Chemistry Syllabus

Vinoba Bhave University Doctoral Eligibility Entrance Test (DEET) Entrance Examination Chemistry Syllabus

Group-A Objective Type

Twenty Question are to be set, Ten are to be answered (4 X 10 = 40)

1. Physical

a) Mole concept, Strength of Solutions, Chemical equivalent, Chemical calculations related to volumetric and gravimetric analysis, Chemical equilibrium, Calculation of molecular weight of (i) Acid (ii) Base (iii) Electrolyte and Non- electrolyte using colligative properties.

b) Ionic Equilibrium, Solubility Product, Common ion effect, pH- (i) Acid Solution (ii) Base solution (iii) Buffer solution, hydrolysis of salts,

c) Concepts of oxidation and reduction, oxidising agent, reducing agent, balancing of redox reactions, equivalent weight of oxidising agent and reducing agent

d) Electrochemistry: Kinds of reversible electrodes, calculation of E.M.F. of cell; concentration cell (i) with and (ii) without transport.

e) Phase rule: Introduction, phase rule and its applications to one and two component systems, eutectic point, triple point, azeotropic mixture, critical solution temperature

f) Thermodynamics: Concept of path dependent and path independent functions, properties of exact differentials, idea of Gibbs free energy, enthalpy and entropy.

2. Organic

a) Reaction intermediates: Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes, nitrenes and benzynes.

b) Effect of inductive effect, resonance and hyperconjugation, basic ideas of S_N1, S_N2, S_Ni, E_1, E_2 and E_{1CB} mechanisms, concept of aromaticity, antiaromaticity and nonaromaticity.

c) Reaction mechanism: structure and reactivity, types of reactions, thermodynamic and kinetic control, Hammond's postulate, Hammett equation and linear free energy relationship, substitution and reaction constants

3. Inorganic

a) Atomic orbitals, electronic configuration of atoms (L-S coupling), Periodic properties of element – atomic & ionic radii, ionization energy, electron affinity and electronegativity.

b) Shape/Structure of molecules and ions: VSPER theory and its limitations, hybridisation.

c) Symmetry and group theory: Symmetry elements, symmetry operations, symmetry group/ point group,

d) Acid, base and salts: Theories of acid and base – Arrhenius theory, Bronsted Lowry theory, Lewis concept, Lux-Flood concept, general solvent concept; salts and their classifications, strength of acids and bases, classifications of acids and bases into hard and soft categories, SHAB principle and stability of acid-base adducts.

e) Principle of acid-base, permanganometry, dichromatory and thiosulphate titrations

f) Principle of gravimetric analysis of Fe, Cu, Ni, Mg, sulphate and chloride

g) Principle of qualitative analysis of following in presence of each other

(i) Cu^{++} & Cd^{++} (ii) Ca^{++} & Sr^{++} (iii) Fe^{++} & Fe^{++} (iv) PO_4^{3-} & AsO_4^{3-} (v) CO_3^{2-} & SO_3^{2-}
(vi) Cl^-, Br^- & I^- (vii) NO_2^- & NO_3^-

GROUP: B

Eighteen Question are to be set out of which twelve questions are to be answered.

1. Thermodynamics Partial molar quantities, excess thermodynamics function, Debye Huckel theory for activity coefficient of electrolyte solution, entropy, residual entropy and third law.
2. Chemical Kinetics Mechanism of photochemical and thermal chain reactions, collision theory of reaction rates, kinetics of unimolecular reactions, primary and secondary salt effect, kinetics of enzyme reactions, laws of photochemistry, quantum yield, photophysical and photochemical process.
3. Electrochemistry Debye Huckel – Onsager equation, electrokinetic phenomenon, zeta potential, sedimentation potential and streaming potential.
4. Surface Chemistry Adsorption and absorption, Freundlich, Langmuir isotherm and BET equation.
5. Quantum Chemistry: Quantum mechanical operators and commutation relation, eigen functions, eigen values, orthonormality, symmetric and antisymmetric wave functions, Particle in one and three dimensional box with infinite potential energy barrier, degeneracy, simple harmonic oscillator (derivation not required), calculation of probability density of a state function whose (a) wave function is Cartesian coordinate dependent & (b) Spherical coordinate dependent.
6. HMO theory: Energy calculation of molecular orbitals of (a) butadiene (b) cyclopropenyl radical by Huckel molecular orbital method. Calculation of electron density, charge density of each carbons of the above two systems.
7. Spectroscopy Rotational spectrum of diatomic molecules, rotational energy, selection rules, population of rotational levels, derivation of J_{max}, calculation of internuclear distance, effect of isotopic substitution, stark effect and its application. Vibration spectra of harmonic and anharmonic diatomic molecules, Morse function, force constant, interaction of rotation and vibration – different branches. Polarizability, classical and quantum theory of Raman spectrum, rotational and vibrational Raman spectrum, Mutual exclusion principle.
8. Bonding and structures of (a) Boranes, carboranes, borazines, silicates, phosphazines, S-N compounds (b) Carbonyls, nitrosyls, dinitrogen and π – complexes of olefins and cyclopentadienes with transition metals (spectroscopic evidences also required)
9. General chemistry of transition metal and inner transition metals.
10. Coordination Chemistry (a) VBT (b) CFT, CFSE and its implications, Jahn – Teller effect, spectral and magnetic properties of complexes, molecular orbital theory, π-bonding in octahedral complexes,
11. Stability of complexes, thermodynamic and kinetic stability, nucleophilic substitution reaction in square planar complexes, trans-effect-theory and applications, nucleophilic substitution reactions in octahedral complexes, acid hydrolysis, base hydrolysis, Eigen-Wilkin's mechanism
12. Electron transfer reactions: Basic concepts, inner sphere mechanism and outer sphere mechanism, mixed valence complexes and their electron transfer resections

13. Organometallic Chemistry Oxidative addition, reductive elimination, insertion and deinsertion reaction, hydroformylation of alkenes, hydrogenation of alkenes, Water gas shift reaction, Wacker process, Monsanto process, Ziegler – Natta Polymerization.
14. Photochemistry Difference between photochemical and thermal reactions, photophysical process, photochemistry of ketones, photoreduction, photolysis Norrish I & II, Paterno – Buchi reaction, photochemistry of 1,3 and 1,4 dienes (both singlet and triplet state) di – π methane rearrangement.
15. Pericyclic Reactions Concerted and non - concerted reactions, FMO theory of electrocyclic, cycloaddition, sigmatropic and chelotropic reactions, discussion of regiospecificity, stereospecificity of pericyclic reactions with special reference to Diel's Alder reaction, Claisen rearrangement and 1,3 – dipolar addition.
16. Aromaticity, antiaromaticity, nonaromaticity of benzenoid and non – benzenoid compounds, aromaticity and physical properties.
17. Stereochemistry: Chiral and achiral molecules, identification of chiral molecules on the basis of point group consideration, R, S and E, Z – descriptors of chiral molecules having (a) Chiral centre (b) Chiral axis (c) Chiral planes. Stereochemistry of (i) E2 reaction (ii) E1 reaction (iii) SN1, SN2 and SNi reaction, stereochemistry of reduction of C = C by homogeneous and heterogeneous catalysis. Stereochemistry of the addition of Grignard reagent across C = O in compounds containing one chiral carbon.
18. Reagents LDA, LDC, TMSC, TBTH, BF_3, B_2H_6, Wilkinson's reagent, DMSO, NBS, Peracids.
19. Applications of spectroscopy:
    a) Basic concepts of UV-VIS spectroscopy, Woodward-Fieser rules to calculate absorption maxima in cyclic and acyclic conjugated dienes and enones.
    b) Theory of molecular vibrations, effect of hydrogen bonding, fingerprint region, characteristic group frequencies of hydroxy group (alcoholic and phenolic) and carbonyl group (aldehyde, ketone, acid chloride and amide).
    c) Basic concepts of proton NMR, chemical shift, anisotropic effect and coupling constant in organic compounds.
    d) Combined problems based on UV, IR and NMR data.