WBCS Chemistry Syllabus 2022 PDF

Paper – I :	**Group A** 1. **Atomic Structure** Bohr theory of hydrogen atom, Mosley's experiment. Heisenberg's uncertainty principle; Schrodinger wave equation; Interpretation of wave function, particle in a one-dimensional box; quantum numbers; hydrogen atom wave functions; shapes of s, p and d-orbitals. 2. **Chemical Bonding** Ionic bond: characteristics of ionic compounds, lattice energy, Born-Haber cycle. Covalent bond and its general characteristics: polarities of bonds in molecules and their dipole moments; shapes of the molecule, VSEPR theory. Valence bond theory, the concept of resonance and resonance energy; molecular orbital theory (LCAO method); bonding in H2 +, H2, He2 + to Ne2, NO, CO, HF, and CN- , comparison of valence bond and molecular orbital theories, bond order, bond strength, and bond length. 3. **Acid-Base & Redox Reactions** Theory of acids and bases; pH, buffer solution; solubility product and salt hydrolysis. Nernst equation (without derivation). Influence of complex formation, precipitation and pH on redox potentials; formal potential. Feasibility of a redox titration, redox potential at the equivalence point, and redox indicators. Redox diagram (Latimer and Frost diagrams) of common elements and their applications. Disproportionation and comproportionation reactions (typical examples). 4. **Chemical Periodicity** Periodic table, group trends, and periodic trends in physical properties. Effective nuclear charge, screening effect, Slater's rules, atomic radii, ionic radii (Pauling univalent), covalent radii. Ionization potential, electron

affinity and electronegativity (Pauling, Mulliken, and AllredRochow scales) and factors influencing these properties. Comparative studies of hydrides, halides, and oxides of s- and p- block elements. Structure and bonding of B2H6, (SN)x, Phosphazenes, and inter-halogens. d-block elements; electronic configuration, ionization energies, oxidation states, atomic and ionic radii variation, and magnetic and spectral properties.

Group-B

5. **Gaseous State and Transport Phenomenon**
Maxwell distribution of molecular speeds, intermolecular collisions, collisions on wall and effusion; thermal conductivity and viscosity of hard sphere gases. van der Waals equation of state, inter-molecular interactions, critical phenomena and liquefaction of gases,

6. **Liquid State**
Viscosity, Poiseuille equation, temperature dependence. Surface tension and surface energy, wetting and contact angle, interfacial tension and capillary action; Laplace equation.

7. **Solid State**
Crystal systems; designation of crystal planes, lattice structure and unit cell; Miller indices, Bragg's law; X-ray diffraction by crystals; close packing, radius- ratio rules, calculation of some limiting radius-ratio values; structures of NaCl, KCl; stoichiometric and non-stoichiometric defects, impurity defects, semiconductors. 8.
Thermodynamics
Work, heat and internal energy; first law of thermodynamics. Second law of thermodynamics; entropy as a state function, entropy change in various processes, reversibility and irreversibility, free energy functions; thermodynamic equation of state; Maxwell's relations; temperature, volume and pressure dependence of

	thermodynamic functions; J-T effect and inversion temperature; criteria for equilibrium, relation between equilibrium constant and thermodynamic quantities; Nernst heat theorem. Definitions and interrelations among Kp, Kc and Kx ; Van't Hoff equation, Le Chatelier principle. Group - C 9. **Aromaticity** Aromaticity and anti-aromaticity; benzene, naphthalene, annulene, azulene, tropolones, fulvenes, sydnones. Electrophilic and nucleophilic substitution. Synthesis and reactions of heteroaromatic compounds (pyrrole, furan, thiophene, pyridine). 10. **Study of Mechanisms** General methods (both kinetic and non-kinetic) of study of mechanism of organic reactions: isotopic method, cross-over experiment, intermediate trapping, stereochemistry; energy of activation; thermodynamic control and kinetic control of reactions. Reactive intermediates: Generation geometry, stability and reactions of carbonium ions and carbanions free radicals, carbenes, benzynes and nitrenes. 11. **Organic Reaction** Types Substitution Reactions: SN1, SN2 and SNi mechanisms; neighbouring group participation. Elimination Reactions: E1, E2 and E1cb mechanisms; orientation in E2 reactions-Saytzeff and Hoffmann; pyrolytic syn elimination – Chugaev and Cope eliminations. Addition Reactions: Electrophillic addition to C=C and CC; nucleophilic addition to C=O, C=N, conjugated olefins and carbonyls. Rearrangements: Pinacol-pinacolone, Hoffmann, Beckmann, Baeyer-Villiger, Favorskii, Fries, Sclaisen, Cope, Stevens and Wagner-Meerwein rearrangements. 12. **Organic Spectroscopy** Principle and applications in structure elucidation: Infra-

	red: typical functional group identification UV-vis: Singlet and triplet states; n-* and -* transitions; application to conjugated double bonds and conjugated carbonyls - Woodward–Fieser rules; charge-transfer spectra. Nuclear Magnetic Resonance (1H NMR): Basic principle; chemical shift, spin-spin interaction, and coupling constants. Mass Spectrometry: Parent peak, base peak metastable peak, McLafferty rearrangement
Paper – II :	**Group-A** 1. **Coordination Chemistry I** Bonding theories of metal complexes; valence bond theory, crystal field theory and its modifications; application of theories in the explanation of magnetism and electronic spectra of metal complexes. 2. **Coordination Chemistry - II** Isomerism in coordination compounds; IUPAC nomenclature of coordination compounds; stereochemistry of complexes with 4 and 6 coordination numbers; chelate effect and polynuclear complexes; trans effect and its theories; kinetics of substitution reactions in square-planer complexes; thermodynamic and kinetic stability of complexes. 3. **Bio-Inorganic Chemistry** Metal ion in biological systems and their role in ion transport across the membranes (molecular mechanism), oxygen-transport proteins: hemoglobin, myoglobin, hemerythrin; electron-transport proteins: cytochromes and ferrodoxins. 4. **Organometallic Chemistry** EAN rule, synthesis, structure and reactivity of metal carbonyls; carboxylate anions, carbonyl hydrides and metal nitrosyl compounds. Complexes with aromatic systems; synthesis, structure and bonding in metal-olefin,

-alkyne and - cyclopentadienyl complexes; coordinative unsaturation, oxidative addition reactions, insertion reactions, fluxional molecules and their characterization; compounds with metal-metal bonds and metal atom clusters.

Group - B

5. **Phase-equilibria and solutions**
Gibbs phase rule and its significance. Clapeyron equation; Clausius – Clapeyron equation; phase diagram for a pure substance; phase-equilibria in binary systems, partially miscible liquids, upper and lower critical solution temperatures; properties of dilute solutions; Raoult's and Henry's law. Partial molar quantities, their significance; excess thermodynamic functions.

6. **Surface phenomena, catalysis and polymers**
Adsorption from gases and solutions on solid adsorbents: Langmuir and B.E.T. adsorption isotherms; determination of surface area, characteristics and mechanism of reactions on heterogeneous catalysts. Number and weight average molecular weight, their determination. Kinetics of polymerization.

7. **Chemical Kinetics**
Differential and integral rate equation for zeroth, first, second and fractional order reactions; rate equations involving reverse, parallel, consecutive and chain reactions; branching chain and explosion; effect of temperature and pressure on rate constant; collision theory and transition state theory.

8. **Photochemistry and spectroscopy** :
Fluorescence & phosphorescence, Jablonsky diagram, Franck-Condon principle, Lambert-Beer law. Laws of photochemistry, quantum yield, photo-stationary state, photosensitized reaction. Rotational spectra of diatomic molecules: Rigid rotator model, selection rule, determination of bond length.Vibrational spectroscopy of

diatomic molecules: SHO model, selection rule, determination of bond energy.

Group – C

9. **Configuration and conformation**
Representation of molecules in three dimension Fischer, Saw-horse and Newman projection; configuration (R and S) of chiral carbon, priority rule. Conformation of acyclic and alicyclic molecules; gauche-butane interaction; chair-boat in cyclohexane.

10. **Chirality and stereoselectivity**
Chirality: asymmetric carbon, axial and planar chirality. Optical activity; resolution of optically active compounds; enantioselective and diastereoselective synthesis; enantiomeric excess; Prelog's rule for configuration determination; Cram's rule.

11. **Organic Synthetic methods**
Condensation reactions; Aldol, Claisen, Diemann, Perkin, Knoevenagel, Stobbe, Acyloin Oxidation; epoxidation, dihydroxylation, periodate, chromate, permanganate, lead tetraacetate, allylic oxidation. Reduction; catalytic hydrogenation, metal hydrides, dissolving metal reduction. Organometalic, catalysis; palladium-catalyzed coupling reaction and allylic substitution; Wilkinson catalyst; alkene metathesis.

12. **Pericyclic and photochemical reactions**
Photochemical reaction; singlet and triplet state; Norrish Type I and Type II. Patterno-Buchi. Photochemical generation of radicals. Pericyclic reaction; conservation of orbital symmetry; electrocyclic reactions; cycloaddition reactions, sigmatropic rearrangements.