

SYLLABI FOR MALVIYA ENTRANCE TEST (MET)

PAPER – 1 (PHYSICS, CHEMISTRY AND MATHEMATICS)

Section –A: Physics

Measurement: Dimensional analysis and error estimation, dimensional compatibility and significant figures.

Motion in one dimension: Average velocity, instantaneous velocity, one-dimensional motion with constant accelerations, freely falling bodies.

Laws of Motion: Force and inertia, Newton's laws of motion, and their significance.

Motion in two dimensions: Projectile motion, uniform circular motion, tangential and radial acceleration in curvilinear motion, relative motion and relative acceleration.

Work, Power and Energy: Work done by a constant and variable forces, kinetic and potential energy, power, Conservative and non conservative forces, conservation of energy, gravitational energy, work energy theorem, potential energy stored in a spring.

Linear Momentum and collisions: Linear momentum and impulse, conservation of linear momentum for two particle system, collisions, collision in one dimension, collision in two dimension, rocket propulsion.

Rotation of a rigid body about a fixed axis: Angular velocity and angular acceleration, rotational kinematics, rotational motion with constant angular acceleration relationship between angular and linear quantities, rotational energy, moment of inertia for a ring, rod, spherical shell, sphere and plane lamina, torque and angular acceleration, work and energy in rotational motion, rolling motion of a solid sphere and cylinder.

Gravitation: Gravitational field, Kepler's laws and motion of planets, planetary and satellite motion, geostationary satellite.

Oscillatory motion: Harmonic motion, oscillatory motion of mass attached to a spring, kinetic & potential energy, Time Period of a simple pendulum, comparing simple and harmonic motion with uniform circular motion, forced oscillations, damped oscillations and resonance.

Mechanics of solids and fluids: States of matter young's modulus, bulk modulus, shear modulus of rigidity, variations of pressure with depth, Buoyant forces and Archimedes principle, Pascal's law, Bernoulli's theorem and its application, surface energy, surface tension, angle of contact, capillary rise, coefficient of viscosity, viscous force, terminal velocity, Stoke's law, stream line motion, Reynold's numbers.

Heat and thermodynamics: First law of thermodynamics, specific heat of an ideal gas at constant volume and constant pressure, relation between them, thermodynamics process (reversible, irreversible, isothermal, adiabatic), second law of thermodynamics, concept of entropy and concept of absolute scale, efficiency of a Carnot engine, thermal conductivity, Newton's law of cooling, blackbody radiation, Wien's displacement law, Stefan's law.

Wave: Wave motion, phase, amplitude and velocity of wave, newton's formula for longitudinal waves, propagation of sound waves in air, effect of temperature and pressure on velocity of sound, Laplace's correction, Principle of superposition, formation of standing waves, standing waves in strings and pipes, beats, Doppler's effect.

Electrostatics: Coulomb's law, electric field and potential due to point charge, dipole and its field along the axis and perpendicular to axis, electric flux, Gauss's theorem and its applications to find the field due to infinite sheet of charge, and inside the hollow conducting sphere, capacitance, parallel plate capacitor with air and dielectric medium between the Plates, series and parallel combination of capacitors, energy of a capacitor, displacement currents.

Current Electricity: Concept of free and bound electrons, drift velocity and mobility, electric current, Ohm's law, resistivity, conductivity, temperature dependency of resistance, resistance in series and parallel combination, Kirchoff's law and their application to network of resistances, principle of potentiometer, effect of temperature on resistance and its application.

Magnetic Effect of Current: Magnetic field due to current, Biot-Savart's law, magnetic field due to solenoid, motion of charge in a magnetic field, force on a current carrying conductors and torque on current loop in a magnetic

field, magnetic flux, forces between two parallel current carrying conductors, moving coil galvanometer and its conversion into ammeter and voltmeter.

Magnetism in Matter: The magnetization of substance due to orbital and spin motions of electrons, magnetic moment of atoms, diamagnetism, paramagnetism, ferromagnetism, earth's magnetic field and its components and their measurement.

Electromagnetic induction: Induced e.m.f., Faraday's laws, Lenz's law, electromagnetic induction, self and mutual induction, B-H curve, hysteresis loss and its importance, eddy currents.

Ray Optics and optical instruments: Sources of light, luminous intensity, luminous flux, illuminance, photometry, wave nature of light, Huygens's theory for propagation of light and rectilinear propagation of light, reflection of light, total internal reflection, reflection and refraction at spherical surfaces, focal length of a combination of lenses, spherical and chromatic aberration and their removal, refraction and dispersion of light due to a prism, simple and compound microscope, reflecting and refracting telescope, magnifying power and resolving power.

Wave Optics: Coherent and incoherent sources of light, interference, young's double slit experiment diffraction due to a single slit, linearly polarized light, Polaroid.

Modern Physics: Photo-electric equation, matter waves, quantization, Planck's hypothesis, Bohr's model of hydrogen atom and its spectra, neutralization potential, Rydberg constant, solar spectrum and Fraunhofer lines, fluorescence and phosphorescence, X-Rays and their productions, characteristic and continuous spectra.

Nuclear Instability, radioactive decay laws, Emission of α , β , γ rays, Mass – defect, Mass Energy equivalence, Nuclear Fission Nuclear Reactors, Nuclear Fusion.

Classification of conductors, Insulators and semiconductors on the basis of energy bands in solids, PN junction, PN Diode, junction Transistors, Transistor as an amplifier and Oscillator.

Principles of Logic Gates (AND, OR and NOT) Analog Vs Digital communication, Difference between Radio and television, Signal propagation, Principle of LASER and MASER, Population Inversion, Spontaneous and stimulated Emission.

Section – B:Chemistry

Atomic Structure: Bohr's concept. Quantum numbers, Electronic configuration, molecular orbital theory for homonuclear molecules, Pauli's exclusion principle.

Chemical Bonding: Electrovalence, co-valency, hybridization involving s,p and d orbital's hydrogen bonding.

Redox Reactions: Oxidation number, neutralizing and reducing agents, balancing of equations.

Chemical Equilibrium and Kinetics: Equilibrium constant (for gaseous system only) Le Chatterley's principle, ionic equilibrium, Ostwald's dilution law, hydrolysis, pH and buffer solution, solubility product, common-ion effect, rate constant and first order reaction.

Acid – Base Concepts: Bronsted Lowry & Lewis.

Electrochemistry: Electrode potential and electro-chemical series.

Catalysis: Types and applications.

Colloids: Types and preparation, Brownian movement, Tyndall effect, coagulation and peptization.

Colligative Properties of Solution: Lowering of vapour pressure, Osmotic pressure, depression of freezing point, elevation of boiling point, determination of molecular weight.

Periodic Table: Classification of elements on the basis of electronic configuration, properties of s,p and d block elements, ionization potential, electro negativity & electron affinity.

Preparation and Properties of the following: Hydrogen peroxide. Copper sulphate, silver nitrate, plaster of paris, borax, Mohr's salt, alums, white and red lead, microcosmic salt and bleaching powder, sodium thiosulphate.

Thermo chemistry: Exothermic & endothermic reactions Heat of reaction, Heat of combustion & formation, neutralization, Hess's law.

General Organic Chemistry: Shape of organic compounds, Inductive effect, mesomeric effect, electrophiles and nucleophiles, Reaction intermediates: carboniumion, carbanions & free radical, Types of organic reactions, Cannizzaro Friedel Craft, Perkin, Aldol condensation.

Isomerism: Structural, Geometrical & Optical

IUPAC: Nomenclature of simple organic compounds.

Polymers: Addition and condensation polymers

Carbohydrates: Monosaccharide's.

Preparation and Properties of the Followings: Hydrocarbons, monohydric alcohols, aldehydes, ketones, monocarboxylic acids, primary amines, benzene, nitrobenzene, aniline, phenol, benzaldehyde, benzoic acid, Grignard Reagent.

SolidState: Structure of simple ionic compounds, Crystal imperfections (point defects only), Born-Haber cycle

Petroleum: Important industrial fractions, cracking, octane number, anti-knocking compounds.

Section – C: Mathematics

Algebra: Sets relations & functions, De-Morgan's Law, Mapping Inverse relations, Equivalence relations, Peano's axioms, Definition of rationales and integers through equivalence relation, Indices and surds, Solutions of simultaneous and quadratic equations, A.P., G.P. and H.P., Special sums i.e. $\sum n^2$ and $\sum n^3$ ($n \in \mathbb{N}$), Partial fraction, Binomial theorem for any index, exponential series, Logarithm and Logarithmic series. Determinants and their use in solving simultaneous linear equations, Matrices, Algebra of matrices, Inverse of a matrix, Use of matrix for solving equations.

Probability: Definition, Dependent and independent events, Numerical problem on addition and multiplication, theorem of probability.

Trigonometry: Identities, Trigonometric equations, properties of triangles, solution of triangles, heights and distances, Inverse function, Complex numbers and their properties, Cube roots of unity, De-Moivre's theorem.

Co-ordinate Geometry: Pair of straight lines, Circles, General equation of second degree, parabola, ellipse and hyperbola, tracing of conics.

Calculus: Limits & continuity of functions, Differentiation of function of function, tangents & normal, Simple examples of Maxima & Minima, Indeterminate forms, Integration of function by parts, by substitution and by partial fraction, definite integral, application to volumes and surfaces of frustums of sphere, cone and cylinder. Differential equations of first order and first degree

Vectors: Algebra of vectors, scalar and vector products of two and three vectors and their applications.

Dynamics: Velocity, composition of velocity, relative velocity, acceleration, composition of accelerations, Motion under gravity, Projectiles, Laws of motion, Principles of conservation of momentum and energy, direct impact of smooth bodies.

Statics: Composition of coplanar, concurrent and parallel forces moments and couples resultant of set of coplanar forces and condition of equilibrium, determination of centroid in simple cases, Problems involving friction.

PAPER – 2 (APTITUDE TEST FOR DIPLOMA HOLDERS IN ENGINEERING)

Engineering Mechanics, Engineering Graphics, Basic Electrical Engg., Basic Electronics Engg., Elements of computer science, Basic Workshop Practice and Physics/Chemistry/Maths of Diploma standard.

PAPER-3 (APTITUDE TEST FOR BBA)

Qualitative and Quantitative Aptitude: Number System, Profit & Loss, Percentage & Average, Work & Time, HCF & LCM, Ratio & Proportion, Time-Speed-Distance, Algebra & Geometry, Coding & Decoding, Multidimensional Arrangements, Visual Reasoning, Course of Action, Critical Reasoning, Statement Conclusions, Pie Chart, Syllogisms, Puzzles

English: Verbal Reasoning, Syllogisms, Jumbled Paragraphs, Sentence Completion, Sentence Correction, Same Word & different usage, Idioms & Analogies, Synonyms & Antonyms, One-word Substitution.

PAPER – 4 (APTITUDE TEST FOR MBA)

The test is aimed at evaluating the verbal ability, quantitative aptitude, logical and abstract reasoning and knowledge of current affairs. The following is a brief description of contents of the test paper.

Section-A(English Language): Grammar, vocabulary, uncommon words, sentence completion, synonyms, antonyms, relationship between words and phrases and comprehension of passages.

Section-B(Numerical Aptitude): Numerical calculation, arithmetic, simple algebra, geometry and trigonometry, Interpretation of graphs, charts and tables.

Section-C (Thinking and Decision Making): Creative thinking, unfamiliar relationships, verbal reasoning, finding patterns trends and Assessment of figures and diagrams.

Section-D (General Awareness): Knowledge of current affairs and other issues related to trade, industry, economy, sports, culture and science.

PAPER – 5 (APTITUDE TEST FOR MCA)

(i) MATHEMATICS

Modern Algebra: Idempotent law, identities, complementary laws, Demorgan's theorem, mapping, inverse relation, equivalence relation, Pano's Axiom, definition of rational numbers and integers through equivalence relation.

Algebra: Surds, solution of simultaneous and quadratic equations, arithmetic, geometric and harmonic progression, Binomial theorem for any index, logarithms, exponential and logarithmic series, determinants.

Probability: Definition, dependent and independent events, numerical problems on addition and multiplication of probability, theorems of probability.

Trigonometry: Simple identities, trigonometric equations, properties of triangles, use of mathematical tables, solution of triangles, height and distance, inverse functions, DeMoiver's theorem.

Co-Ordinate Geometry: Co-ordinate geometry of the straight lines, pair of straight lines, circle, parabola, ellipse and hyperbola and their properties.

Calculus: Differentiation of function of functions, tangents and normal, simple examples of maxima of minima, limits of function, integration of function (by parts, by substitution and by partial fraction), definite integral (application to volumes and surfaces of frustums of sphere, cone and cylinder).

Vectors: Position vector, addition and subtraction of vectors, scalar and vector products and their applications.

Dynamics: Velocity, composition of velocity, relative velocity, acceleration, composition of acceleration, motion under gravity, projectiles, laws of motions, principles of conservation of momentum and energy, direct impact of smooth bodies, pulleys.

Statics: Composition of co-planar, concurrent and parallel forces, moments and couples, resultant of set of coplanar forces and conditions of equilibrium, determination of Centroids in simple case, problems involving friction.

Statistics: Theory of probability, Mean, Median, Mode, Dispersion and Standard Deviation.

(ii) COMPUTER AWARENESS

Organization of a computer, Central Processing Unit (CPU), Structure of instructions in CPU, input / output devices, computer memory, memory organization, back-up devices, Representation of characters, integers, and fractions, binary and hexadecimal representations, Binary Arithmetic: Addition, subtraction, division, multiplication, Logical Gates: AND, OR, NOT, XOR, NAND, Block structure of computers, peripheral devices, devices, Computer languages: Machine, Assembly and high-level language, Flow chart and Algorithms

(iii) ANALYTICAL ABILITY

Questions shall be set to test analytical and reasoning capability of candidates.

PAPER-6 (M.Tech. Admission Test)

For admission to M.Tech. programme, the admission test shall include objective type questions from the core subjects of the respective disciplines.

PAPER-7 (M.Sc. Physics Admission Test)

Mathematical Methods: Calculus of single and multiple variables, partial derivatives, Jacobian, imperfect and perfect differentials, Taylor expansion, Fourier series. Vector algebra, Vector Calculus, Multiple integrals, Divergence theorem, Green's theorem, Stokes' theorem. First order equations and linear second order differential equations with constant coefficients. Matrices and determinants, Algebra of complex numbers.

Mechanics and General Properties of Matter: Newton's laws of motion and applications, Velocity and acceleration in Cartesian, polar and cylindrical coordinate systems, uniformly rotating frame, centrifugal and Coriolis forces, Motion under a central force, Kepler's laws, Gravitational Law and field, Conservative and non-conservative forces. System of particles, Center of mass, equation of motion of the CM, conservation of linear and angular momentum, conservation of energy, variable mass systems. Elastic and inelastic collisions. Rigid body motion, fixed axis rotations, rotation and translation, moments of Inertia and products of Inertia, parallel and perpendicular axes theorem. Principal moments and axes. Kinematics of moving fluids, equation of continuity, Euler's equation, Bernoulli's theorem.

Oscillations, Waves and Optics: Differential equation for simple harmonic oscillator and its general solution. Superposition of two or more simple harmonic oscillators. Lissajous figures. Damped and forced oscillators, resonance. Wave equation, traveling and standing waves in one-dimension. Energy density and energy transmission in waves. Group velocity and phase velocity. Sound waves in media. Doppler Effect. Fermat's Principle. General theory of image formation. Thick lens, thin lens and lens combinations. Interference of light, optical path retardation. Fraunhofer diffraction. Rayleigh criterion and resolving power. Diffraction gratings. Polarization: linear, circular and elliptic polarization. Double refraction and optical rotation.

Electricity and Magnetism: Coulomb's law, Gauss's law. Electric field and potential. Electrostatic boundary conditions, Solution of Laplace's equation for simple cases. Conductors, capacitors, dielectrics, dielectric polarization, volume and surface charges, electrostatic energy. Biot-Savart law, Ampere's law, Faraday's law of electromagnetic induction, Self and mutual inductance. Alternating currents. Simple DC and AC circuits with R, L and C components. Displacement current, Maxwell's equations and plane electromagnetic waves, Poynting's theorem, reflection and refraction at a dielectric interface, transmission and reflection coefficients (normal incidence only). Lorentz Force and motion of charged particles in electric and magnetic fields.

Kinetic theory, Thermodynamics: Elements of Kinetic theory of gases. Velocity distribution and Equipartition of energy. Specific heat of Mono-, di- and tri-atomic gases. Ideal gas, van-der-Waals gas and equation of state. Mean free path. Laws of thermodynamics. Zeroth law and concept of thermal equilibrium. First law and its consequences. Isothermal and adiabatic processes. Reversible, irreversible and quasi-static processes. Second law and entropy. Carnot cycle. Maxwell's thermodynamic relations and simple applications. Thermodynamic potentials and their applications. Phase transitions and Clausius-Clapeyron equation. Ideas of ensembles, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distributions.

Modern Physics: Inertial frames and Galilean invariance. Postulates of special relativity. Lorentz transformations. Length contraction, time dilation. Relativistic velocity addition theorem, mass energy equivalence. Blackbody radiation, photoelectric effect, Compton effect, Bohr's atomic model, X-rays. Wave-particle duality, Uncertainty principle, the superposition principle, calculation of expectation values, Schrodinger equation and its solution for one, two and three dimensional boxes. Solution of Schrodinger equation for the one-dimensional harmonic oscillator. Reflection and transmission at a step potential, Pauli exclusion principle. Structure of atomic nucleus, mass and binding energy. Radioactivity and its applications. Laws of radioactive decay.

Solid State Physics, Devices and Electronics: Crystal structure, Bravais lattices and basis. Miller indices. X-ray diffraction and Bragg's law; Intrinsic and extrinsic semiconductors, variation of resistivity with temperature. Fermi

level. p-n junction diode, I-V characteristics, Zener diode and its applications, BJT: characteristics in CB, CE, CC modes. Single stage amplifier, two stage R-C coupled amplifiers. Simple Oscillators: Barkhausen condition, sinusoidal oscillators. OPAMP and applications: Inverting and non-inverting amplifier. Boolean algebra: Binary number systems; conversion from one system to another system; binary addition and subtraction. Logic Gates AND, OR, NOT, NAND, NOR exclusive OR; Truth tables; combination of gates; de Morgan's theorem.

Atomic Physics and Laser: Bohr and Sommerfeld model of atom. Idea of discrete energy levels and electron spin: Franck – Hertz and Stern – Gerlach experiments. Significance of four quantum numbers and concept of atomic orbitals. Orbital magnetic dipole moment, Orbital, spin and total angular momenta, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Normal Zeeman Effect. Two valence electron atoms: LS and JJ coupling schemes and resulting spectra. Idea of normal and inverted doublet. Basics of Stark effect. Einstein coefficients, Threshold condition for LASER action, Rate equation for three level laser system, Characteristics of laser radiation. He-Ne and Nd-YAG Laser. Significance of non-linear polarization of lasers and some applications: Second harmonic generation using non-linear optical methods.

PAPER-7 (M.Sc. Maths Admission Test)

Sequences and Series of Real Numbers: Sequence of real numbers, convergence of sequences, bounded and monotone sequences, convergence criteria for sequences of real numbers, Cauchy sequences, subsequences, Bolzano-Weierstrass theorem. Series of real numbers, absolute convergence, tests of convergence for series of positive terms- comparison test, ratio test, root test; Leibniz test for convergence of alternating series.

Mathematical Programming: Simplex method, Dual Simplex method, Transportation Problem, Assignment Problem, Game Theory.

Numerical Analysis: Finite differences, Numerical solutions of algebraic equation, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel method.

Integral Calculus: Integration as the inverse process of differentiation, definite integrals and their properties, fundamental theorem of calculus. Double and triple integrals, change of order of integration, calculating surface areas and volumes using double integrals, calculating volumes using triple integrals.

Differential Equations: Ordinary differential equations of the first order of the form $y' = f(x,y)$, Bernoulli's equation, exact differential equations, integrating factor, orthogonal trajectories, homogeneous differential equations, variable separable equations, linear differential equations of second order with constant coefficients, method of variation of parameters, Cauchy-Euler equation.

Vector Calculus: Scalar and vector fields, gradient, divergence, curl, line integrals, surface integrals, Green, Stokes and Gauss theorems.

Group Theory: Groups, subgroups, Abelian groups, non-Abelian groups, cyclic groups, permutation groups, normal subgroups, Lagrange's Theorem for finite groups, group homomorphisms and basic concepts of quotient groups.

Linear Algebra: Finite dimensional vector spaces, linear independence of vectors, basis, dimension, linear transformations, matrix representation, range space, null space, rank-nullity theorem. Rank and inverse of a matrix, determinant, solutions of systems of linear equations, consistency conditions, eigen values and eigenvectors for matrices, Cayley-Hamilton theorem.

Real Analysis: Interior points, limit points, open sets, closed sets, bounded sets, connected sets, compact sets, completeness of \mathbb{R} . Power series (of real variable), Taylor's series, radius and interval of convergence, term-wise differentiation and integration of power series. Functions of One Real Variable: Limit, continuity, partial derivatives, differentiability, maxima and minima. Functions of Two or Three Real Variables: Limit, continuity, partial derivatives, differentiability, maxima and minima.

PAPER-7 (M.Sc. Chemistry Admission Test)

Reactions and reagents: Organometallic compounds - Grignard reagent - synthesis of different types of compounds like alcohol, aldehyde, acid, amine and organometallic. Acetoacetic ester - tautomerism - base hydrolysis - acid hydrolysis - malonic ester - cyano acetic ester - synthesis of dicarboxylic acids and unsaturated acids.

Carbohydrates: Occurrence, classification and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures.

Alicyclic compounds, aromatic compounds, fats and oils: Alicyclic compounds - nomenclature - synthesis of alicyclic compounds using carbon - acryloin condensation - Diels Alder reaction, Freund's synthesis - Bayer's strain theory postulates, drawbacks - theory of strainless rings - conformations of cyclohexane.

Amino Acids, Peptides and Proteins: Amino acids, Peptides and their classification. α -Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structures - end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting,

Nucleic acids: Structure of components of nucleic acids: Bases, Sugars, Nucleosides and Nucleotides. Nomenclature of nucleosides and nucleotides, structure of polynucleotides (DNA and RNA), Biological roles of DNA and RNA.

Heterocyclic compounds and natural products: Heterocyclic compounds - synthesis and reaction of pyrrole, furan, thiophene, pyridine, quinine, isoquinoline. Alkaloids - Isolation from natural products - colour reaction - structural elucidation of nicotine. Terpenoids - Isolation - Isoprene rule - structural elucidation of citral.

Polymer: Nomenclature, functionality, classification, methods of polymerization, mechanism of polymerization, molecular weight determination - Viscometry, light scattering methods. Plastics - Moulding constituents of a plastics and moulding of plastics into articles. Important thermoplastics and thermosetting resins - synthesis & applications. Conductive polymers.

Nucleophilic substitution: Reactivity, structural and solvent effects, substitution in SN^1 , SN^2 , SN^i . Neighbouring group participation - Norbornyl and bridgehead systems, substitution at allylic and vinylic carbons, substitution by ambident nucleophiles, aromatic nucleophilic substitution, SN^Ar , benzyne, SN^1 . Aromatic nucleophilic substitution of activated halides

Elimination reactions: E1, E2, E1cB - mechanism, stereochemistry, orientation of double bonds - Hoffmann, Zaitsev, Bredt's rule - pyrolytic elimination, Chugaev reaction. Oxidation and reduction: Reduction using hydride reagents, $LiAlH_4$, $NABH_4$ and other organoboranes.

Theories of aromaticity: Aromaticity, antiaromaticity, Huckel's rule, annulenes and heteroannulenes, fullerenes (C₆₀). Other conjugated systems, Chichibabin reaction. Aromatic electrophilic substitution: Orientation, reactivity, and mechanisms.

Addition to carbon-carbon multiple bonds: Electrophilic, nucleophilic and free radical addition. Stereochemistry and orientation of the addition. Hydrogenation, halogenation, hydroxylation, hydroboration. Addition to carbonyl compounds - 1,2 and 1,4-addition, benzoin, Knoevenagel, Stobbe and Darzen glycidic ester reactions.

Photochemistry: Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitized reactions, quenching.

Gaseous state: Kinetic theory of gases, Vander waal's equation. Law of equipartition principle, Translational, Rotational and vibrational energies of molecules, Joule-Thomson effect, liquefaction of gases. Critical constants.

Atomic structure: Photoelectric effect, dual nature of electrons, Heisenberg's uncertainty principle, quantum numbers, electronic configuration, wave mechanics.

Reaction kinetics: Rate order and molecularity of chemical reactions. Methods of their evaluation. Calculation of rate constants. Consecutive - Parallel and opposing reactions. Chain reactions. Energy of activation - Theories on reaction rates. Heterogeneous reactions - zero order reactions.

Phase equilibria: Phase rule: Application - to one components system (water, sulphur and carbon dioxide), Two component systems (Eutetic, Intermediate compound formation and solid solutions) and simple three components systems.

Solutions and Colligative Properties: Dilute solutions; lowering of vapour pressure, Raoult's law. Thermodynamic basis of the colligative properties - lowering of vapour pressure, elevation of Boiling Point, Depression of Freezing point and Osmotic pressure and derivation of expressions for these using chemical potential. Application of colligative properties in calculating molar masses of normal, dissociated and associated solutes in solutions.

Electrochemistry: Conductivity of electrolytes- Specific, molar and equivalent conductivity, Nernst equation for electrode potential, EMF series, hydrogen electrode, calomel electrode, glass electrode, Electrolytic and galvanic cells, cell EMF, its measurement and applications.

Ionic equilibrium: Acids, bases - definitions a) based on proton transference, dissociation constant, amphoteric electrolyte - pH -Buffer solutions. Salts - water of crystallization, double salts, complex ions and salts, hydrolysis. Decomposition potential, over voltage, e.m.f. and energy relations. Conductometry, Potentiometry, their applications, Fuelcells.

Surface chemistry: Derivation of Langmuir adsorption isotherm, B.E.T adsorption isotherm, Determination of surface area of solids by B.E.T. method. Catalysis- Homogeneous catalysis, heterogeneous catalysis, Enzyme catalysis, adsorption chromatography.

Thermodynamics: Entropy as a thermodynamic quantity, entropy changes in isothermal expansion of an ideal gas, reversible and irreversible processes, physical transformations, work & free energy functions, Helmholtz and Gibbs free energy functions, Gibbs-Helmholtz equation, Gibbs-Duhem equation, Clapeyron-Clausius equation & its applications, Van't Hoff isotherm and applications.

Chemical Bonding: Basic concepts, bonding in metals, electron gas theory, physical properties of metals. Alloy-substitutional alloys, interstitial alloys. Coordinate bond, EAN rule, 16 & 18 electron rule.

Shape & Intermolecular Interactions: Shape-Lewis dot structures, formal charge, VSEPR method, consequences of shape, dipole moment, valence bond theory; Intermolecular interactions-ion ion interactions, ion-dipole interactions, hydrogen bonding, dipole-dipole interactions, London / dispersion forces, relative strength of intermolecular forces; Consequences-surface tension.

Solid State: Types of solids - close packing of atoms and ions - bcc, fcc structures of rock salt - cesium chloride-spinel - normal and inverse spinels, Stoichiometric Defect, controlled valency & Chalcogen semiconductors.

Theories of coordination compounds - VB theory - CFT - splitting of d orbitals in ligand fields and different symmetries - CFSE - factors affecting the magnitude of $10 Dq$ - evidence for crystal field stabilization - spectrochemical series - site selection in spinels - tetragonal distortion from octahedral symmetry - Jahn-Teller distortion.

Nuclear Chemistry: Mass defect and binding energy, nuclear reactions, fission and fusion, nuclear reactor and breeder reactors, radio dating.

Electronic spectra and magnetism: Microstates, terms and energy levels for $d1-d9$ ions in cubic and square fields - selection rules - band intensities and band widths - evaluation of $10 Dq$ and β for octahedral complexes of cobalt and nickel - charge transfer spectra - magnetic properties of coordination compounds - change in magnetic properties of complexes.

Rotational spectra: Diatomic and polyatomic molecules - selection rules, rotational Raman spectra - vibrational spectra of diatomic molecules - rotational character of vibration spectra - Morse potential of real molecules - selection rules - overtones and combination - Fermi resonance.

Vibrational spectra: Polyatomic molecules - harmonic and anharmonic oscillators - Morse potential - selection rules - normal modes of vibrations of polyatomic molecules - selection rules - Fourier transformation in IR spectroscopy - Raman spectroscopy – fundamentals - rotational Raman - vibrational Raman spectra - IR/Raman instrumentation.

Periodic table of elements: s-block, p-block, d-block and f-block elements, their periodicity and general properties.

Separation techniques: Solvent extraction, chromatography - thin layer chromatography, ion exchange chromatography and size exclusion chromatography, HPLC, Gas chromatography.

PAPER-8 (Ph.D. Admission Test)

For admission to Ph.D. programme, the admission test shall include objective type questions from the core subject of the respective disciplines.