B. Sc. Part - I:- CHEMISTRY (HONOURS)

Paper-IA (Physical Chemistry)

Five questions will have to be answered selecting at least one question and not more than two from each group. Four questions will be set from each of the three groups.

GROUP-A: THE STATES OF MATTER

1. Gaseous State: Kinetic theory of gases, derivation or kinetic gas equation, deduction of gas laws, calculation of gas constant and kinetic energy. Maxwell Boltzmann distribution law of velocities (derivation not needed) and energy, distribution curves at different temperatures, calculation of most probable; average and root mean square velocities of molecules.

Real gases, compressibility factor, derivation from ideality, various equations of state for real gases with special emphasis on Van der Waals equation of state and its application to the calculation of Boyle's temperature.

2. Liquid State: Qualitative treatment of the structure of the liquid state including various approaches to the structure of liquids, radial distribution function, physical properties of liquids (molar volume, vapour pressure, surface tension, parachor).

3. Solid State: Types of solid, crystal forces, law of constancy of angles, seven crystal systems, law of rational indices, labelling the planes, Miller indices, qualitative idea of point and space groups, elementary idea of symmetry, symmetry elements.

4. Colloidal State: Definitions, classification, preparation of colloidal solution and their purification, properties of colloids, protection of colloids, application of colloids.

GROUP-B: EQUILIBRIUM

1. Chemical Equilibrium: Reversible and irreversible reaction, statement of law of mass action and its kinetic derivation , equilibrium constant for homogeneous and heterogeneous reaction, relationship between Kc, Kp and Kx . Le Chatelier's Principle and its applications.

2. (a) The First in Action: Thermochemistry : Heats of chemical reactions, reaction enthalpy, standard enthalpy changes, Hess's Law, Kirchoff's law, Relation between enthalpy H and internal energy U, bond energies and their determination, enthalpies of ions in solutions.

(b) Thermodynamics I: Thermodynamic terms: systems, extensive and intensive properties, thermodynamic process, state functions and exact differentials.

3. Thermodynamics II: Work done in a system, internal energy, first law of thermodynamics, heat capacities, relation between Cp and Cv, isothermal and adiabatic processes for ideal gas, relation between P-V, V-T and P-T for ideal gas, adiabatic processes for ideal gas, adiabatic reversible expansion of ideal gas, Elementary idea of entropy and Clausius inequality.

4. Ionic Equilibrium: Ionic product of water, pH, pKa , pKb and pKh buffer solution, buffer index , buffer capacity, buffer range, pH of buffer solution, idea of role of buffer solutions in day to day life, Dissociation constant of acids and bases, solubility product and its applications in salt analysis, Common effect, HSAB concept.

GROUP-C: CHANGES

1. Chemical Kinetics: Rate of reaction, order and molecularity, expression for

specific rate constant of first order reaction, half life period, unit, experimental determination of order or reaction.

2. Dilute Solutions and Changes of State-I: Colligative properties, Osmosis, Osmotic pressure and its experimental determination, van't Hoff factor, vapour pressure, Roult's Law of lowering of vapour pressure.

Experimental determination of relative lowering of vapour pressure and molecular weight determination, relation between osmotic pressure and lowering of vapour pressure.

3. Dilute Solutions and Changes of States-II: Elevation of boiling point of solution, depression of freezing point of solutions, experimental determination of colligative properties, abnormal colligative properties of solutions.

4. Processes at Solid Surface: Elementary idea of crystal growths, Adsorption: Physisorption and chemisorption, chemisorbed species. Idea of catalytic activity at surfaces, anti catalytic processes such as hydrogenation, oxidation, cracking and reforming.

PAPER-IB – (Inorganic Chemistry)

Five questions will have to be answered covering at least one question and not more than two questions from each group. Four questions will be set from each of the three groups.

GROUP-A: FOUNDATION

1. Atomic Structure:

(a) Features of H-spectra and Bohr's interpretation of H-spectra and limitation, refinement of Bohr theory. Bohr-Sommerfeld theory.

(b) Shapes of orbitals and their labellings, idea of quantum numbers, Pauli's exclusion principle, Hund’s rules, Aufbau principle, Electronic configuration of elements.

2. Bonding Models in Inorganic Chemistry

(a) Ionic bond: Energetics involved in ionic bond formation. Born Haber cycle, Radius ratio rule, different types of crystal lattice, Fajan's rule, I.P., Inert pair effect.

(b) Covalent Bond: Exceptions to the octet rule, idea of orbital overlap, hybridization of orbitals.

(c) Van der Waal's forces, H-bonding.

3. (a) Nomenclature of Inorganic Compounds: Acquaintance with IUPAC use of multiplying affixes, enclosing marks, numbers and letters. Names for ions and radicals, isopoly and heteropoly anions.

(b) Acid-Base Chemistry: Bronsted-Lowry definition, solvent system definition, Lowers concept, aqua acids, periodic trends in aqua acid strength, HSAB concept.

4. Periodicity: Pauli's exclusion principle and periodic table. Fundamental trends of atomic/ionic radii, ionization energy, electron affinity, electronegativity, hardness and softness, first and second row anomalies, Idea of ct-orbital participation by non-metals and its influence on their reactivity. Periodic anomalies of non-metals and post transition metals.

GROUP-B

SYSTEMATIC CHEMISTRY OF THE ELEMENTS

1. **Hydrogen and hydrides:** Position in P.T., isotopes of hydrogen, ortho and para hydrogen. Hydrides: ionic, covalent, metallic and intermediate. Hydrogen ion. H_2O_2: preparation, properties, structure and uses.
2. **Principles of Metallurgy:** (a) Idea of Mohs' scale of hardness of minerals, Holme's classification of metals into five groups, general methods of extraction their position in electrochemical series and extraction, Gibbs free energy.

(b) **Principles of various concentration methods:** Calcination, roasting and smelting, Role of carbon and other reducing agents. Electrolytic reduction, hydrometallurgy, methods of refining and purification, electrolytic, chromatographic, ion exchange solvent extraction, oxidative refinings. Zone refining, Kroll's process, Van Arkel de Boer method, Mond's process.

3. Chemistry of the following metals: (a) Li, Be, Ra (b) Sn, Pb.
4. Chemistry of halogens with reference of extraction, oxidation states and halides.

GROUP-C: MISCELLANEOUS TOPICS

1. **(a) Molecular Symmetry:** An Introduction: Symmetry elements and symmetry operations, centre of symmetry, axis of symmetry and plane of symmetry (definitions).

   (b) Elementary Magnetochemistry: Types of magnetic behaviours, paramagnetism, diamagnetism and ferromagnetism, dependence of paramagnetism on S & L.
2. Principles involved in the volumetric estimations of Ag^{+} ion, Cu^{++} ion and Ca^{++} ion.
3. Principles involved in the gravimetric estimation of Cu^{++} ion, Ni^{++} ion, Mg^{++} ion, Ba^{++} ion, SO_4^{--} ion.
4. Isotopes: Detection and separation.Tracer technique and applications, radiocarbon dating.

PAPER-1C (ORGANIC CHEMISTRY)

There shall be three groups of 4 questions each. The candidate shall be asked to answer five questions taking at least one question and not more than two from each group.

GROUP-A: FOUNDATION

1. **Shapes and Structure of Organic Molecules:** Hybridisation, Bond angle, bond length and bond energy. Idea of covalent bonds, shapes/structures of methane, ethane, acetylene and benzene molecules.
2. **Nomenclature of organic compounds:** Acquaintance with IUPAC nomenclature of aliphatic and aromatic compounds.
3. **Introductory Organic Reaction Mechanism:** Elementary idea of electronic distribution, inductive effect, electromeric effect and mesomeric

effect, resonance, bond fission and fission products. Elementary idea of the reagents and types of reactions.

4. **Elementary Stereochemistry:** Brief idea of geometrical and optical isomerism.

GROUP-B

DETAILED STUDY OF THE DIFFERENT

CLASSES OF COMPOUNDS

1. **(a) Alcohol:** Monohydric, dihydric, trihydric and unsaturated alcohols.

   (b) Aldehydes and ketones.

2. **(a) Carboxylic acids:** monocarboxylic acids and dicarboxylic acids.

   (b) Organometallic compounds of Mg and Li.

3. **(a) Amines and Urea:** Classification, preparation, separation, distinction identification and estimation.

   (b) Organosulphur compounds.

4. **Aromaticity and Structure of Benzene:** Mono substituted benzene derivatives, Orientation and directive influence of different groups in benzene.

GROUP-C:

APPLICATION TECHNIQUES

1. **Analytical Organic Chemistry I**: Qualitative and quantitative estimation of C, H, N, S, P and halogens in organic compounds.
2. **Analytical Organic Chemistry II**: Molecular weight determination of organic acids by silver salt method and of organic bases by platinic chloride method.
3. **Purification of Organic Compounds**: Purification of organic compounds and criteria of purity, chromatography.
4. (a) Synthetic fibres and plastics.

   (b) Soaps and detergents including chemistry of their actions.

B. Sc. Part - I: CHEMISTRY (Honours)

PRACTICAL

PAPER-II

[Time: 6 Hours] **[Full Marks: 50]**

1. **Volumetric analysis:** 25

   (a) Acidimetry and alkalimetry.

   (b) Use of potassium permanganate; potassium dichromate and sodium thiosulphate.

2. Detection of nitrogen, sulpher and halogen in organic compounds and identification of organic compounds containing one functional group including monosaccharides. 15

3. Note book and Viva Voce. 10

B. Sc. Part - I:- CHEMISTRY (GENERAL SUBSIDIARY)

Five questions will have to be answered selecting at least one question from each group. Four questions will be set from each group.

GROUP-A: PHYSICAL CHEMISTRY

[Time: 3 Hours] **[Full Marks: 75]**

1. The States: (a) Gaseous State: Kinetic theory of gases, derivation of kinetic gas equation, deduction of gas laws, calculation of gas constants and kinetic energy.

(b) Types solid, crystal forces, law of constancy of angles, seven crystal systems, law of rational indices, Bragg's law, Lattice Energy, Born Haber Cycle. .

2. Thermochemistry: Heat of chemical reactions, reaction enthalpy, standard enthalpy changes, Hess Law, Kirchhoff's Law, Bond energies and determination.

3. Ionic Equilibrium: Ionic product of water, pH, pK_a , pK_b, and pK_w, buffer solution. Idea and role of buffer solutions in day-to-day life. Solubility product and its applications in salt analysis common ion effect. Electrolytic conductance, specific conductance, equivalent conductance and molar conductance.

4. (a) Chemical Kinetics: Rate of reaction, order and molecularity, expression for specific rate constant of first order reaction, half life period, unit.

(b) Colligativ Properties: Colligative properties, osmosis, osmotic pressure and its determination. Vapour pressure, Roult's law of lowering of vapour pressure, relation between osmotic pressure and lowering of vapour pressure.

GROUP-B: INORGANIC CHEMISTRY

1. Atomic Structure and Bonding: Features of H-spectra and Bohr's theory, shapes of orbitals and their labellings, idea of quantum, number Pauli's exclusion Principle, Hund's rulers, Aufbau principle Electronic configuration of elements.

Idea of ionic and covalent bonds, I.P., E.N. and E.A., Fajan's rule

2. Chemistry of the following elements: Li, Sn, Fluorine, Chlorine, Iodine

3. Principle involved in the volumetric and gravimetric estimations of Cu^{++} and iron.

4. Isotopes: Brief idea of detection and separation, tracer techniques radiocarbon dating.

GROUP-C: ORGANIC CHEMISTRY

1. Structure and Mechanism: Hybridisation, bond angles bond length,

idea of δ and π bonds, inductive effect, electrometric effect and mesomeric effect, bond fission and fusion products, elementary idea of reagents and type of reactions .

2. Nomenclature: Acquaintance with IUPAC nomenclature of aliphatic and aromatic compound.

3. (a) Alcohols :monohydric, **(b)** Grignard's reagent.

4. Idea of purification of compounds, criteria of purity, Chromatography.

CHEMISTRY

SUBSIDARY/ GENERAL

[Time: 5 Hours] **[Full Marks: 25]**

PRACTICAL

GROUP-A:

INORGANIC CHEMISTRY **12 Marks**

1. Volumetric Analysis: (a) Acidimetry and alkalimetry

(b) Use of potassium permanganate and potassium dichromate, iodometry.

GROUP-B:

ORGANIC CHEMISTRY **8 Marks**

2. Organic Detection: Detection of nitrogen, sulphur and halogens in organic compounds. Detection of the following functional group of Organic compounds:

(i) OH (Phenolic), (ii) CHO (iii) C = 0

(iv) COOH (v) NH_3 and (vi) NO_2 (aromatic)

3. Record of class work and viva-voce **5 Marks**

B. Sc. Part - II:- CHEMISTRY (HONOURS)

PAPER-IIIA (Physical Chemistry)

There shall be four questions from each group and the candidate shall be expected 10 answer five questions selecting at least one questions and not more than two each group.

GROUP-A

STATES OF MATTER

1. Gaseous State: Critical phenomena and Andrew's experiment, intermolecular forces and liquid faction of gases, critical state: relation between critical constants and Van der Waals constants, Law of corresponding states, derivation of reduced equation of state.

2. Liquid State: Critical temperature and structure, Physical properties of liquids: viscosity, refractive index, idea of liquid crystals.

3. Solid State: Bravais lattices and lattice planes, Bragg's Law. Lattice energy and its calculations, crystal structures of NaCl, KCl, ZnS and diamond. Radius ratio rule and co-ordination number.

4. Colloids: Lyophilic and lyophobic colloids, coagulation, dialysis, Hardy Schulze Law, Tyndall effect, Brownian movement, electrophoresis, origin of charge, gold number, size determination, electrokinetic potential, gel, emulsion.

GROUP-B (EQUILIBRIUM)

1. Thermodynamics: Second law of thermodynamics. Carnot theorem, Carnot cycle, Entropy and its probability view, entropy change for reversible and irreversible processes and ideal gases entropy of mixing of ideal gases, free energy and work function criteria of chemical reactions, Gibban Helmholtz Equation, Clausius-Clapyeron equation and its applications.

2. Ionic Equilibrium: Ostwald's dilution law, conductance measurement of dissociation constant of acetic acid, relative strength of acids and bases and effect of subsittuents on them. Salt hydrolysis, application of conductance for determination of solubility product, degree of ionisation, hydrolysis constant, Theory of acid-base indicators.

3. Phase Equilibrium: Phase rule, terms and derivation, one component water and sulfur systems, two component solid and liquid systems (Ag-Pb, Mg-Sn, KI-H_2O, $FeCl_2$ - H_2O), Eutectic mixture, azeotropic mixture, congruent and incongruent compounds.

4. Distribution Law: Nernst distribution law, factors affecting partition coefficient, thermodynamic derivation, limitations and application, modification in case of association dissociation and chemical change.

GROUP-C (CHANGES)

1. Chemical Kinetic : Second order reaction, expression or specific rate constant of second order reaction, half life period and its unit, effect of temperature on reaction rate (Arrhenius equations, effect of catalyst on reaction rate, Energy of activation and its determination . Experimental measurement of order in acid catalysed hydrolysis of methyl acetate, saponification of ester and inversion of cane sugar, first order gas phase reaction (Lindemann theory).

2. Catalysis: Definitions and classification of catalyst, characteristics of catalyst, theory of catalysis, acid base catalysis, auto catalysis, enzyme catalysis, promoter, inhibitor, catalytic poison.

3. Conductance: Conductance of electrolytes cell constant, specific conductance, equivalent conductance and molecular conductance, effect of dilution on various type of conductance and their measurement. Kohlrausch's law of independent migrations of ions and its applications, conductometeric titration.

4. Electrochemical Cells: Reversible and irreversible cells and electrodes, E. M. F. of a cell and its measurement, Galvanic cells, electrode potential and its origin, standard electrode potential, Nernst equation,-determination of electrode potential, concentration cells, definition , classification, working of concentration cells and their applications, potentiometric titrations (acid-base, redox and precipitation).

PAPER-III B (Inorganic Chemistry)

Five questions will have to be answered selecting at least one question from and not more than two each group. Four questions will be set from each group.

GROUP-A (FOUNDATION)

1. Atomic Structure: Determination of electronic change and e/m ratio. Bohr frequency condition, Dual nature of electrons, particles or waves, uncertainty principle. Idea of group of group state term symbols. Excited state term symbol for d^2 system.

2. Bonding Modal: (a) Expansion of valence Bond Theory, qualitative treatment, simple applications Sidgwick-Powell theory, structures of BF_3, NH_3, H_2O, PCl_5, ClF_3, SF_4, I_3, SF_6 and IF_7 and bonds.

(b) Metallic bond-idea of free electron theory and V.B.T. explanation, conductors, semi conductors.

3. Co-ordination Chemistry: Double salts and co-ordination compounds, Werner's postulates, EAN rule. Shape of d-orbitals, valence bond method of explaining structures of co-ordination compounds, isomerism - types with examples.

4. (a) Nomenclature of inorganic Compounds: IUPAC nomenclature of co-ordination compounds including complexes with unsaturated molecules or groups and bridging groups.

(b) Chemistry in aqueous and non-aqueous solutions: Protic/aprotic solvent. Inorganic reactions in liq. NH_3 and liq. SO_2 , Solutions of metals in liquid NH_3.

GROUP-B: SYSTEMATICCHEMISTRYOFTHEELEMENTS

1. General Chemistry, structure and bonding of

(a) Noble gas compounds.

(b) Pseudo halogens and poly halides.

2. Introductory transition metal-chemistry: General features including variable oxidation states, complexes, atomic/ionic sizes and magnetism.

3. General Chemistry of the following elements with special reference to periodic position states, reactivity, oxides, halides, complexes, organomentallic chemistry and uses: **(a)** Sc, Y,La **(b)** Ti, Zr, Hf **(c)** V, Nb, Ta **(d**) Fe, Co, Ni

4. Chemistry of Group 14 elements: C, Si and Ge: Carbides, sillicates and tetrahalides, idea of fullerenes and zeolites.

GROUP-C: SOME APPLICATIONS AND MISC. TOPICS

1. Spectroscopy: Elementary qualitative idea of regions principles and simple applications of the following: i.e. spectroscopy, UV-vis spectroscopy.

2. Analytical Chemistry:

(a) Use of complexation qualitative inorganic mixture analysis organic reagents in inorganic analysis: EDTA, dimethyl glyoxime oxime α-nitroso β-naphthol, cupferron, thio-salicyclic acid. **(b)** Theory behind the group separation in inorganic qualitative cationic analysis.

3. Oxidation and Reduction: Applications of the concept: redox half reactions, kinetic factors, redox stability in water, oxidation by atmospheric oxygen.

4. (a) Outline of the chemistry involved in the following and allied phenomena: cement, steel, water, fuel and industrial gases.

(b) Idea of major chemical pollutants in environment.

PAPER-III C: ORGANIC CHEMISTRY

Four questions will be set from each group. Five questions will have to be answered selecting at least one question and not more than two from each group.

GROUP-A (FOUNDATION)

1. Stereochemistry-I: Stereoisomerism, project ion formula elements of symmetry, geometrical and optical isomerism, E-Z, D-L and R- S modes of nomenclature, threo and erythro, elementary idea of configuration, diastereo isomerism, asymmetry and dissymmetry.

2. Stereochemistry-II: Tautomerism, keto and enol tautomerism, estimatics and enolic content.

3. Reaction Mechanism: Electrophilic substitution in benzene nucleus, mechanism of nucleophilic substitution at saturated carbon.

4. Name Reactions: Name reactions involving topics in group-B

GROUP-B

DETAILED STUDY OF DIFFERENT CLASSES OF COMPOUNDS

1. Nomenclature, classification, structure and configuration of glucose and fructose. Ring structure, Ruff degradation, Kiliani Fischer Synthesis, Osa-zone and inter conversions.

2. Aromaticity and Huckel's rule.

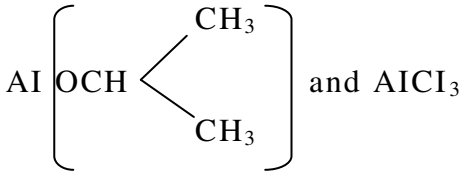
3. Detailed preparation and properties of benzene, toluene, benzene sulphonic acid, nitrobenzene, aniline, diazonium salt, benzaldehyde, benzoic acid.

4. Hydroxy acids: Lactic acid, citric acid, general methods of preparation and distinction between α and β hydroxy acids. Stereo chemistry of hydroxy acids.

5. Polymethylenes and Baeyer's Strain Theory including preparation and properties.

GROUP-C: APPLIED ORGANIC CHEMISTRY

1. Synthetic applications of the following reagents in organic chemistry



and $AICl_3$

2. Brief introduction of TLC, paper and gas chromatography.

3. (a) Organic polymers and resins. (b) Brief idea of proteins.

4. Test of functional groups.

B. Sc. Part - II: CHEMISTRY HONOURS
PRACTICAL

PAPER-IV

[Time: 6 Hours] **[Full Marks: 50]**

GROUP- A **25 Marks**

1. Determination of Molecular weight of volatile liquids by Duma's bulb method.

2. Determination of Molecular weight of volatile liquids by Victor Meyer method.

3. Determination of surface tension of liquids using stalagnometer and calculation of parachor values.

4. Determination of co-efficient of viscosity of liquids using Ostwald viscometer.

5. Determination of partition co-efficient of solutes between two immiscible liquids.

6. Determination of rate constant for hydrolysis of ester catalysed by H^+ ions at room temperature.

7. Determination of refractive index of liquids by Abbe refractometer and calculation of molecular refractivity.

8. Thermochemistry: Heat of solution of solute in a Solute in a solvent, heat of neutralisation.

GROUP-B **15 Marks**

1. Gravimetric Analysis: Estimation of Ag+, Ba+2, Ni+2, Cu+2, Cl- & SO_4^{-2}

GROUP-C **10 Marks**

1. **N. B. and Viva.**

B. Sc. Part - II:- CHEMISTRY (SUBSIDIARY)

Five questions will have to be answered selecting at least one question an not more than two from each group. Four question will be set from each group.

GROUP-A: PHYSICAL CHEMISTRY

1. States of Matter: (a) Gaseous State: Vander Waal equation (no derivation), critical constants collision no. collision frequency, mean free path

(b) Solid State: Bravais lattices and lattice planes, elementary idea of types of lattices and stoichiometric, and non stoichiometric defects in simple ionic solids.

2. Thermodyamics: Definitions of terms: system, extensive, intensive properties. First and second laws of themodynamics. Carnot theorem and Carnot Cycle.

3. (a)Ionic Equilibrium: Ostwald's dilution law conductance measurement of dissociation constant of acetic acid. Salt Hydrolysis Idea of theory of acid bases indicators.

(b)Phase rule: Terms, equation (no derivation required), H_2O system, S-system.

4. (a) Chemical kinetics: Second order reaction, expression for specific rate constant of second order reaction, half life period and its unit. Effect of temperature on reaction rate, Arrhenius equation. Idea of catalytic activity at sufraces and catalytic processes such as hydrogenation, oxidation, cracking and reforming.

GROUP-B: INORGANIC CHEMISTRY

1. (a) Atomic Structure and Bonding: Idea of duality and matter waves, de Broglie relation , Schrodinger equation (no derivation), and idea of its applications, idea of orbital overlap, hybridisation of orbitals vander Waal forces, Metallic bonding.

(b) Idea of complex formation: double salts and complexes, Werner's postulates.

2. Introductory transition metal Chemistry: General features including variable oxidation states, ideas of complexes, magnetism of transition metals.

3. Chemistry of group 14 elements: C, Si, brief introduction of fullerenes and zeolites, Idea of major chemical pollutants in environment.

4. Chemistry of the following elements and their important compounds:

(a) Fe, Co, Ni, **(b)** Cr **(c)** Mn

GROUP-C: ORGANIC CHEMISTRY

1. Structure and Mechanism: Different types of isomerism, idea of E-Z n9tations. Electrophilic substitution in benzene nucleus and mechanism of

nucelcophilic substitution at saturated carbon (general idea).

2. **Natural Products:**

(a) Carbohydrates: Nomenclature, Classification, Non- detailed structures of glucose and fructose, Elementary idea of glycosides

(b) Elementary idea of alkaloids and terpenes (no structural elucidation needed.)

3. **(a)** Structure of benzene preparation and uses of benzenediazoniumchloride.

(b) Lactic acid, citric acid

4. **(a)** Test of common functional groups.

(b) Brief idea of polymers, resins, proteins and sulfa drugs.

B. Sc. Part - II: CHEMISTRY (Subsidiary)

[Time: 5 Hours] **PRACTICAL** **[Full Marks: 25]**

GROUP-A **12 Marks**

1. **Qualitative inorganic analysis of mixtures containing four radicals**.

Basic radicals: Ag^{+}, Hg^{2+} , Pb^{2+}, Cu^{2+}, Hg^{2+} , Bi^{3+}, Cd^{2+}, Sb^{3+}, Sn^{2+}, Sn^{4+}, Fe^{3+}, Al^{3+}, Cr^{2+} , Ni^{2+},Co^{2+}, Zn^{+2} , Mn^{2+} , Ca^{2+}, Ba^{2+}, Sr^{2+}, Mg^{2+}, Na^{+} , K^{+}, NH_4^{+}•.

Acid radicals: CO_3^{-2}, SO_4^{-2}, Cl^{-}, SO_4^{-2}, $N0_2^{-}$, $NO_{3,}^{-}$, halides.

Group-B **8 Marks**

2. Organic Preparations: Preparation of Organic-Compounds by using following reactions.

(a) acetylation of aniline and p-toluidine.

(b) nitration of nitrobenzene.

(c) oxidation of benzaldehyde and

(d) hydrolysis of esters like ethyl benzoate and methyl Salicylate.

3. **Record of Class work and Viva-voce.** **5 Marks**

B. Sc. Part - III:- CHEMISTRY (HONOURS)

PAPER-V-A (PHYSICAL CHEMISTRY)

There shall be four questions from each of the three groups and the candidate shall be required to answer five questions selecting at least one quest ion and not more than two from each group.

GROUP-A

STATES AND STRUCTURE

1. Gaseous State: Collision number, collision frequency, collision diameter and mean free path of molecules of a gas (including temperature and pressure dependance). Viscosity of gases, relation between mean free path and coefficient of viscosity, temperature and pressure dependance of viscosity (η). Calculation of δ from, η , degree of freedom of motions, principle of equipartition of energy, its use for determination of Avogadro 's number.

2. Solid State: Crystal forces, more about radius ratio rule and co-ordination number of ions, stoichiometric and non-stoichiometric defects in simple ionic solids. Elementary idea of X-ray diffraction techniques.

3. Spectroscopy: Basis principles of different types of absorption, idea or IR, UV-vis spectroscopy.

4. Photochemistry: Basic principles, Lambert-Beer Law, molar extinction coefficient, Stark Einstein Law of photochemical equivalence, Primary and secondary processes, examples of low and high quantum yield. Photochemical reactions such as $H_2 + Cl_2 \rightarrow HCl$, $H_2 + Br_2 \rightarrow HBr$ and decomposition of *HI*. Phosphorescence and fluoresence. Elementary idea of electron spectroscopy and area of its applications.

GROUP-B

EQUILIBRIUM

1. Thermodynamics: Derivation of law of mass action, molal elevation and molal depression constants, van't Hoff reaction, isochore and isotherms, Maxwell thermodynamic relations, Partial molar quantities, chemical potential, chemical potential with tempearture and pressure. Chemical potential in an ideal gas mixture. Absolute entropy and third law of thermodynamics.

2. Phase Equilibrium: Three component systems. Idea of sorting out triangular co-ordinates, partially miscible liquids and role of added salts

$Cl^- - (NH_4)_2SO4 - H_2O$. Phase diagram of cement.

3. Wave Mechanics: de-Broglie equation. Schrodinger equation and its application to H-atom (only interpretation of solution and not solving), Idea of operators, Uncertainty Principle.

GROUP-C

CHANGES

1. Chemical Kinetics: Kinetics of third order reactions, half life period and its unit, kinetics of complex reaction-side reactions, opposing reactions and consecutive reactions, chain reactions.

2. Electrochemistry: E.M.F. of concentration cells with and without transference, Liquid junction potential, application of E.M.F. measurements.

Electrodes : Hydrogen electrode, calomal electrode, quinine-hydroquinone electrode, glass elect rode, measurement of pH using hydrogen electrode.

3. Dynamic Electrochemistry: (a) Transport number and its determination by Hittort's and moving boundary methods Abnormal transport number. Determination of mean activity by E M.F. method. (b) Gouy-Chapman model of double layer, elementary idea of over potential, power generation in fuel cells, thermodynamics of corrosion.

4. Surface Chemistry: Types of adsorption, adsorption isotherms, Freundlich, Langmuir and Gibbs adsorption isotherms: Limitations and applications.

PAPER -VI (INORGANIC CHEMISTRY)

Five questions will have to be answered selecting at least one question and not more than two from each of tt1e three groups. Four questions will be set from each group.

GROUP-A

THEORETICAL INORGANIC CHEMISTRY

1. Atomic Structure: Idea of de Broglie waves, Schrodinger equation and its derivation. Significance of wave function, normal and orthogonal wave functions. Probability density pattern for *H*-atom (qualitative idea only and no derivation reqd.), radial and angular wave functions, sign of wave functions.

2. Bonding Models in Inorganic Chemistry:

(a) Molecular orbital method (qualitative treatment only). LCAO combinations of s-s, s-p, p-p, p-d orbitals rules of L.C.A.O. bonding, anti-bonding and non-bonding orbital, simple MO diagrams of homonuclear diatomic molecules, calculation of bond order.

(b) Factors affecting radii of ions, radius of polyatomic ions, efficiency of packing, radius ratio, Idea of structures ionic compounds of AX (*ZnS, NaCl, CsCl) and* AX_2 *(*CaF_3*,* TiO_2*,* SiO_2*)* types idea of delocalization of electrons, structure *of* CO_3^{2-}*,* NO_3^-*,* SO_3*,* CO_2 and O_3 molecules.

3. (a) Co-ordination Chemistry : C.F.T , C.F.S.E. calculations, effects of C.F. splitting, chelates.

(b) Metallic Bonding: M.O. method of explanation of bonding in metals, outline of structure of interstitial alloys and substitutional alloys. superconductivity and its applications.

4. Nuclear Chemistry: Ground state properties of nucleus- constituents of nucleus, nuclear properties binding energy per nucleon and stability of nucleus, α and β emissions and their properties, concept of potential barrier, radioactive decay law, partial decay constant , half life and mean life periods. Features of *4n, 4n + 2, 4n + 3* and *4n + 1* radioactive series, nuclear fusion and stellar-energy, idea of theory of origin of elements, nucleosynthesis of lighter elements.

GROUP - B

SYSTEMATIC CHEMISTRY OF THE ELEMENTS

1. Complex formation in d-block elements.

2. General chemistry of the following elements with reference to their periodic position, important compounds, their structures and uses: (a) Nitrogen, phosphorus, arsenic, antimony and bismuth. (b) Oxygen, sulfur, selenium and tellurium.

3. Comparative chemistry of the following transition metals with reference to their P.T. Position, oxidation states, complex format ion and formation of organometallic compounds: (a) Chromium, molybdenum and tungusten. (b) Manganese, (c) Platinum metals.

4. General Chemistry of f-block elements: Electronic configuration and periodic position of lanthanides and actimides, lanthanide contraction and consequences, magnetic properties of lanthanides.

GROUP -C

INTRODUCTION TO ADVANCED TOPICS

1. Organometallic Chemistry: Definitions, idea of nomenclature of simple organometallic compound, E.A.N. rule, ionic and electron deficient compounds, metal alkyis of grou 1, 2 and 13 elements. Elementary idea of carbonyls, nitrosyls and ferrocenes.

2. Inorganic Chemistry in Biological Systems: Elementary idea of the role of the following metals in biological systems: Na, K, Mg, Ca, Fe and Co.

3. Spectroscopy: Eiemetary idea of principles and simple applications of the following: (a) Raman spectroscopy (b) Mossbaner spectroscopy.

4. Inorganic Chains, Rings, Cages and Clusters: Elementary idea of the terms involved with examples, idea of catenation and intercalation chemistry, and hetero polyanions, borazines, boranes and metal-metal bonding.

PAPER -VII (ORGANIC CHEMISRY)

There shall be four questions from each group and the candidate shall be expected to answer five questions selecting at least one question from each group.

GROUP -A

RAEACTIONS AND MECHANISMS

1. General Principles: Hyperconjugation, mesomeric effect, hydrogen bond, intermediate species, their detection and character isation. Carbocation, carbanion carbens, Niteene and benzyne.

2. Types of Reactions: Nucleophilic substitution at saturated and unsaturated carbon electrophilic and nucleophilic substitution in benzene nuclens. Addition reactions electrophilic and nucleophilic elimination reactions-Hofmann's rule and Saytoze rule.

3. Name Reactions and Rearrangement: Name reactions and rearrangements involving simple aliphatic and aromatic compounds.

GROUP - B

Detailed Study of Different Classes of Compounds

1. (a) Plynuclear hydrocarbons: Naphthalene, anthracene and Phenanthrene. (b) Amino acids.

2. Heterocyclic Compounds: Furan, thiophene, Pyrrole, pyridine, quinoline and isoquinoline.

3. (a) Dyes : Azo, TPM dyes, Phthalein dyes, Zanthene dyes, Vat dyes (indigo including its structure and stereo-Chemistry).

(b) Natural colouring pigment: Anthocyanins , flavones and isoflavones, general methods of isolation and structural elucidation.

4. Alkaloids and Terpenes: Blief idea of general methods of isolation and structural elucidation.

GROUP - C

Analytical and Applied Organic Chemistry

1. Drugs: Sulfa drugs, antimaterials, antibioties, analgesics, pyrigenic sedatives, antiseptics.

2. Synthetic fuels and propellants.

3. Explosives, insecticides, adhesivea.

4. Use of reagents HIO_4, lead tetra-acetate, N.B.S., Br_2, SeO_2.

B. Sc. Part - III: CHEMISTRY (Honors)

PRACTICAL

PAPER-VIII

[Time: 6 Hours] **[Full Marks: 100]**

GROUP -A

1. Qualitative inorganic analysis of mixture containing six radicals e.g., these give below one interfering radical must be there.

Basic radicals: Ag^{+}, Hg^{+2}, Pb^{+2}, Bi^{+3}, Cd^{+2}, Cd^{+2}, Cu^{+2}, Sn^{+4}, Fe^{+3}, Al^{+3}, Cr^{+3}, Ni^{+2}, Co^{+2}, Co^{+2}, Zn^{+2}, Mn^{+2}, Ca^{+2}, Ba^{+2}, Sr^{+2}, Mg^{+2}, Na^{+}, K^{+}, NH_4^{+}, Acid radicals CO_2^{-2}, SO_4^{-2}, SO_8^{-2}, S^{-2}, NO_8^{-}, NO_2^{-} , Halides, Oxalate , Acetate, Borate, Phosphate.

GROUP-B [40 marks

1. Preparation of organic compounds:

(a) Acetylation of salicylic acid, aniline and *p*-toluidine.

(b) Benzoylation: Preparation of benzanilide and benzoyl derivative of *p*-toluidine.

(c) Nitration: preparation of *p*-nitroacetanilide pioric acid, and m-dinitrobenzene.

(d) Reduction - Preparation of *m*-nitroaniline from *m*-dinitrobenzene.

(e) Oxidation: Preparation of

(i) benzoic acid from benzaldehyde, and

(ii) anthranilic acid anthrancene**.**

(f) Esterifications: Preparation of ethyl benzoate.

2. Determination of the molecules wieght of organic acids by silver salt method.

2. Volumetric estimation of glucose.

N. B. and Viva. -20 Marks

B. Sc. Part - III:- CHEMISTRY (GENERAL)

Twelve questions will be set covering four from each group. At least one question will have to be answered from each group.

GROUP -A

PHYSICAL CHEMISTRY

1. Physical properties of liquids and their application in establishing molecular structure: viscosity, surface tension and refractive index.

2. Electrochemistry: (a) Standard electrode potential E.M.P and application of e.m.f. measurements. **(b)** Transport number and its measurement by Hittorf's method.

3. Chemical Kinetics and Catalysis: (a) Idea of side reactions, opposing reactions and conservative reaction, chain reactions. **(b)** Catalysis : Difinitions and classification. Theory of catalysis. Ideas of acid base and enzyme catalysis.

4. Photochemistry: Basic principles, Lambert-Beer Law, Stark- Einstein Law of PC. Equivalence, $H_2 + Cl_2$ and $H_2 + Br_2$ reactions (only reactions) Quantum yield, Phosphoresience, fluorescence, elementary idea of photoelectron spectroscoph.

GROUP - B

INORGANIC CHEMISTRY

1. Atomic Structure and Bonding: Idea of V.B.T. and M.O.T. (qualitative treatments only) MO correlation diagram for homonuclear diatomic molecules. Calculation of bond order on its basis. (b) Complexes: E.A.N. rule, shapes of d-orbitals Nomenclature, isomerism.

2. Outline of the chemistry involved in the following industries cement, fuel and industrial gases.

3. Uses of organic reagents in inorganic analysis: E.D.T.A. dimethyl glyoxime, *α*-nitrose, *β*-naphthol, cupefeorn.

4. Chemistry of the following elements and important compounds.

(a) N, P, As **(b)** O, S, Sc

GROUP -C

ORGANIC CHEMISTRY

1. Structure and Mechanism: Hyperconjugation, carbonium and carbanion, carbene, nitrene (imp. reactions involving nitrane formation). Additioh reactions electrophitic and nucleophilic elimination reactions, saytzeff rule. Friedal Craft reaction, Pinacole-pinacolone rearrangement.

2. Synthetic Organic Chemistry: (a) Malanie ester and use in synthesis A. A. E. **(b)** Use of the following reagents in organic chemistry : Na , HNO_2, $LiAlH_4$ and $AiCl_3$.

3. Aromat1city and Hiickel's rule.

B. Sc. Part - III: CHEMISTRY PRACTICAL

(GENERAL)

[Time: 6 Hours] **[Full Marks: 25]**

GROUP –A

INORGANIC CHEMISTRY

1. Gravimetric Analysis: Estimation of Ag^{+}, Fe^{+2} Cl^{-} and SO_4^{-2}.

10 marks

2. Group B (Physical Chemistry). One experiment to be set- **10 marks**

(a) Determination of surface tension of liquids (e.g. Benzene, Acetone, Chloroform) using stalagmometer.

(b) Determination of Co-efficient of viscosity of liquid e.g. Benzene, Acetone, Chloroform using Ostwald Viscometer.

(c) Determination of Partition co-efficient of solutes between two immisicible liquids.

(d) Determination of Molecular Weight of volatile liquid by Victor Meyer Method.

3. Record of class work and viva-voce.