# Chemistry
## B.Sc.Part I :

Paper I : Inorganic and Analytical Chemistry

1. Structure of Atom : Black body radiation, Photoelectric effect, Bohr's atomic model and its application to hydrogen atom, Limita tions of Bohr's atomic model, Bohr's Sommerfield model of atom,de Broglie hypothesis, Experimental verification of wave nature of atom, Heisenberg's uncertainty principle, wave mechanical model of atom, postulates of quantum and Schrodinger wave Equation, Derivation and importance of equation, Eigen values and eigen functions, Born-oppenhemer approximations, Physical significance of the wave function.Quantum numbers. Aufbau principle.Electronic structures of various elements having abnormal configurations possible reasons for doing so.

2. Periodicity : Periodicity of properties of elements -Atomic Radii, Ionization Potential, Electron affinity, electronegativity, magnetic properties.

3. Chemical Bonding : (a) Recapitulation of different types of bond formation and only elementary concept to explain the nature of bond formation (Nature of the bonds between elements and electronic configuration of elements forming the bonds) - a correlation and its reasons-interpretation in terms of electronegativity, size of the atom in the bonded state (ionic and covalent bonds).

(b) Structure of elements (non-metals) in solid state.Structure of non metals in their various allotropic forms (diamond, graphite,fluorine, nitrogen and phosphorus, oxygen and sulphur).

4 . (a) Structure of very simple molecules of non-metals (eg. AB2, AB3, AB4, AB5 and AB6 type A and B, both non metals ; A – non metal and metal ).

(b) The structures of above type molecules and their approximate correlation with the electronic structure of the element A and B. Concept of hybridization, VSEPR theory. Their strong and weak points-Partial ionic character in a bond and electronegativity. Inference of ionic character of a bond in the molecular properties.Gradation in properties of the compounds along the period and along the group in the periodic table.Polarizability of an atom in abonded state and its effect on the molecular properties like solubility etc. of the compound. Lattice forces and solubility.

5. Bond energy and stability of ionic state of the elements in their compounds. Inert pair effect and its relationship with the oxidizing and reducing properties of various elements. Non - Metals :

6. Hydrogen - General chemistry,Hydrogen Bond and its effect on the properties of compounds.General chemistry of water and hydrogenperoxide.

7. Chemistry of B,C and Si.General survey of their reactions, trends in their properties and their explanations on the basis of the electronic structure.Special emphasis on those properties which show diagonal relationship and which are abnormal.

8. Chemistry of N,P and As.General survey of their reactions. Tendancy of their ion formation and correlation with electronic structures.Chemistryof nitrogen halides, $NH_3$, $PH_3$, $AsH_3$, Oxides and oxyacids.The trends in their properties with special emphasis on abnormal properties down the group and across the periodic table and their correlation with electronic structures. Liquid $NH_3$ as a non aqueous solvent.

9. Chemistry of oxygen and sulphur-General survey of their reactions.Trend in their properties down the group.Difference among the properties of oxygen, sulphur and selenium.

10. Chemistry of halogens-General survey of the reactions,Trends in their properties and their explanation on the basis of their electronic structure, oxides and oxyacids. Interhalogens. Iodo and Iodimetry. Properties of $I^+$ ion.

11. A general discussion about hydrides, halides, oxides and oxyacids. Borides, carbides and silicides. Various silicates and their structures glass, molecular sieves, zeolites, thiocyanate (SCN-) as an analytical ion.
12. Chemistry of p-block elements with special reference to Ga, In, Tl, Ge, Sn, Pb and As, Sb, Bi. General characterstics, their important compounds, preparation, properties, uses and structures.
13. General reactions of inert gases, their simple compounds and structures.
14(a). Caliberations,error and deviations,significant figures.
(b) Basic principles involved in the qualitatative analysis of anions and cations.
(c) Numerical problems pertaining to volumetric analysis (acid base, oxidation-reduction titrations).

Paper II: Organic Chemistry
1. Bonding in carbon compounds: Hybrdization and shapes of molecular orbitals.Factors affecting covalent bonds: Inductive, electromeric and mesomeric (Resonance) effects, hyperconjugation and hydrogen bonding. Modern concepts of acids and bases : Factors affecting strength of acids and bases. Homolytic and heterolytic bond fission: For mation and stability or reactive intermediates (Carbo-cations, carbanions and free radicals). General concepts of types of reactions: Substitution, addition and elimination.Nomenclature of aliphatic organic compounds.
2. Hydrocarbons
(a) Alkanes: Mechanisms of Kolbe's electrolytic synthesis;Wurtz Reaction and halogenation (free radical mechanism).
(b) Alkenes : Introduction of double bond in a compound. Mechanism, of electrophilic addition. Markownikoffs rule, peroxide effect and polymerisation. Hydroboration oxidation, epoxidation and ozonolysis of C = C compound. Location of C = C in alkenes and polyenes. Polyethylenes and polyvinyl chloride. Free radical allylic substitution.
(c) Dienes : Addition to conjugated dienes (mechanism of Diels Alder reaction).
(d) Alkynes : Introduction of triple bond in a compound. Mechanisms of electrophilic and nucleophilic addition to – C = C – (hydration, vinylation ethenylation, etc.) comparision of reactivities of alkenes and alkynes towards electrophiles. Elementary idea about
tautomerism occuring during hydration of alkynes. Acidity of alkynes.
(e) Petroleum and Petrochemicals: Petroleum refining, Knocking Octance and Cetance numbers,reforming,cracking,synthetic fuels petrochemicals.
(f) Aromatic Hydrocarbons : Benzene and its homologues; nomenclature of disubstituted benzene.Structure of benzene, aromaticity and Huckel's rule.Mechanisms of Fridels - Crafts, Wurtz Fitting reactions, and other electrophilic substitutions (SE1 and
SE2 ), Orientation in benzene. Explanation of directive influence of substituents.
(g) Polynuclear Hydrocarbons:
(i) Naphthalene : Synthesis, structure and important reactions.
(ii)Anthracene and phenanthrene:Synthesis and important reactions.
(iii) Carcinogenic Hydrocarbons: Elementary idea.
3. Halogen Derivatives of Hydrocarbons: (a) alkyl Halides: Mechanism of substitution (SN1, SN2 and SN3) and elimination (E1 andE2) reactions of alkyl halides, haloform reaction ( its application and mechanism). Grignard Reagents. Polyhalogen derivatives.
(b) Vinyl and Allyl Halides ; Synthesis and reactions. (c) Halogen
Derivatives of Benzene and Alkyl Benzene, Nuclear and side chain halogenation.
Paper III: Physical Chemistry
1. Mathematical concepts and computers : Logarithmic relations, Curve sketching, Regression analysis.Differentiation of functions like f(x), ex, xn, sin x, log x, Maxima and Minima, Parital , Total

and Exact differentials, Reciprocity relations.Integration of some useful/relevant functions, permutations and combinations.Expansion of trigonometric functions. Operators, factorials and Stirling's approximation.

Computers : General introduction of computers. Different components of a computer, Hardware and Software, input-output devices. Binary numbers and arithmetics.Operating systems.Introduction to computer language. Basic and Fortran. Simple programming like
conversion of oC to oF.

2. Structure of Atom : Black body radiation, Photoelectric effect Bohr's atomic model and (a) Schrodinger's equation. Concept of operators, especially energy and angular momentum. Concept of standing waves and its relationship with his equation.Concept of wave function. (b) Ideas of different force fields with special emphasis on central force field and its relationship with hydrogen atom. (c) Schrodinger equation as applied to hydrogens atom (in terms of cartesian and polar coordinates). (d) Concept of good wave function for hydrogenation (Boundary conditions). (e) Concept of central force field. Repurcussion if the force field is not central type but another type. Concept of interelectronic repulsions between two or more electrons.Approximates for and solutions of solving Schrodinger equation for multi electron system. ( Nomathematical treatment required.Application of Schrodinger wave equation for particle in one dimensional box.

3. Fundamental particles and their classification. Nuclear forces, Nuclear spin, magnetic moment of nuclei and magic number. Liquid.drop and shell models of nucleous. Nuclear stability. Kinetics of radioactive decay. Energy changes in nuclear reactions, Nuclear energy, Fission and fusion reactions.Principles of nuclear reactor. Radiolysis of water. Carbon dating and tracer techniques. Separation and identification of isotopes.

4. Chemical Bonding : Elementary ideas of wave mechanical concept of covalency. Molecular Orbital approach, Criteria for forming MO's from atomic orbitals, Construction of MO's by LCAO in homonuclear diatomic molecules.Physical picture of Bonding and Antibonding molecular orbital wave function, concept of $\sigma$, $\sigma$ + and $\pi$ and $\pi$ + molecular orbitals and their characteristics.Evaluation of bond order in simple homonuclear diatomic molecules.Valence bond approach to H2molecule.Comparison of V.B. and M.O. approach. Hybridisation (a qualitative quantum mechanical approach).

5. Molecular structure : Dipole moments: bond angles,bond moments,ionic character in bonds,and their applications in elucidation of molecular structure.Optical activity and chemical constitution.Basic principles of molecular spectroscopy: Electromagnetic radiations,regions of spectrum and concept of molecular energy levels.Lambert-Beer's law.Basic principles of UV,visible and IR spectroscopy.IR spectra of H2O and CO2 molecules (only brief discussion).

6. Gaseous State :Postulates of kinetic theory of gases,deviations from ideal behaviour.Van der Waals equation of state for n moles.Critical Phenomenon: PV-isotherms of real gases,continuity of state,the isotherms of Van der Walls equation. Critical constants and their experimental determination, relationship between critical constants and Van der Walls constants.Law of corresponding states. Reduced equations of state.Elementary idea of other equations of state.Molecular Velocities:Root mean square velocity,average and most probable velocities,a qualitative discussion of Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter.Liquefaction of gases.

7. Liquid State: Intermolecular forces,structure of a liquid(a qualitative description). Structural differences between solids,liquids and gases.Liquids crystals:Classification, structure,properties and a few applications.Surface tension,surface energy and Parachor
viscosity and refractive index of liquids in view of molecular con stitution.

8. Solid State: Crystaline state,Space lattice and Unit cell.Laws of crystallography, Symmetry elements in crystals,labelling of planes.Crystal systems and Bravais lattices. X-ray diffraction by crystals,derivation of Braggs' equation.Determination of crystal structure of NaCl and KCl crystals.Limiting radius ratio,close packing,lattice energy,Born-Haber cycle and its importance.Defects in crystals:Point defects.Elementary ideas about semiconductors, super conductors and nanoparticle materials. Band theory of solids and solid state reactions.

9. The Colloidal State and Macromolecules : Colloidal systems.Lyophobic and Lyophilic colloids.Preparation kinetic optical and electrical properties.Origin of charge on colloidal particles. Coagulation of colloids, Hardy-Schultz rule. Stability of colloids, protection and gold number.Elementary idea of electrical double layer and electro kinetic potential,colloidal electrolytes and association colloids.Detergents.Emulsions and gels.

Macromolecules and their molecular weights. Determination of molecular weights of macromolecules by ultracentrifuge, light scattering osmotic pressure and viscosity methods. Concept of micelles and critical micelle concentration.Conducting and light emittingpolymers.

# Chemistry
# B.Sc.Part II :

## Paper I : Inorganic and Analytical Chemistry

1. Concept of electrodepotential and its application in predicating the occurrence of a chemical reaction.Electrochemical series and its application.
2. Acids and Bases, ways of defining acids and Usanovich bases.Arrhenius,Bronsted– Lowry and Lewis concepts, protonic and nonprotonic solvents, pH and pk, factors affecting and strength of acids and bases.Theory of hard and soft acids and bases( HSAB theory) and its applications.
3. Solid State :Classification of solids,size and shape of crystals,types of crystals, symmetry of crystals, crystal systems, Bravais lattices, crystal structure of metals. Structures of NaCl ,Zinc blende and Calcium, Carbide crystals. Defects in stoichiometric and non stoichiometric crystals.
4. Magnetic properties of chemical substances, importance of magnetism in transition element chemistry magnetic moment and magnetic susceptibility, para -dia - and ferro - magnetism,Curries Law and ferro magnetism in deciding spin pair and spin free metal complexes.
5. Coordination Chemistry: Introduction and meaning of terms double salts, complex salts, coordination number, chelation,central metal ion, ligands and metal complexes.Werner's coordination theory,nomenclature of complex compounds,simple type of isomerism (such astonisation,hydrate,coordination,linkage,coordination position, etc )
6. General study of d–block elements of first, second and third transition series based on their positions in periodic table.Electronic configuration, variable valency, ability to form complexes,magnetic properties, metallic character and oxidation states.
7. Comparative study of the following groups of elements and their compounds in different oxidation states, gradation in ionization potential electron affinity, atomic radii and ionic radii
(a) Tatanium family (b) Chromium family (c) Fe,CO,Ni
(d) Copper family and Zinc family
8. Chemistry of the isolation, extraction, purification and uses
of Ti,V2 ,Cr, Ni, Pt and Au.
9. Reactions involved in the preparation of the following compounds, their important properties, structures and uses (a) Potassium dichromate (b) Potassium permanganate (c) Chromyl chloride (d) hexa cyanoferrate and sodium nitropruside (e) Aurous and Aurie chlorides (f) Milton's Base (g) Ni and Pt catalysts.
10. Principles of gravimetric analysis, precipitation from homogeneous medium, purity of precipitates, coprecipitation, post-precipitation, washing and ignition of precipitates.
11. Numerical problems based on gravimetric analysis prescribed.

## Paper II : Organic Chemistry

1. Hydroxy Derivatives of Hydrocarbons:
(a) Alkanols: Preparation of all classes of alcohols from Grignard Reagent, distinction and interconversion of 1°, 2° and 3°alcohols. Dehydration of alcohols and its mechanism.Vinyl alcohol.
(b) Diols and Triols: Glycol and glycerol,synthesis and important reactions. Structure of glycerol.
(c) Ethers: Synthesis and reactions, mechanism of Williamson's synthesis.
(d) Phenols: Synthesis and important reactions, acidity of phenols mechanism of Reimer-Tiemann and Kolbe's reactions. Dihydric phenols and trihydric phenols.
2. Carbonyl compounds: Aliphatic and aromatic aldehydes and ketones: Methods of preparation and important reactions ( Nucleophilic addition, reduction and oxidation). Acidity of a-hydrogen atoms. Mechanism of fol

lowing reactions: aldol condenstation,Cannizzaro's reaction,Claisen Schmidt reaction,Perkin reaction, Benzoin condensation, Knoevenagel reaction and Michacl addition.
(ii) Thiols:Disulphides,sulphonic acids,their methods of formation and reactions. Saccharine and chloramine-T: Preparation and uses. Names of medicinally active compounds of sulphur and their uses.

Paper III : Physical Chemistry

1. Thermodynamics Definition of thermodynamic terms: System and surroundings. Type of systems, Intensive and Extensive properties.State and path functions and their differentials. Thermodynamic processes. First law of thermodynamics. Concepts of heat and work. Maximum work. Internal energy and enthalpy- Molecular concept. Relation between
heat capacity at constant volume and at constant pressure for a perfect gas.Internal energy and ethalpy changes in chemical reactions. Thermochemical equations. Kirchhoff's equations. Bond energy and bond enthalpies. Carnot's cycle. Need for the second law : Different statements of law, concept foentropy-physical significance of entropy,entropy as a state function, entropy as a function of V and T and entropy as a function of P and T. Entropy changes in reversible and irreversible processes. Entropy changes in physical processes (transitions). Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases. Gibbs and Hehmholtz functions: Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities. A and G as criteria for thermodynamic equilibrium and spontaneity. Variation of G and A with P, V and T-Gibbs-Helmholtz equation. Clausius Clapeyron equation. Partial molar quantities-chemcial potential. Interpretation of feasibility of a process in terms of DH, DS and DG data.

2. Chemical Kinetics Reaction rates,specific reaction rate.Rate expression.Experimental techniques of the measurement of reaction rates.Order and molecularity of chemcial reactions. Determination of order and rate constants of a reaction.Factors affecting reaction rates. Energy of activation and activated complex: Arrhenius equation. Kinetic molecular interpretation of reaction rates.

3. Photochemistry: Light absorption.Primary and secondary processes.Laws of Photochemistry. Quantum yield. Law of photochemical equivalence and reasons of high and low quantum yields.Chemistry of excited states internal conversion,Intersystem crossing.Flourescence, quenching of flourescence, phosphorescence and chemilumine scence. Simple photochemical reactions. Photosenstisation, photopolymerisation. Chemical lasers and solar cells.

4. Catalysis: Homogeneous and heterogeneous catalysis. Adsorption theory of catalysis.Active centres. Kinetics of homogenous catalysis. Acidbase catalysis and enzyme catalysis. Surface reactions. Industrial catalysts.

5. Solutions: Partial molar quantities,partial molar volume. Raoult;s law. Ideal solutions. Henry's law.Thermodynamics of ideal solutions. Pressure Temperature,pressure-composition and temperature composition diagrams of binary liquid mixtures. Azeotropses. Non-ideal solutions (elementary idea about activity and activity coefficients and excess functions).Solutions of solids in liquids.Lowering of vapour pressure and Raoult's law.Elevation of boiling point and depression of freezing point.Molal elevation and depression contants. Osmotic pressure of solutions. Abnormal colligative properties and Vant-Hoff factor.

6. Electrochemistry:

(a) Electrical Conductance Specific, molar and equivalent conductivities.Effect of dilution, on conductance in non-aqueous solvents. Qualitative idea about interionic attraction theory of conductance of strong electrolytes. Transport number, ionic mobility and their determination. Kohlrauseh's law. Applications of conductometric measurements.

(b) Ionic Equilibria in Solutions: Degree of dissociation,Ostwald's Dilution law.Ionisation constant and ionic product of water. Solubility product, common ion effect and isohydric solutions. Acid-base Concepts-Bronsted and HSAB concepts. Dissociation of polybasic acids. Relative strengths of acids and bases. pH-value and its measurement. Buffer solutions. Salt hydrolysis and hydrolysis constant.Ionic strength and its calculation.Theories of indicators, pH-metric titrations.
(c) Electrochemical Cells Electrochemical cells.Electrode reactions and concept of half cell. Nernst theory of electrode potential. Reference electrodes and their uses. Oxidation-Reduction potentials, their measurements and applications in predicting reactions. Reversible and irreversible cells. Thermodynamics of galvanic cells. EMF and equilibrium constant. Concentration cells. Liquid junction potential and its elimination. Fuel cells. Applications of EMF measurements.

Chemistry Practicals

The duration of practical examination will be of six hours and will comprise of the following exercises :
1. Gravimetric Analysis:
(i) Barium as BaSO4 (ii) Zinc as ZnO (iii) Copper as CuO
2. Organic preparation (one step) & Crystalization :
(i) Acetylation (ii) Nitration (iii) Bromination (iv) Osazone forma tion (v) Picrate formation (vi) Azo-dye formation
3. Preparation of Simple Inorganic Compounds:
(i) Micro-cosmic salt (ii) sodium thiosulphate (iii)Tetrammine cop per (II) Sulphate (iv) Ammonium Ferric Sulphate (v) Chrome Alum
4. Physical Chemistry experiments:
(i) Experiments on surface tension (using stalagano meter)
(ii) Experiments on viscosity (using Viscometer)
(iii) Partition coefficient determination
(iv) Determination of solubility (at different temps)
(v) Mol. Wt. Determination by Rast Method.
5. Record and Viva Voce : The distribution of marks is as follows:
Gravimetric exercise 15 marks ; Organic Preparation 08 marks
Inorganic Preparation 08 marks ; Physical Experiment 10 marks
Record 04 marks ; Viva Voce 05 marks
(c) Electrochemical Cells
Electrochemical cells.Electrode reactions and concept of half cell. Nernst theory of electrode potential. Reference electrodes and their uses. Oxidation-Reduction potentials, their measurements and ap plications in predicting reactions. Reversible and irreversible cells. Thermodynamics of galvanic cells. EMF and equilibrium constant. Concentration cells. Liquid junction potential and its elimination. Fuel cells. Applications of EMF measurements.
Chemistry Practicals
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5. Record and Viva Voce : The distribution of marks is as follows:
Gravimetric exercise 15 marks ;
Organic Preparation 08 marks
Inorganic Preparation 08 marks ;
Physical Experiment 10 marks
Record 04 marks ;
Viva Voce 05 marks.

# Chemistry
# B.Sc.Part III :

## Paper I : Inorganic and Analytical Chemistry

1. Nature of Covalent Bond : Hietler - London, Pauling-Slater and Hund Mulliken theories, Molecular Orbital theory, Difference between A.O. and Molecular orbital comparision of Valence Bond and Molecular Orbital theories, LCAO , MO principle. Formulation of bonding non-bonding and anti-bonding molecular orbitals, Molecular-orbital energy level diagrams and M.O. electron configurations in homo and hetero nuclear diatomic molecules, bond order.
2. Resonance and its applications to inorganic compounds, metallic bond, odd electron bond.
3. Coordination Chemistry : Stereo-isomerism of complexes having co ordination numer 4 and 6. Stability of complex ions and the nature of metal Ligand Bond. Crystal field theory : Definition of crystal field, d-orbital splitting in octahedral, tetrahedral and square planer field. Explanation of weak and strong field ligands, Dq and factors influending its magnitude, calculation of crystal field stabilisation energy for d1 - d9 weak and strong field complexes. Interpretation of magnetic properties on the basis of crystal field theory.
4. Elementary treatment of π -bonded metal complexes (carbonyls and nirosyls).
5. Electron -Transfor Reactions Mechanism, outer and inner spheres electron transfer reaction, synthesis of co-ordination compounds using electron-transfer reactions.
6. Inorganic Reaction Mechanism, Classification of Inorganic reactions intermediate, Nucleophilicity, Substitution reaction in Octeheral and square planner complexes.
7. Nuclear Chemistry and Radioactivity : Radioisotopes and their applications in various fields. Applications of nuclear energy.
8. The f -Block Elements : General Discussions of lanthanides and actinides, occurrence, electronic configuration, oxidation states, magnetic properties, sizes of atoms and lanthanides contraction Separation of Lanthanides.Comparison of 4f and 5f-Block elements and their separation.
9. Outlines of extraction, isolation,purification and uses of
La,Ce,Th, U and Pu.
10. Role of Metals in Biological Systems : Different roles played by metals in Biological Systems, Coordination and roles of following metals in specified protiens :
(a) Fe in myoglobin and haemoglobin
(b) Cu in plastocyanin and haemocyanin
(c) Zn in carbosypeptidase and carbonic anhydrase

(d) Mg in chlorophyll
(e) Co in Vitamin B12
(f) Pt-complexes in canser chemotherapy.
11. Environmental Chemistry : Air pollution, water pollution and soil pollution. Major pollutants, Oxides of C, S , N. Photochemical pollutants, acid rains, effects of inorganic pollutants on life. Toxic elements ( Pb, Hg, Cr, F) and their effects in environment.
12. Organometallic Compounds : Definition, nomenclature, classification and general methods of preparation, properties and their uses in homogeneous catalytic reactions.
13. Inorganic layered materials used as acid and base catalysts.
14. Principles and techniques of semi-micro qualitative analysis.
15. Complexometric volumetric analysis, uses of EDTA for determination of Ca++ and Mg++ and hardness of water, Numerical problems on it.

Paper II : Organic Chemistry

1. Spectroscopy : U.V.-Visible : Origin, elementary idea of instruments used, simple application in structure determination of
organic molecules, Woodward-Fieser rule for λ max of conjugated dienes and α , β unsaturated carbonyl compounds.
I.R. Spectroscopy : Principle and instrumentation, absorption frequencies of common organic functional groups. Applications to simple organic compounds.
2. Heterocyclic Compounds : Nomenclature, synthesis and reactions of following compounds containing one hetero atom.
(i) Five Membered Ring Systems : Furan, Pyrrole & Thiophene, THF Pyrrolidine.
(ii) Six-Membered Ring Systems - Pyridine and Piperidine. Condensed six-membered ring system-quinoline and isoquinoline.
3. Cycloparaffins : Nomenclature, methods of formation of small, medium and large ring compounds and Baeyer's strain theory, strainless rings, conformational analysis of cyclohexane and mono substituted cyclohexanes.
4. Carbohydrates : Classification and Nomenclature, Monosaccharids, Structure and important reactions of glucose and fructose, mechanism of osazone formation, interconversion of glucose and fructose, chain lenghthening and chain shortening in aldoses, configuration of monosaccharides epimerisation, cyclic structures of D (+) glucose, mechanism of mutarotation. disaccharides structure of (+). Maltose, (+) Lactose and (+) Sucrose, Dinstinction between α - and β - glycosidic linkages.
5. Nitrogen Compounds : (i) Nitroalkane and aryl nitro compounds, their preparation and important reactions. Reduction of nitro compounds under different condition. Distinction between alkyl nitrites and nitro compounds.(ii) Amines - Aliphatic and aromatic amines : Preparation and important reactors, distinction between primary, secondary and tertiary amines, methods of separation from their mixtures. Comparison of their basicity. (iii) Diazonium Compounds - Structures, stability and important reaction. Diazomethane - its preparation and uses, chemistry of carbenes. Derivatives of hydrocyanic acid (Cyanides and isocyanides) and carbonic acid (urea, guanidine and isocyanates).
6. Amino acids, Peptides and Proteins : Amino acids : Methods of preparation and important chemical reactions ; Peptides - The peptide linkage, important methods of peptide end group analysis and peptide synthesis. Proteins - General characteristics, classification, primary and secondary structure of proteins. Proteomics.
7. Purines and Nucleic Acids : RNA, DNA, genome, genetic code and genetic engineering
8. Synthetic Polymers : Introduction.Modes of polymerisation

(a) Addition or chain growth polymerisation : Free radical ionic mechanism. some important vinyl polymers e.g. Polythene, PVC, polystyrene. Acrylic fibres, Orlon and Acrilon.(b) Condensation or step growth polymerisation -Polyesters, Polyamides, phenol formaldehyde resins, polyurethanes. (c) Coordination polymers.(d)
Light emitteng polymers.
9. Organic Photochemistry : Photochemistry of carbonyl compounds - Photoreduction, Norrish Type-I and Norrish Type-II cleavages. Addition of Alkenes of carbonyl compounds (oxitane formation).
10. Cambinatorial Chemistry : Elementary idea of combinatorial chemistry and its applications inmodelling chemical reactions.
11. Recent Advances in Drug Developments : General description of new drugs introduced, their chemical nature, biochemistry and applications.

Paper - III : Physical Chemistry

1. Statistical / Molecular Thermodyanamics : Energy lavels. Macrostate and microstates.Elements of statistical mechanics. Probability and most probable distribution for independent particles. Boltzmann distribution law. The Boltzmann factor. Partition function and its physical significance. Grand partition function. Evaluation of partition function. Relation between partition function and thermodyamic functions. Translational, rotational and vibrational partition functions for diatomic molecules. Partition function and equilibrium constant. The Sackur-Tetrode equation.
2. Electrochemistry : Activity and activity coefficient. Physical significance of activity. Mean ionic activity of electrolytes. Debye- Huckel limiting law. (solubility and simple e.m.f. methods). Ionic mobility and its experimental determination. The Einstein relation between the absolute mobility and diffusion coefficients. Ionic strength and its calculation.
3. Interface Chemistry : Characterization of solid surfaces. Physical and chemical adsoption. Freundlich and Langmuir adsorption isothems. B.E.T. equation (Statement, interpretation and applications in determination of surface area of adsorbents). Activated and exchange adsorption. Application of adsorption phenomena (adsorption indicators and chromatography).
4. Theory of Reaction Rates : Kinetics of Complex Reactions : Theory of reaction rates, collision and transition state theories. Activated complex. Lindenmann mechanism of unimolecular reactions. Kinetics of simple opposing reactions, parallel reactions, consecutive reaction and chain reactions. Kinetics of fast reactions including picosecond time interval. Beam kinetics and brief description of reaction dynamics.
Kinetics and mechanism of polymerisation (unsaturated monomers). Kinetics of co-polymerisation. Salt effect and effect of solvent on reaction rates.
5. Phase Equilibria : Heterogeneous physical equilibria. Nernst distribution law, Gibb's phase rule. Statement 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 liquid helium. Phase equilibria of two component system : solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems. Systems with congruent and simple cutectic Bi-Cd, Pb-Ag systems. Systems with congruent and incongruent melting points. Phase diagram of chloroform-acetic acid water system. First and Second order phase transitions.
6. Free Energy and Chemical Equilibrium : Spontaneous and reversible reactions. Standard free energy change. Law of mass action and its thermodynamic treatment. Law of chemical equilibrium and equilibrium constant. Equilibrium constant and free energy. Thermodynamic relations for chemical affinity. Equilibria in Homogeneous and Heterogeneous reversible reactions. Examples of homogeneous and heterogeneous reactions. Temperature dependence of equilibrium constant-

the van's-Hoff equation. Gibbsduhem equations. Le'Chatelier's principle and its thermodynamic treatment. Equilibria of simple biochemical reactions.

7. Molecular Spectroscopy : Rotational and vibrational Spectroscopy. Rotational and vibrational spectra of diatomic molecules. Isotopic substitution and rotational constant. Normal modes of vibrations for linear, symmetric, asymmetric and bent triatomic molecules. Overtones and combination frequencies. Raman spectroscopy. Experimental determination of Raman shift. Raman selection rules. Symmetric and assymmetric stretching vibrations. Polarised and depolarised Raman lines. NMR spectroscopy. Theory of NMR spectroscopy, experimental determination of chemical shift, high resolution spectrum of ethanol (spin-spin splitting), RMI and its applications, Elementary idea of ESR and mass spectroscopy.

8. Biological Membranes : A brief description of lipids constituting the biological membranes. Formations of miscelles, bilayer and liposomes, bilipids, general features of the biological membranes and their fluid mosaic model. Diffusion, facilitated diffusion and active transport through a biological membrane.

9. Recent Advances in Chemical Sciences : Acquantance with some recent advances in chemical sciences, such as, material chemistry, superconductivity, biotechnology and nanotechnology.

Chemistry Practical

The duration of practical examination will be of Six hours.

1. Inorganic analysis :

(i) Paper chromatographic separation of metal ions.

$Cu^{2+}$ , $Pb^{2+}$ , $Zn^{2+}$ , $Co^{2+}$ , $Ni^{2+}$ , $Cd^{2+}$ , ions ( Binary mixtures only )

(ii) EDTA titrations of $Ca^{2+}$ , $Mg^{2+}$ , $Zn^{2+}$ and $Cu^{2+}$

(iii) Determination of carbondioside content in polluted water.

(iv) Colorimetric determination of metal ions

$Fe^{3+}$ , $Co^{2+}$ , $Ni^{2+}$ and $Mn^{2+}$ .

2. Organic Analysis of Industrial Importance :

(i) Determination of Iodine value of a vegetable oil.

(ii) Determination of acid value of a vegetable oil.

(iii) Determination of saponifaction value of a vegetable oil.

(iv) Paper chromatographic separation of amino acids and sugars (only binary mixtures)

3. Physical Chemistry Experiments :

(i) Kinetic study of Hydrolysis of methyl acetate catalysed by an acid.

(ii) Kinetic study of Hydrolysis of ethyl acetate.

(iii) Adsorption of acetic acid on Charcol.

(iv) Heat of solution of a substance (oxalic acid) by solubility method.

(v) Transition temperature of Glaubey's salt by thermometric method.

(vi) Heat of Neutralization of NaOH and HCl.

(vii) Molecular weight determination of a volatile substance by Duma's method.

(viii) Study of kinetics of Acetone-Iodine reaction catalysed by $H^{+}$. ion.

The distribution of marks is as follows :

Inorganic Experiment 20 Marks

Organic Experiment 20 Marks
Physical Experiment 20 Marks
Viva Voce 05 Marks
Record 10 Marks
Total Marks : 75 Marks