



**DIRECT RECRUITMENT FOR THE POST OF POST GRADUATE ASSISTANTS /
PHYSICAL EDUCATION DIRECTORS GRADE-I - 2018-2019
SUBJECT : CHEMISTRY**

UNIT-I

- ❖ Periodic properties - Atomic radius - ionic radius, ionization potential, electron affinity and electronegativity - Their significance in chemical bonding. VB theory, MO theory applications - Comparison of VB and MO theories - VSEPR theory - Bond order - Bond energy - Bond length Bond polarity - Partial ionic character of bonds - The concept of multicentre bond - Electron deficient compounds - Hydrogen bond - Its influences.
- ❖ Non aqueous solvents - A general study of typical reactions in non aqueous media - comparison with reactions in aqueous media.
- ❖ Solid state chemistry - Ionic bonding - Lattice energy - Born equation - Born Haber cycle - Radius ratio rule - Born Meyer equation - Kapustinski's Modification energetics of the dissolution of ionic compounds in polar solvents - different types of electrostatic interactions.
- ❖ Structural aspects of solids - Fourier synthesis and analysis structure factors scattering factors - Spinels and Inverse spinels - defects in stoichiometric and Non stoichiometric crystals.
- ❖ Electrical properties of solids - Band theory semi conductors - Junction devices Super conductivity - Ionic conductivity - Optical properties of solids - Lasers and phosphors Photovoltaic effect - solar energy.
- ❖ Magnetic properties of solids - Different types - dia, para, ferro, antiferro and ferri Magnetism - Magnetic hysteresis.

UNIT II

- ❖ Co-ordination chemistry - Methods of preparation of complexes - isomerism in complexes - applications of complex formation in analytical chemistry - complexes and their stability chelate effect Stability constants - Their determination - complexes of Metals in different oxidation states and their stability.
- ❖ Optical activity and concept of chirality - Different kinds of optical active compounds - configuration - Fischer, sawhorse and Newman projections - Absolute configuration R and S Notations - Methods with more than one chiral center - Asymmetric synthesis - optical purity.
- ❖ Geometrical isomerism resulting from double bonds - The E.Z. system of nomenclature - Geometrical isomerism of monocyclic compounds and fused ring systems Stereospecific and stereo selective reactions with examples.
- ❖ Conformational analysis - conformation and reactivity in acyclic and cyclo - hexane systems - conformation of decalins, cyclohexane and cyclohexanone.

UNIT III

- ❖ Organic reaction mechanisms - General methods of investigating reaction mechanisms - kinetic and non-kinetic methods - different types of reaction intermediates.
- ❖ Aliphatic nucleophilic substitution SN1, SN2 and SNi reactions - substitution at vinylic and benzylic carbon - stereo chemistry of nucleophilic reaction - solvents and substituent effects - Nucleophilicity Neighboring group participation.
- ❖ Addition to double and triple bonds - Mechanism Hydration - Hydroboration Hydroxylation - epoxidation.
- ❖ Elimination reactions E1, E2, E1cB Mechanism - Orientation effects in elimination reactions - stereo chemistry of elimination reactions - dehydration of alcohols - dehydro halogenation - cope elimination.
- ❖ Heterocyclics - synthesis and reactivity of furan, thiophene, pyrrole pyridine, quinoline, isoquinoline, Indole, flavenes, and anthocyanins - skraup synthesis - Fischer indole synthesis.
- ❖ The chemistry ; of natural products structure elucidations and Biogenesis of the following:
 - ❖ Alkaloids : Reticulene, Reserpine, Morphine
 - ❖ Terpenoids: Zingiberene, Squalene, Lanosterol
 - ❖ Steroids : Cholesterol, Oestrone, Progesterone
 - ❖ Carbohydrates: Maltose, Starch, Cellulose (biogenesis not expected)
 - ❖ Structure and functions of biopolymer such as proteins and Nucleic acids Primary, Secondary and tertiary structures of proteins - Mechanism of Enzyme action - DNA and RNA.

UNIT IV

- ❖ The old quantum theory - Inadequacy of classical mechanics - Failure of classical mechanics - success of quantum hypothesis explaining black body radiation - Photo electric effect - the hydrogen spectrum - Bohr's explanation of hydrogen spectrum - Failure of Bohr's model.
- ❖ De Broglie's postulates of Matter waves - experimental observation of matter waves - Heisenberg's uncertainty principle - wave particle dualism - Davisson, Germer experiments - Postulates of quantum mechanics - Time dependent Schrodinger equation - Needs of an acceptable wave function - Physical significance of Psi function.
- ❖ Operators in quantum mechanics. Operator algebra - Linear and Hermitian operators - Eigen functions and Eigen values - Hamiltonian operators - Angular momentum.
- ❖ Application of Schrodinger equation - particle in one and three dimensional boxes - quantum mechanical results for a simple harmonic oscillator and rigid rotator - approximation methods - perturbation methods - variation method - VB and MO methods.
- ❖ Symmetry elements and symmetry operations - Point groups - representation of groups reducible and irreducible representations characters tables - Orthogonality theorem and its consequences.

- ❖ Symmetry selection rule for IR and Ramanspectra - Systematic procedure for determining symmetries of normal modes of vibration - symmetry applied to MO theory and orbital hybridization.

UNIT V

- ❖ Thermodynamic equations of state - closed and open systems - partial molal quantities - chemical potential with temperature and pressure - third law of thermodynamics.
- ❖ Fugacity - methods of determination - activity and activity co-efficient standard states for gases, liquids - solids and solutions - mean activity co-efficients of electrolytes.
- ❖ Maxwell's distribution of molecular velocities - derivation of expression for average, most probable and root mean square velocities - Microstates Macrostates - partial functions - Sackur tetrode equation - statistical approach to the third law of Thermodynamics Maxwell Boltzmann - Bose Einstein and Fermi
- ❖ Dirace statistics - Heat capacities of solids - Einstein and Debye Models Low temperature - Negative absolute temperature.
- ❖ Chemical equilibrium - thermodynamic derivation of equilibrium constant standard free energy - calculations.
- ❖ Phase equilibrium - thermodynamic derivation of phase rule application of phase rule - three component systems.
- ❖ Chromotography - column, paper, thinlayer, gas-liquid, High pressure liquid chromatography HPLC principle and applications.
- ❖ Thermal analysis - different thermal analysis (DTA) - Principle and applications - thermogravimetric analysis (TGA) Principle and application.
- ❖ Chemical crystallography - Diffraction methods - X ray Neutron, electron diffraction methods. Principle and applications.
- ❖ Polarimetry - Circular ichroism - Optical Rotatory dispersion (ORD) Principle and applications.

UNIT VI

- ❖ Nuclear - chemistry - Nuclear nadii spin and moments - Nuclear structure Nuclear forces - Nuclear stability - Nuclear modes - Modes of Radioactivity decay. Nuclear isomerisation Nuclear Reaction Energy - Coulomb barrier cross section - excitation function Radiactive Equilibria - Types of Neclear reactions - Nuclear fision Nuclear Reactors - Atomic Power Project in India - Radiation hazards - Radiation desimetry - Nuclear fusion - Stellar Energy.

UNIT VII

- ❖ Term symbols and term states - d^n - ions energy levels - Diagrams weakfield and strong field and strong field concepts - spin orbit coupling - The Nephelauxetic effect charge transfer spectra - Applications of UV, IR, NMR, BSR and Mossbauer spectroscopy techniques in the study of co-ordination chemistry.
- ❖ Magnetic interactions - Magnetic susceptibilities determination - application in co-ordination chemistry. Application of VB, MO, CF and LF theories in co-ordination chemistry - Group theoretical approach - splitting of d-orbitals - spectro-chemical series - concept of weak and strong fields - Thermodynamic and chemical effect of d-orbitals splitting - Jahn Teller distortion.
- ❖ Nuclear Magnetic Resonance Spectroscopy - Theory - Study of PMR chemical shift - Type of shielding - Spin-spin coupling spin decoupling - applications to simple natural products.
- ❖ Electron spin resonance spectroscopy - paramagnetism - Nuclear hyperfine structure - Hyperfine coupling.

UNIT VIII

- ❖ Huckel's rule and concept of aromaticity - aromaticity of Benzenoid Nonbenzenoid aromatics. The annulenes - Aromaticity in charged rings and fused ring systems. Aromatic electrophilic substitution - Mechanism and reactivity, Typical reactions to include diazonium coupling - Halogenation, sulphonation. Friedel craft alkylation and acylation. Aromatic Nucleophilic substitution - Benzyne mechanism - Examples. Oxidation - Reduction reactions - Mechanisms - selectivity in oxidations and reductions.
- ❖ Molecular rearrangements - Rearrangements with Carbon to Nitrogen, Carbon to Oxygen and Carbon migrations. Curtius, Lossen, Schmitts Baeyer - Villiger, Pinacol Pinacolene, Benzoin - Benzilic acid, Benzidine, Favorski and Fries rearrangements - sigmatropic rearrangements - Claisen and Cope. Pericyclic reactions, selection rules - orbital symmetry Electrocyclic reactions - cycloadditions sigmatropic reactions.
- ❖ Modern synthetic reactions - Diels Alder reaction Wittig reactions - Stork Enamine reactions - Mannich reactions, Birch reductions.

UNIT IX

- ❖ Theories of reaction rates - simple collision theory - absolute reaction rate theory (ARRT) - Reaction co-ordinate - Potential energy surfaces. Hammett - Taft equation Hammett acidity function - Acid base catalysis Bronsted relation Enzyme catalysis - Michaelis Menton Law - influence of pH and temperature. Surface phenomenon - Heterogeneous catalysis - Adsorption isotherms. Electrolytic conductance - applications - solubility product Interionic attraction theory - Debye - Huckel - Onsager equation - equivalent conductivity of electrolytes.



- ❖ Electro potentials - Electrochemical cells - electrode - electrolyte interface electrical double layer electro capillary phenomena - electro kinetic Phenomena - Membrane potential - Polarisation - over potential - Polarography - concentration polarization - electro chemical polarization - Butler - Volmer equation.

UNIT X

- ❖ Theory and applications of the following spectroscopic methods; electronics spectra- UV-Visible spectra - IR spectra - Raman spectra - Laser - Raman spectra - NMR WCR- ESR Spectra - Mossbauer spectroscopy - photoelectron spectroscopy - Polymerisation reactions - Mechanism - stereochemical aspects. Types of polymers - organic and inorganic polymers - preparation - properties - structure - polystyrene - Polyvinylchloride - Polyesters Nylon - Phenol resin - amino resins - epoxy resins. Phosphonitrilic compounds - silicones Borazines applications of polymers.

Professor Academy