg-Zn) and incongruent melting point, ($FeCl_3.2H_2O$) and ($CuSO_4.5H_2O$)

B.Sc. – II (Practical) 180 hrs. (6 hrs/week)

Inorganic Chemistry :

Calibration of fractional weights, pipettes and burettes, Preparation of standards solutions, Dilution – 0.1 M to 0.001 M solutions.

Quantitative Analysis:

Volumetric Analysis :

(a) Determination of acetic acid in commercial vinegar using NaOH.

(b) Determination of alkali content – antacid tablet using HCl.

(c) Estimation of calcium content in chalk as calcium oxalate by permanganometry.

(d) Estimation of hardness of water by EDTA.

(e) Estimation of ferrous and ferric by dichromate method.

(f) Estimation of copper using thiosulphate.

Gravimetric Analysis :

Analysis of Cu as CuSCN and Ni as Ni (dimethylgloxime).

Organic Chemistry :

Laboratory Techniques

A. Thin Layer Chromatography

Determination of R*f* values and identification of organic compounds:

(a) Separation of green leaf pigments (spinach leaves may be used).

(b) Preparation of separation of 2, 4-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2, and 3-one using toluene and light petroleum (40:60)

(c) Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5).

B. Paper Chromatography: Ascending and Circular

Determination of R*f* values and identification of organic compounds:

(a) Separation of a mixture of phenylalanine and glycine, Alanine and aspartic acid, Leucine and glutamic acid, Spray reagent – ninhydrin.

(b) Separation of a mixture of D, L – alanine, glycine, and L-Leucine using n-butanol:acetic acid:water (4:1:5), Spray reagent – ninhydrin.

(c) Separation of monosaccharide – a mixture of D-galactose and D-fructose using n-butanol:acetone:water (4:5:1), spray reagent – aniline hydrogen phthalate.

Qualitative Analysis:

Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

Physical Chemistry :

Transition Temperature

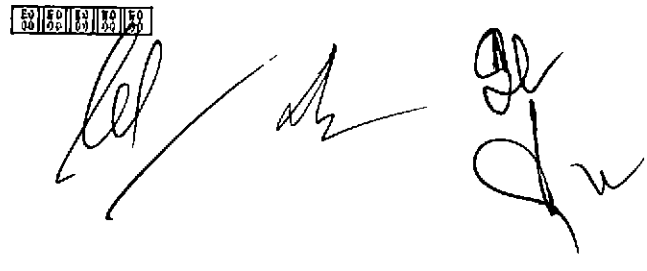
1. Determination of the transition temperature of the given substance by thermometric /dialometric method (e.g. $MnCl_2.4H_2O/SrBr_2.2H_2O$).

Phase Equilibrium

2. To study the effect of a solute (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol-water system.
3. To construct the phase diagram of two component (e.g. diphenylamine – benzophenone) system by cooling curve method.

Thermochemistry

1. To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.
2. To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the entrhalpy of ionization of the weak acid/weak base.
3. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber Cycle.



B.Sc Part III

Paper I (Inorganic chemistry)

Unit-I

I. **Metal-ligand Bonding in Transition Metal complex**-Limitations of valence bond theory, Elementary idea of crystal field theory, Crystal field splitting energy and crystal field stabilization energy, Crystal field splitting in Octahedral, tetrahedral and square planer complexes, factor affecting the crystal field parameters.

II. **Thermodynamic and kinetic aspects of metal complexes** A brief outline of thermodynamic stability of metal complexes and factor effecting the stability, stability constants of complexes and their determination, substitution reaction of square planer complexes.

Unit-II

III. **Magnetic properties of Transition metal complexes**
Types of magnetic behavior, method of determing magnetic susceptibility, spin only formula, L-S coupling, correlation of μ_s and μ_{eff} values,orbitals contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

IV. **Electronic spectra of Transition Metal complexes :** Types of electronic transitions, Selection rule for d-d transitions, Spectroscopic ground states,spectrochemical series, Orgel- energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion

Unit-III

V. **Organometallic chemistry** Definition, nomenciature and classification of organometallic compounds,Preparation,properties, bonding and application of alkyls and aryls of Li, Al , Hg & Sn.

Metal carbonyls: 18 electron rule, preparation, structure and nature of bonding in the mononuclear and polynuclear metal carbonyls

VI. **Silicones and Phosphazenes** Silicones and phosphazenes as examples of inorganic polymer, nature of bonding in triphosphazenes.

Unit-IV

VII. **Hard and Soft Acids and Bases(HSAB)** Classification of acids and base as hard and soft, Pearson's HSAB concept, acid-base strength and hardness & softness, Symbiosis, theoretical basis of hardness and softness,electronegativities and hardness and softness.

VIII. **Bioinorganic Chemistry:** Essential and trace element in biological processes, metalloporphyrins with special reference to hemoglobin and myoglobin, Biological role of alkali and alkaline earth metal ion special reference to Ca^{+2}

B.Sc Part III

Paper II (Organic chemistry)

Unit-I

I. **Spectroscopy**-Nuclear magnetic resonance(NMR)spectroscopy, proton magnetic resonance(1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constant, areas of signals, interpretation of ^{1}H NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone, problems pertaining to the structure elucidation of simple organic compounds using UV , IR and 1H NMR spectroscopy.

Unit-II

II. **Organometallic Compounds** Organomagnesium compounds: the Grignard reagents, formation, structure and chemical reactions.Organozinc compounds: formation and chemical reactions.Organolithium compounds: formation and chemical reactions.

III. **Organosulphur compounds**
Nomenclature, structural formation, method of formation and chemical reactions of thiols, thioethers,sulphonic acids and sulphur ylides

IV. **Hetrocyclic Compounds :** Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, thiophene and pyridine, Methods of synthesis and chemical reactions with special emphasis on the mechanism of electrophilic substitution, Mechanism of nucleophilic substitution reaction in pyridine derivatives,comparision of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and six member heterocycles, preparation and reaction of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Nepieralski synthesis, mechanism of electrophilic substitution reaction of indole, quinoline and isoquinoline.

Unit-III

V. **Carbohydrates** Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, Chain lengthening and chain shortening of aldoses Configuration of monosaccharide's, Erythro and threo diastereomers, Conversion of glucose into mannose, Formation of glycosides, ethers and esters, Determination of ring size of monosaccharide's, cyclic structure of D(+)-glucose, mechanism of mutarotation.

Structures of ribose and deoxyribose

An introduction to disaccharides(maltose,sucrose and lactose)

VI. **Aminoacids,Peptides and proteins** Classification, structure and stereochemistry of amino acids, Acid-base behavior, isoelectric point, preparation and reactions of α-amino acids, structure and nomenclature of peptides and proteins, classification of proteins, peptide structure determination, end group analysis, selective hydrolysis of peptides, classical peptide synthesis, solid-phase peptide synthesis, structures of peptides and protein, Levels of protein structure, Protein denaturation/renaturation

Unit-IV

VII. **Synthetic polymers** Addition or chain-growth polymerization, free radical vinyl polymerization, ionic vinyl polymerization, Zigler-Natta polymerization and vinyl polymers.

Condensation or step growth polymerization,Polyesters,polyamides,phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes, natural and synthetic rubbers, elementary idea of organic conducting polymers.

VIII. **Organic Synthesis via Enolates:** Acidity of α-hydrogens, alkylation of dimethyl malonate and ethyl acetoacetate,Synthesis of ethyl acetoacetate: Claisen condensation, Keto-enol tautomerism of ethyl acetoacetate.

Alkylation of1,3-dithianes, Alkylation and acylation of enamines.

B.Sc Part III

Paper III (Physical chemistry)

Unit-I

I. **Introductory Quantum Mechanics**-Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen(without derivation) and its defect, Compton effect, de-Broglie's hypothesis, Heisenberg's uncertainty principle, Hamiltonian Operator

II. **Spectroscopy** Introduction: Electromagnetic radiation, regions of the spectrum, basis features of different spectrophotometers, statement of Born-Oppenheimer approximation, degrees of freedom.

III. **Physical properties and Molecular structure:**
Optical activity, polymerization-(Clausius-Mossotti equation),Orientation of dipoles in an electric field,dipole moment, induced dipole moment, measurement of diple moment-dielectric constant and refractivity method, dipole moment and structure of molecules, magnetic properties-paramagnetism, diamagnetism and ferromagnetism

Unit-II

IV. **Elementary Quantum Mechanics:** Schrodinger wave equation and its importance, physical interpretation of wave function, postulates of quantum mechanics, Particle in a one dimensional box.

Schrodinger wave equation for H-atom, separation into three equations(without derivation), quantum numbers and their importance, Hydrogen like wave functions, radial wave functions, angular wave functions.

Molecular orbital theory basic ideas-criteria for forming M.O from A.O., construction of M.O's by LCAO- H_2^+ ion, calculation of energy levels from wave functions, physical picture of bonding and antibonding wave functions, concept of σ ,σ^* ,π, π^* orbitals and their characteristics, Hybrid orbitals- sp , sp^2, sp^3, calculation of coefficient of A.O's used in sp and sp^2 hybrid orbital's and interpretation of geometry.

Unit-III

V. **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-rigid rotor, isotopic effect.

Raman Spectrum: Concept of polarizability, Raman spectra of diatomic molecules, Stoke and anti-stokes line, selection rule.

Electronic Spectra: Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rule and frank-Condon principle.

Unit-IV

VI. **Photochemistry** Interaction of matter with matter, difference between thermal and photochemical processes, Laws of photochemistry: Grothus-Drapper law, Stark-Einstein law, Jablonski diagram depicting various 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), Kinetics of photochemical reaction

VII. **Solutions, Dilute Solutions and Colligative Properties:**

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient

Dilute solution, colligative properties, Raoult's law, relative lowering of vapor pressure, molecular weight determination, Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, elevation of boiling point and depression of freezing point, Thermodynamic derivation of relation between molecular weight and elevation of boiling point and depression of freezing point. Experimental methods for determining various colligative properties.

Abnormal molar mass, Van't Hoff factor, Colligative properties of degree of dissociation and association of solutes.

B.Sc. – III (PRACTICAL)

180 hrs. (12 hrs /week)

Inorganic Chemistry :

Synthesis and Analysis:

(a) Preparation of sodium trioxalator ferrate (III), $Na_3[Fe(C_2O_4)_3]$ and determination of its composition by permagonometry.
(b) Preparation of Ni-DMG complex, $[Ni(DMG)_2]$
(c) Preparation of copper tetraammine complex. $[(Cu(NH_3)_4]SO_4$
(d) Preparation of *cis*-and *trans*-bisoxalato diaqua chromate (III) Ion.

Instrumentation:

Colorimetry

(a) Job's method (b) Mole-ratio method
Adulteration – Food stuffs.
Effluent analysis, water analysis

Solvent Extraction

Separation and estimation of Mg(II) and Fe(II)

Ion Exchange Method

Separation and estimation of Mg(II) and Zn(II)

Organic Chemistry :

Laboratory Techniques:

Steam Distillation

Naphtalene from its suspension in water
Clove oil from cloves
Separation of *o*-and *p*-nitrophenols

Column Chromatography

Separation of fluorescein and methylene blue
Separation of leaf pigments from spinach leaves
Resolution of racemic mixture of (±) mandelic acid

Qualitative Analysis

Analysis of an organic mixture containing two solid components using water, $NaHCO_3$,
NaOH for separation and preparation of suitable derivatives

Synthesis of Organic Compounds

(a) Acetylation of salicylic acid, aniline, glucose and hydroquinone, Benzoylation of aniline and phenol
(b) Aliphatic electrophilic substitution
Preparation of iodoform from ethanol and acetone
(c) Aromatic electrophilic substitution
Nitration
Preparation of m-dinitrobenzene
Preparation of p-nitroacetanilide

Halogenation
Preparation of p-bromoacetanilide
Preparation of 2, 4, 6-tribromophenol
(d) Diazotization/coupling
Preparation of methyl orange and methyl red
(e) Oxidation
Preparation of benzoic acid from toluence
(f) Reduction
Preparation of aniline from nitrobenzene
Preparation of m-nitroaniline from m-dinitrobenzene

Stereochemical Study of Organic Compounds via Models

R and S configuration of optical isomers
E, Z configuration of geometrical isomers
Coformational analysis of cyclohexanes and substituted cyclohexanes

Physical Chemistry :

Electrochemistry:

1. To determine the strength of the given acid conductometrically using standard alkali solution.
2. to determine the solubility and solubility of a sparingly soluble electrolyte conducometrically.
3. to study the saponification of ethyl acetate condutometrically.
4. To determine the ionization constant of a weak acid condutometrically
5. To titrate potentiometrically the given ferrous ammonium sulphate solution using $KMnO_4/K_2Cr_2O_7$ as titrant and calculate the redox potential of Fe^{++}/Fe^{+++} system on the hydrogen scale.

Refractrometry, Polarimetry:

1. To verify law of refraction of mixtures (e.g. of glycerol and water) using Abbe's refractometer
2. To determine the specific rotation of a given optically active compound.
3. To determine stoichiometry and stability constant of complexes

Molecular Weight Determination:

1. Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point method.
2. Determination of the apparent degree of dissociation of an electrolyte (e.g , NaCl) in aqueous solution at different concentrations by ebullioscopy.

Colorimetry:

1. To verify Beer – Lambert Law for $KMnO_4/K_2Cr_2O_7$ and determining the concentration of the given solution of the substance from absorption measurement.

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180 hrs. (09 hrs./week)

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