GROUP-25

Scientific Assistants/Analyst (Level of Exam- B.Sc.- PCB)

1) General awareness, Reasoning, Mathematics, Science, History including Haryana related history, current affairs, literature, Geography, Civics, Environment, Culture etc.- **Weightage 20%**

2) Computer terminology, Fundamentals, word software, excel software, Power point, internet, web browsing, Communication, emails, downloading and uploading data on websites etc**. -**
Weightage 10%

3) Subject related syllabus- **Weightage 70%**

Inorganic Chemistry

Atomic Structure Idea of de Broglie matter waves, Heisenberg's uncertainty principle, atomic orbitals, quantum numbers, radial and angular wave functions, normal and orthogonal wave functions, significance of Ψ and Ψ2, probability distribution curves, shapes of s, p, d, f orbitals, Aufbau and Pauli exclusion principles, Hund's multiplicity rules, electronic configuration of elements, effective nuclear charge, Slater's rules.

Periodic table and atomic properties Classification of periodic table into s, p, d, f blocks, atomic and ionic radii, ionisation energy, electron affinity and electronegativity definition, methods of determination or evaluation, trend in periodic table (in s and p-block elements).

Covalent Bond Valence bond theory (Hettler-London and Pauling approach) and its limitation, directional characteristics of covalent bond, various type of hybridisation and shapes of simple inorganic molecules and ions (BeF2, BF3, CH4, PF5, SF6, IF7, SO4 -2, ClO4 -1 , NO3 -1) valence shell electron pair repulsion (VSEPR) theory to NH3, H3O + , SF4, ClF3, H2O, SnCl2, ClO3 -1 and ICl2 -1 . Molecular orbital theory of homonuclear (N2, O2) heteronuclear (CO and NO) diatomic molecules and ions, bond energy, bond angle, bond length and dipole moments, percentage ionic character from dipole moment and electronegativity difference

Ionic Solids Ionic structures (NaCl, CsCl, ZnS (Zinc blende), CaF2) size effects, radius ratio rule and its limitations, Stoichiometric and Non stoichiometric defects in crystals,born Haber cycle, Solvation energy and its relation with solubility of Ionic solids, Polarizing power and Polarizability of ions, Fagan's rule.

Hydrogen Bonding and Van der Waals forces Hydrogen Bonding – Definition, types, effects of hydrogen bonding on properties of substances, application Brief discussion of various types of Van der Waals forces.

Metallic Bond and semiconductors Metallic bond – Qualitative idea of valence bond and Band theories of metallic bond (conductors, semiconductors, insulators). Semiconductors – Introduction, types and applications.

s-Block elements Comparative study of the elements including diagonal relationship, salient features of hydrides, oxides, halides, hydroxides (methods of preparation excluded.

Chemistry of Noble Gases General physical properties, low chemical reactivity, chemistry of xenon, structure and bonding in fluorides, oxides and oxyfluorides of xenon.

p-Block elements: Boron family (13th group, Carbon family and Nitrogen family (14th and 15th group): Oxygen family (16th group): Halogen family (17th group): Chemistry of d-Block elementsCoordination Compounds

Physical Chemistry

Gaseous States Kinetic Molecular Theory of Gases, Maxwell's distribution of velocities and energies (derivation excluded) Calculation of root mean square velocity, average velocity and most probable velocity. Collision diameter, collision number, collision frequency and mean free path (Derivations excluded), Deviation of Real gases from ideal behaviour, Derivation of Van der Waal's Equation of State, its application in the calculation of Boyle's temperature (compression factor)

Critical Phenomenon Critical temperature, critical pressure, critical volume and their determination. PV isotherms of real gases, continuity of states, the isotherms of Van der Waal's equation, relationship between critical constants and Van der Waal's constants. Critical compressibility factor. The Law of corresponding states.

Liquid States Structure of liquids, Properties of liquids

Solid State Classification of solids, Law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry and symmetry elements, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law.

Kinetics Rate of reaction, rate equation and its types, Electrochemistry Electrolytic conduction, Laws of Thermodynamics, Chemical Equilibrium, Distribution Law, Nernst distribution law

Organic Chemistry

Structure and Bonding Localized and delocalized chemical bond, Stereochemistry of Organic Compounds Concept of isomerism, Relative and absolute configuration, sequence rules, R & S systems of nomenclature, Geometric isomerism, Mechanism of Organic Reactions, Alkanes and Cycloalkanes IUPAC nomenclature of branched and unbranched alkanes, Alkenes, Dienes and Alkynes, Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation of alkynes, Alkyl and Aryl Halides, Alcohols, Phenols, Epoxides, Carboxylic Acids & Acid Derivatives, Ultraviolet (UV) absorption spectroscopy.

Classical Mechanics

Basic concepts of Classical mechanics: Mechanics of single and system of particles, Conversion law of linear momentum, Angular momentum and mechanical energy for a particle and a system of particles, Centre of Mass and equation of motion, Constrained Motion.

Generalized Notations: Degrees of freedom and Generalized coordinates, Transformation equations, Generalized Displacement, Velocity, Acceleration, Momentum, Force and Potential, Hamilton's variational principle, Lagrange's equation of motion from Hamilton's principle, Linear Harmonic oscillator, Simple pendulum, Atwood's machine.

Electricity, Magnetism and Electromagnetic theory

Vector background and Electric field: Gradient of a scalar and its physical significance, Line, Surface and Volume integrals of a vector and their physical significance, Flux of a vector field, Divergence and curl of a vector and their physical significance, Gauss's divergence theorem, Stoke's theorem. Derivation of electric field E from potential as gradient, Derivation of Laplace and Poisson equations, Electric flux, Gauss's Law, Mechanical force of charged surface, Energy per unit volume.

Magnetism: Magnetic induction, Magnetic flux, Solenoidal nature of vector field of induction, properties of (i), (ii), Electronic theory of dia and Para magnetism, Domain theory of ferromagnetism (Langerin's theory), Cycle of magnetization- hysteresis loop (Energy dissipation, Hysteresis loss and importance of Hysteresis Curve)

Electromagnetism: Maxwell equations and their derivations, Displacement current, Vector and Scalar potentials, Boundary conditions at interface between two different media, Propagation of electromagnetic wave (Basic idea, no derivation), Poynting vector and Poynting theorem.

A. C. Analysis: A.C. circuit analysis using complex variable with (a) Capacitance and Resistance (CR) (b) Resistance and Inductance (LR) (c) Capacitance and Inductance (LC) and (d) Capacitance, Inductance and Resistance (LCR), Series and parallel resonance circuit, Quality factor (sharpness of resonance).

Semiconductor Devices

Semiconductors: Energy bands in solids, Intrinsic and extrinsic semiconductors, carrier mobility and electrical resistivity of semiconductors, Hall effect, p-n junction diode and their characteristics, Zener and Avalanche breakdown, Zener diode, Zener diode as a voltage regulator. Light emitting diodes (LED), Photoconduction in semiconductors, Photodiode, Solar Cell, p-n junction as a rectifier, half wave and full wave rectifiers (with derivation), filters (series inductor, shunt capacitance, L-section or choke, π and R.C. filter circuits).

Transistors: Junction transistors, Working of NPN and PNP transistors, Three configurations of transistor (C-B, C-E, C-C modes), Common base, common emitter and common collector characteristics of transistor, Constants of a transistor and their relation, Advantages, and disadvantages of C-E configuration. D.C. load line. Transistor biasing; various methods of transistor biasing and stabilization.

Transistor Amplifiers: Amplifiers, Classification of amplifiers, common base and common emitter amplifiers, coupling of amplifiers, various methods of coupling, Resistance- Capacitance (RC) coupled amplifier (two stage, concept of band width, no derivation), Feedback in amplifiers, advantages of negative feedback, emitter follower, distortion in amplifiers.

Oscillators: Oscillators, Principle of oscillation, classification of oscillators, Condition for self-sustained oscillation: Barkhuizen criterion for oscillation, tuned collector common emitter oscillator, Hartley oscillator, C.R.O. (Principle and Working).

Quantum and Laser Physics

Origin quantum physics: Overview, scale of quantum physics, boundary between classical and quantum phenomena, Photon, Photoelectric effect, Compton effect (theory and result), FrankHertz experiment, de-Broglie hypothesis. Davisson and Germier experiment, ·G.P. Thomson experiment. Phase velocity, group velocity and their relation. Heisenberg's uncertainty principle. Time energy and angular momentum, position uncertainty. Uncertainty principle from de Broglie wave. (Wave-particle duality). Gamma Ray Microscope, Electron diffraction from a slit. Derivation of 1-D time-dependent Schrodinger wave equation (subject to force, free particle). Time-independent Schrodinger wave equation, eigen values, eigen functions, wave functions and its significance. Orthogonality and Normalization of function, concept of observer and operator. Expectation values of dynamical quantities, probability current density.

Application of Schrodinger wave equation: (i) Free particle in one-dimensional box (solution of Schrodinger wave equation, eigen functions, eigen values, quantization of energy and momentum,

nodes and anti-nodes, zero-point energy). (ii) One dimensional step potential E > Vo (Reflection and Transmission coefficient) (iii) One dimensional step potential E < Vo (penetration depth calculation). (iv) One dimensional potential barrier, E > Vo (Reflection and Transmission coefficient) (v) One-dimensional potential barrier, E < Vo (penetration or tunnelling coefficient). (vi) Solution of Schrodinger equation for harmonic oscillator (quantization of energy, Zero-point energy, wave equation for ground state and excited states).

Laser Physics: Absorption and emission of radiation, Main features of a laser: Directionality, high intensity, high degree of coherence, spatial and temporal coherence, Einstein's coefficients and possibility of amplification, momentum transfer, life time of a level, kinetics of optical absorption ((two and three level rate equation, Fuchbauerlanderburg formula).population inversion: A necessary condition for light amplification, resonance cavity, laser pumping, Threshold condition for laser emission, line broadening mechanism, homogeneous and inhomogeneous line broadening (natural, collision and Doppler broadening). He-Ne laser and RUBY laser (Principle, Construction and working), Optical properties of semiconductor, Semiconductor laser (Principle, Construction and working), Applications of lasers in the field of medicine and industry.

Solid State and Nano Physics

Crystal Structure: Crystalline and glassy forms, liquid crystals, crystal structure, periodicity, lattice and basis, crystal translational vectors and axes. Unit cell and Primitive Cell, Winger Seitz primitive Cell, symmetry operations for a two-dimensional crystal, Bravais lattices in two and three dimensions. Crystal planes and Miller indices, Interplanar spacing, Crystal structures of Zinc Sulphide, Sodium Chloride and Diamond. X-ray diffraction, Bragg's Law and experimental X-ray diffraction methods. K-space and reciprocal lattice and its physical significance, reciprocal lattice vectors, reciprocal lattice to a simple cubic lattice, b.c.c. and f.c.c.

Super conductivity: Historical introduction, Survey of superconductivity, Super conducting systems, High Tc Super conductors, Isotopic Effect, Critical Magnetic Field, Meissner Effect, London Theory and Pippards' equation, Classification of Superconductors (type I and Type II), BCS Theory of Superconductivity, Flux quantization, Josephson Effect (AC and DC), Practical Applications of superconductivity and their limitations, power application of superconductors.

Introduction to Nano Physics: Definition, Length scale, Importance of Nano-scale and technology, History of Nano-technology, Benefits and challenges in molecular manufacturing. Molecular assembler concept, Understanding advanced capabilities. Vision and objective of Nano-technology, Nanotechnology in different field, Automobile, Electronics, Nano-biotechnology, Materials, Medicine.

Important Note: The Weightage as mentioned against the syllabus is tentative & may vary.