CHEMISTRY

PAPER- FIRST

No. of Questions : 150 **Time : 03 Hrs**

(Section – A)
Inorganic Chemistry

1. **Structure of atom:** Electron behaviour, quantum numbers, orbitals and their shapes, rules for filling of electrons in various orbitals of sub-shells. Electronic configuration of elements.
2. **Periodic classification of elements and atomic properties:** Modern periodic laws, periodicity in properties of elements and extended form of periodic table including trans lawrencium elements. Types of elements based on blocks (s,p,d,f). Atomic properties: atomic and ionic radii, ionization potential, electron affinity and electronegativity.
3. **Chemical bonding:** Ionic bond - ionic solids, close-packed structure of simple ionic compounds. Classification and properties of ionic solids. Imperfections in ionic solids. Covalent bond: VBT, concept of hybridisation, sigma and pi bonds, VSEPR theory and shapes of simple inorganic molecules, general discussion of MO theory, MO energy level diagrams for homo and hetero nuclear diatomic molecules, bond order. Weak Interactions: hydrogen bond and van der Waals' forces.
4. **Radioactivity and nuclear chemistry:** Theory of disintegration of radioactive substances and emission of particles/rays. Soddy-Fajan's group displacement law. Rate of disintegration of radioactive elements, disintegration constant, half-life and average life. Artificial radioactivity: Transmutation of elements, nuclear fission and fusion, nuclear reactions & their balancing. Nuclear forces, nuclear binding energy, nuclear stability and N/P ratio.

5. **Oxidation, reduction and electrolysis:** Modern concept of oxidation & reduction. Valency and Oxidation number. Oxidants & reductants and their equivalent weights. Redox reactions and their balancing.

(Section – B)
Physical Chemistry

1. **Solid state:** Classification of solids based on different binding forces, unit cell in two dimensional and three-dimensional lattices, packing of solids and number of atoms per unit cell in a cubic cell.
2. **Gaseous state**: Kinetic theory of gases & gas laws, Maxwell's law of distribution of velocities, van der Waals' equation, critical behaviour of gases, law of corresponding states, heat capacity of gases.
3. **Liquid state &solution:** Properties of liquids - viscosity, surface tension & vapour pressure. Raoult's law of lowering of vapour pressure, depression of freezing point, elevation of boiling point, osmotic pressure, association & dissociation of solutes.
4. **Chemical kinetics:** Chemical kinetics, rate of chemical reaction, specific reaction rate. Molecularity & order of a reaction - zero order, first order, second order & third order reaction. Energy of activation. Reversible & irreversible reactions.
5. **Chemical equilibrium**: Chemical equilibrium, law of mass action & its applications. Le-Chatelier's principle & its applications.

(SECTION – C)
Organic Chemistry

1. **General Organic Chemistry**: Classification and nomenclature of organic compounds. Electronic displacement – inductive, electrometric and mesomeric effects, Resonance & hyperconjugation and their applications in organic compounds. Electrophiles, nucleophiles, carbocations, carbanions and free radicals. Organic acids and bases. Effects of structure on the strength of organic acids and bases. Hydrogen bond and its effect on the properties of organic compounds.
2. **Stereochemistry**: Elements of symmetry, optical and geometrical isomerism in simple organic compounds. Absolute configuration (R & S), configurations of geometrical isomers, E & Z notations. Conformations and stability of cyclohexane, mono- and di substituted cyclohexane.
3. **Aliphatic Compounds**: Chemistry of simple organic compounds belonging to following classes with special reference to the mechanisms of the reactions involved therein; alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, thiols, aldehydes, ketones, carboxylic acids, amines and their derivatives.
4. **Aromatic Compounds** – Modern structure of benzene; concept of aromaticity, Huckel rule and its simple application to non-benzenoid aromatic and heterocyclic compounds. Activating and deactivating effect of substituent groups, directive influence. Chemistry of the compounds containing following groups attached to benzene ring – halogen, hydroxyl, nitro, amino, aldehydic, ketonic and carboxylic groups.
5. **Name reactions & rearrangements and their mechanism**- Reimer-Tiemann reaction, Vilsmeier reaction, Sharpless epoxidetion reaction, Barton reaction, Favorskii reaction, Wagner-Meerwein rearrangement and Beckmann rearrangement.

CHEMISTRY

PAPER- SECOND

No. of Questions : 150 **Time : 03 Hrs**

(Section – A)
Inorganic Chemistry

1. **Elements of Group 1 and 2: Hydrogen, alkali and alkaline earth metals (s-block):** Position of hydrogen in periodic table. Nuclear spin isomers of hydrogen molecule, heavier isotopes of hydrogen, heavy water and hydrogen peroxide. General properties, chemical reactivity and group trends of s-block metals, chemical behaviour with respect to their hydrides, halides and oxides.

2. **Elements of Groups 3 to 12: Transition & inner transition elements (d & f-blocks):**Position of d & f-block elements in periodic table. Characteristic properties of d-block elements: variable oxidation states, complex formation tendency, colour, magnetic and catalytic properties. Comparative study of 3d, 4d and 5d transition elements with reference to their ionic radii and oxidation states. Characteristic properties of f-block elements - lanthanide contraction, oxidation states, colour and magnetic properties.

3. **Elements of Groups 13 to 18 (p-block):** General properties, chemical reactivity of elements and group trends. variable oxidation states (inert pair effect), chemical behaviour with respect to their hydrides, oxides and halides. Position of noble gases in periodic table. Xenon fluorides and uses of noble gases.

4. **Extraction of metals:** Ores and minerals, concentration of ores. General methods of extraction and refining of metals.

5. **Coordination chemistry:** IUPAC system of nomenclature, isomerism in coordination compounds, nature of bonding - VBT, CFT. Crystal field splitting of d-orbitals in octahedral, tetrahedral and square planar complexes, spectrochemical series. Calculation of CFSE for d^1 to d^9 weak and strong field octahedral complexes, electronic transitions and selection rules. Electronic spectra of 3d-transition metal complexes.

6. **Bioinorganic chemistry:** Essential & trace elements in biological processes, biological role of Na^+ K^+ Mg^{2+} and Ca^{2+} cations.

(SECTION-B)
Physical Chemistry

1. Ionization: Theory of electrolytic dissociation. Factors affection ionization. Ionic product & ionization constant of water. Ionic equilibrium - Ostwald's dilution law. Concepts of acids & bases. Solubility product & its application in analytical chemistry. Salt hydrolysis.

2. pH and buffer solutions

3. Catalysis: Types and theories of catalysis, classification & characteristics of catalysts.

4. Distribution law & its applications.

5. Colloidal state

6. Thermodynamics &thermochemistry: Terms used in thermodynamics. First law of thermodynamics - heat content, heat capacity. Second law of thermodynamics. Thermochemistry - heat of reaction, heat of formation, heat of combustion, heat of neutralization, heat of solution, intrinsic energy. Hess's law of constant heat summation.

(SECTION – C)
Organic Chemistry

1. **Carbohydrates:** Classification and general reactions of monosaccharides. Chemical properties and structure of glucose, fructose and sucrose.

2. **Natural products:** General methods of structure elucidation of terpenoids and alkaloids.
3. **Elementary idea of Chemistry of:** Oils, fats, amino acids, proteins, vitamins and their roles in nutrition and industry.
4. **Organic Polymers**: Mechanism of polymerization, polymers of industrial importance, synthetic fibres.
5. **Organometallic Compounds**: Organometallic reagents of lithium, magnesium & zinc and their synthetic applications.
6. **Spectroscopy:**Basic principles and applications of spectroscopic techniques - UV, Visible, IR & NMR.
7. **Chromatography**: Classification of chromatographic techniques, general principles of adsorption, partition, ion exchange, paper and thin layer chromatography.
8. **Environmental Chemistry**: Air pollutants and their toxic effects, depletion of ozone layer, effects of oxides of nitrogen, chlorofluorocarbons and their effects on ozone layer, greenhouse effect, acid rain, strategy for the control of environmental pollution.