"we simply make you react"

Royal Chem

CSIR NET/JRF Chemistry coaching centre

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CHEMISTRY SYLLABI CSIR NET/JRF

PHYSICAL CHEMISTRY

- **Basic Principles of Quantum Mechanics**: Postulates; operator algebra; exactlysolvable 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 π-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, benzynes 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** – electrocyclisation, 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, 1 H & 13C NMR and Mass spectroscopic techniques.

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.

INTERDISCIPLINARY TOPICS

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