

Pondicherry University

Department of Chemistry

Syllabus of the Entrance Examination for Ph.D. (Chemistry) Programme

Organic Chemistry

- IUPAC nomenclature of organic compounds.
- Principles of stereochemistry, conformational analysis, isomerism and chirality.
- Reactive intermediates and organic reaction mechanisms.
- Concepts of aromaticity.
- Pericyclic reactions.
- Named reactions.
- Transformations and rearrangements.
- Principles and applications of organic photochemistry. Free radical reactions.
- Reactions involving nucleophilic carbon intermediates.
- Oxidation and reduction of functional groups.
- Common reagents (organic, inorganic, and organometallic) in organic synthesis.
- Chemistry of natural products such as steroids, alkaloids, terpenes, peptides, carbohydrates, nucleic acids, and lipids.
- Selective organic transformations – chemoselectivity, regioselectivity, stereoselectivity, enantioselectivity. Protecting groups.
- Chemistry of aromatic and aliphatic heterocyclic compounds.
- Physical characterisation of organic compounds by IR, UV-, MS, and NMR.

Inorganic Chemistry

- Chemical periodicity
- Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules.
- Concepts of acids and bases.
- Chemistry of the main group elements and their compounds. Allotropy, synthesis, bonding and structure.
- Chemistry of transition elements and coordination compounds – bonding theories, spectral and magnetic properties, reaction mechanisms.
- Inner transition elements – spectral and magnetic properties, analytical applications.
- Organometallic compounds - synthesis, bonding and structure, and reactivity. Organometallics in homogenous catalysis.
- Cages and metal clusters.
- Analytical chemistry- separation techniques. Spectroscopic electro- and thermoanalytical methods.
- Bioinorganic chemistry – photosystems, porphyrines, metalloenzymes, oxygen transport, electron- transfer reactions, nitrogen fixation.
- Physical characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-, NQR, MS, electron spectroscopy, and microscopic techniques.
- Nuclear chemistry – nuclear reactions, fission and fusion, radio-analytical techniques, and activation analysis.

Physical Chemistry:

- Basic principles and applications of quantum mechanics – hydrogen atom, angular momentum.
- Variational and perturbational methods.
- Basics of atomic structure, electronic configuration, shapes of orbitals, hydrogen atom spectra.
- Theoretical treatment of atomic structures and chemical bonding.
- Chemical applications of group theory.
- Basic principles and application of spectroscopy – rotational, vibrational, electronic, Raman, ESR, NMR.
- Chemical thermodynamics.
- Phase equilibria.
- Statistical thermodynamics.
- Chemical equilibria.
- Electrochemistry – Nernst equation, electrode kinetics, electrical double layer, Debye-Hückel theory.
- Chemical kinetics – empirical rate laws, Arrhenius equation, theories of reaction rates, determination of reaction mechanisms, experimental techniques for fast reactions.
- Concepts of catalysis.
- Polymer chemistry. Molecular weights and their determinations. Kinetics of chain polymerization.
- Solids - structural classification of binary and ternary compounds, diffraction techniques, bonding, thermal, electrical and magnetic properties
- Collids and surface phenomena.
- Data analysis.

Basics of Interdisciplinary topics

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

Research Methodology

- Fundamentals of research, types of research, and ethics.
- Identification of research problems through effective literature survey using scientific databases.
- Designing experiments with proper hypotheses, controls, and safety measures.
- Methods of data collection and Good Laboratory Practices.
- Basics of computational chemistry and use of scientific software.
- Scientific writing, referencing styles, and preparation of research proposals.
- Essential aspects of laboratory safety, green chemistry, and chemical waste management.