

## 18. CHEMISTRY

नोट : प्रत्येक भाग से बराबर-बराबर प्रश्न रखे जायेंगे। प्रत्येक भाग से सभी अभ्यर्थियों द्वारा प्रश्न हल किया जाना अनिवार्य होगा।

### INORGANIC CHEMISTRY

1. Chemical periodicity.
2. Structure and bonding in homo and hetero molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard- Soft acid base concept. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.
4. Chemistry of the main group elements and their compounds. Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
5. Chemistry of transition elements, transition metal complex and coordination compounds: bonding theories, spectral and magnetic properties and reaction mechanism. Spin crossover in coordination compounds.
6. Inner transition elements: spectral and magnetic properties, analytical applications.
7. Organometallic Compounds: Nomenclature and classification based on nature of metal-carbon bond. Metal Carbonyls. EAN and 18- electron rule. Organometallics in homogeneous catalysis.
8. Cages and metal clusters.
9. Analytical Chemistry: Separation techniques, spectroscopic, electro and thermo analytical methods.
10. Bioinorganic Chemistry: Role of metal ions in biology, essential and trace elements in biological systems. Photosystems, porphyrins, metallozymes, oxygen transport, electron transfer reactions, biological nitrogen fixation, metal complexes in medicines.
11. Physical Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mossbauer, UV-Vis, NQR, MS, electron spectroscopy and microscopic techniques.
12. Nuclear Chemistry: Nuclear reactions, radio analytical techniques and activation analysis.
13. Supramolecular Chemistry.

### PHYSICAL CHEMISTRY

1. Basic principles and applications of quantum mechanics, hydrogen atom, angular momentum.
2. Approximate methods of quantum mechanics: variational principle, perturbation theory up to second order in energy, applications.
3. Basics of atomic structure, electronic configuration, shapes of orbitals, hydrogen atom spectra.
4. Theoretical treatment of atomic structures and chemical bonding.

5. Chemical applications of group theory, symmetry elements, point groups, character tables, selection rules.
6. Basic principles and application of spectroscopy: rotational, vibrational, electronic, Raman, ESR and NMR.
7. Chemical thermodynamics.
8. Phase equilibria.
9. Statistical thermodynamics: Boltzmann distribution, kinetic theory of gases, partition functions and their relation to thermodynamic quantities- calculations for model systems.
10. Chemical equilibria.
11. Electrochemistry: Nernst equation, electrode Kinetics, electrical double layer.
12. Chemical Kinetics: Empirical rate laws, Arrhenius equation, theories of reaction rates, determination of reaction mechanisms, experimental methods for fast reactions.
13. Concepts of catalysis.
14. Polymer Chemistry: Molecular weights and their determinations, kinetics of chain polymerization.
15. Solids: Structural Classification of binary and ternary compounds, diffraction techniques, bonding, thermal, electrical and magnetic properties.
16. Colloids and surface phenomena.
17. Data analysis.
18. Nano Chemistry: Scope of nanomaterials, methods of preparations, characterization, determination of particle size and surface structure.

## ORGANIC CHEMISTRY

1. IUPAC nomenclature of organic compounds including regio and stereoisomers.
2. Principles of stereochemistry, conformational analysis, isomerism and chirality, reactive intermediates and organic reaction mechanisms.
3. Concept of aromaticity.
4. Pericyclic and other related concerted reactions.
5. Name reactions: Vilsmeier reaction, Sharpless asymmetric epoxidation, Stobbe reaction, Heck reaction, Still reaction, Sonogashira and Negishi coupling. Barton reaction and Favorskii reaction.
6. Transformations and rearrangements.
7. Principles and applications of organic photochemistry. Free radical reactions.
8. Reactions involving nucleophilic carbon intermediates.
9. Oxidation and reduction of functional groups.
10. Common reagents (organic, inorganic and organometallic) in organic synthesis.
11. Chemistry of natural products such as steroids, alkaloids, terpenoids, peptides, nucleic acids and carbohydrates.

12. Selective organic transformations: Chemo selectivity, regioselectivity, stereoselectivity, enantioselectivity, protecting groups.
13. Chemistry of aromatic and aliphatic heterocyclic compounds.
14. Physical characterization of organic compounds by IR, UV-Vis, MS and NMR spectroscopy.
15. Green Chemistry: Basic principles, green reagents, green catalyst, phase transfer catalysis for green synthesis, choice of starting material.
16. Medicinal Chemistry: Development of new drugs, structure-activity relationship (SAR), Quantitative Structure activity relationship (QSAR). Chemistry of Antineoplastic agents and cardiovascular drugs.

Environmental Chemistry: Concept and scope, terminology and nomenclature, Environmental segments, Aerosols, photo chemical smog, BOD and COD.