The syllabi for PhD Entrance Test (Chemistry) comprises of two parts.

1. **Research Methodology**
2. **Subject concern (Chemistry)**

## 1. Research Methodology

1. Introduction of research methodology: meaning of research, objectives of research, types of research, significance of research, problems encountered by researchers in India;
2. Research problem: definition, necessity and techniques of defining research problem, formulation of research problem, objectives of research problem;
3. Research design: meaning, need and features of good research design, types of research designs, basic principles of experimental designs, design of experiments, synopsis design for research topic.

## 2. Subject concern (Chemistry)

### 1. Inorganic Chemistry

1. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
2. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
3. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
4. 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.
5. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.

### 2. Physical Chemistry:

1. 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
2. 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.

3. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye- Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.
4. 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.
5. Symmetry operation: Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules

## 3. Organic Chemistry

1. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogeniity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
2. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.
3. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
4. Pericyclic reactions – electro-cyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
5. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.