

UNIVERSITY DEPARTMENT OF CHEMISTRY



B.B.M.K. University, Dhanbad, (Jharkhand)

Ref. No.

Date

Syllabus of Ph.D.in Chemistry Entrance Examination

Inorganic Chemistry

1. Chemical Periodicity
2. Structure and bonding in homo- and hetero nuclear molecules, including shapes of molecules (VSEPR Theory)
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Transition elements and coordination compounds: Structure, Bonding theories, spectral and magnetic properties, reaction mechanisms.
5. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
6. Organometallic compounds: synthesis, bonding and structure, and reactivity. organometallics in homogeneous catalysis.
7. Analytical chemistry-separation, spectroscopic, electro- and thermoanalytical methods.
8. Bioinorganic Chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron-transfer reactions; nitrogen fixation, metal complexes in medicine

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: 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 concept of MO and VB theories; Huckel theory for conjugated π -electron systems.
2. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.
3. Molecular spectroscopy: rotational; and vibrational spectra of diatomic molecules: electronic spectra; IR and Raman activities-selection rules; basic principles of magnetic

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resonance.

4. 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.
5. Statistical thermodynamics : Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities-calculation for model systems.
6. Electrochemistry : Nernst equation, redox systems, electrochemical cells; Debye- Huckel theory; electrolytic conductance -Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.
7. Chemical kinetics : Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanism; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.
8. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.

Organic Chemistry

1. Aromaticity : Benzenoid and non-benzenoid compounds-generation and reactions.
2. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions free radicals, carbenes, benzyne and nitrenes.
3. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
4. Common named reactions and rearrangements-applications in organic synthesis.
5. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysis and reagents (organic, inorganic, organometallic and enzymatic) Chemo, regio and stereoselective transformations.
6. 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
7. Pericyclic reactions- electrocyclicization, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
8. Structure determination of organic compounds by UV-Vis, ^1H & ^{13}C NMR and Mass spectroscopic techniques.

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B. Kumar
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