



TAMIL NADU STATE ELIGIBILITY TEST(TNSET2024)

SUBJECT : Chemical Sciences

Code No.:2404

Inorganic Chemistry

- ❖ Chemical periodicity
- ❖ Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
- ❖ Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
- ❖ Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
- ❖ Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
- ❖ Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
- ❖ Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
- ❖ Cages and metal clusters.
- ❖ Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods.
- ❖ Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.
- ❖ Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.
- ❖ Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Physical Chemistry:

- ❖ Basic principles of quantum mechanics: Postulates; operator algebra; exactly solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.
- ❖ Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
- ❖ Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.
- ❖ Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated pi-electron systems.
- ❖ Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.
- ❖ Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities - selection rules; basic principles of magnetic resonance.
- ❖ Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations;



- spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.
- ❖ Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities - calculations for model systems.
 - ❖ Electrochemistry: Nernst equation, redox systems, electrochemical cells; DebyeHuckel theory; electrolytic conductance - Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.
 - ❖ Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.
 - ❖ Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.
 - ❖ Solid state: Crystal structures; Bragg's law and applications; band structure of solids.
 - ❖ Polymer chemistry: Molar masses; kinetics of polymerization.
 - ❖ Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Organic Chemistry

- ❖ IUPAC nomenclature of organic molecules including regio- and stereoisomers.
- ❖ Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
- ❖ Aromaticity: Benzenoid and non-benzenoid compounds - generation and reactions.
- ❖ Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzyne and nitrenes.
- ❖ Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
- ❖ Common named reactions and rearrangements - applications in organic synthesis.
- ❖ Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.
- ❖ Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.
- ❖ Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution - optical and kinetic.
- ❖ Pericyclic reactions - electrocycloisatation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
- ❖ Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).



- ❖ Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.
- ❖ Structure determination of organic compounds by IR, UV-Vis, ^1H & ^{13}C NMR and Mass spectroscopic techniques.

Interdisciplinary topics

- ✚ Chemistry in nanoscience and technology.
- ✚ Catalysis and green chemistry.
- ✚ Medicinal chemistry.
- ✚ Supramolecular chemistry.
- ✚ Environmental chemistry.

Professor Academy