12. B. TECH (2nd / Special OJEE)

A. MATHEMATICS (+ 2 Level) - (40 Questions)

Logic : Statement, Negation, Implication, Converse, Contraposititve, Conjuction, Disjunction, tautology, Truth Table, Principle of Mathematical induction.

Sets, Relation and Function : Union, Intersection, Difference, Symmetric difference and Complement of sets , De Morgan's laws,Venn diagram, Cartesian product of sets,Power Set, Relation and function : domain , codomain and range of a relation, types of relations, Equivalence relation, Representation of three dimensional space by RxRxR, types of functions and their domain and range such as:
Constant function, identity function, modulus function, logarithm function, exponntial function, greatest integer function.
surjective, injective and bijective functions, sum , difference and quotient of functions and their range, Composite function, Inverse of a function.

Number system : Real numbers (algebraic and order properties, rational and irrational numbers), Absolute value, Triangle inequality, AM ≥ GM, Inequalities(simple cases), Complex numbers as ordered pairs of reals, representation of a complex number in the form a +ib and their representation in a plane, Argand diagram, Algebra of complex numbers, modulus and argument of complex numbers, Conjugate a complex number, Quadratic equation in real numbers, and their solution, Relation between roos and coefficients, nature of roots, formation of quadratic equation with roots.Permutations and Combinations, fundamental principle of counting, permutation as an   arrangement and combination as a selection, meaning of P(n,r) and C(n,r), simple applications, Binomial theorem for positive integral index, general term and middle term, properties of Binomial coefficient and their applications, Identities involving binomial co-efficients.

Determinants and matrices : Determinants and matrices up to third order, Minors and cofactors, Properties of determinants, Matrices upto third order, Types of matrices, algebra of matrices, properties of determinant, evaluation of determinants, Adjoint and inverse of matrix, Application of determinants and matrices to the solution of linear equations (in three unknowns).

Trigonometry : Compound angles, Multiple and Submultiple angles, Trigonometric identities , Solution of trigonometric equations,trigonometric functions, Properties of triangles, Inverse trigonometric function and their properties

Co-ordinate geometry of two dimensions : Cartesian system of rectangular co-ordinates in a plane,distance formula,section formula,locus and its equation,translation of axes,slope of a line,parallel and perpendicular lines,intercepts of a line on the coordinate axes. Various forms of equations of a line, intersection of lines, angles between two lines, conditions for concurrence of three lines, distance of a point from a lineequations of internal and external

bisectors of angles between two lines, coordinates of centroid, orthocentre and circumcentre of a triangle, equation of family of lines satisfying various conditions,. Pairs of straight lines, Standard form of equation of a circle, general form of the equation of a circle, radius and centre of a circle, equation of a circle when the end points of a diameter are given, points of intersection of a line and a circle and condition for a line to be tangent to a circle, Equations of tangents to a circle, Equations of parabola, Ellipse and hyperbola in simple forms, their tangents in standard form. Condition of tangency.

Coordinate geometry of three dimensions : Coordinates of a point in space, distance between two points, section formula, Direction cosines and direction ratios, Projection, angle between two intersecting lines.Angle between two planes, Angle between a line and a plane. Distance of a point from a line and a plane.Equations of a line and a plane in different forms, intersection of a line and a plane, coplanar lines.

Sequence and Series : Definition, Infinite geometric series, Arithmetico-geometric series, Exponential and Logarithmic series, Geometric mean between two given numbers, Relation between AM and GM

Vectors : Vectors and scalars,addition of vectors,components of a vector in two dimensions and three dimensional space,scalar and vector products, scalar and vector triple product.

Differential calculus: Concept of limit, limits of polynomial functions, rational functions, trigonometric functions, exponential and logarithmic functions, Continuity of functions, Contuinity and differentiability, Derivative of standard Algebraic and Transcendental functions, Differentiation of trigonometric,inverse trigonometric,logarithmic and exponential functions,Derivative of composite functions, functions in parametric form, Implicit differentiation, Differentiation of the sum, difference, product and quotient of two functions, derivatives of order upto two,Rolle's and Lagrange's Mean Value Theorems,Applications of derivatives: Rate of change of quantities, monotonic – increasing and decreasing functions,Maxima and minima of functions of one variable,tangents and normals, Geometrical application of derivatives such as finding tangents and normals to plane curves.

Integral calculus: Standard methods of integration (substitution, by parts, by partial fraction, etc), Integration of rational, irrational functions and trigonometric functions. Definite integrals and properties of definite integrals, Fundamental Theorem of Calculus, Evaluation of definite integrals, determining areas of the regions bounded by simple curves in standard form.

Differential equations : Definition, order, degree of a differential equation, General and particular solution of a differential equation, Formation of a differential equation, Solution of a differential equations by method of separation of variables, Homogeneous differential equations of first order
and first degree, Linear differential equations of the form $dy/dx + p(x)y = q(x)$,

Probability and statistics:
Measures of Dispersion: Calculation of mean, median, mode of grouped and ungrouped data, calculation of standard deviation, variance and mean deviation for grouped and ungrouped data,

Probability: Probability of an event, addition and multiplication theorems of probability, Mutually exclusive events, Independent events, Compound events, Conditional probability, Addition theorem,Baye's theorem, random variables, probability distribution of a random variate(Binomial distribution only)

B. PHYSICS (+ 2 Level) - (40 Questions)

Measurements and Motion: Fundamental and derived physical quantities, Concept of Mass, Length and Time, Measurement of different quantities in SI Units. Practical units for measurement of microscopic and macroscopic lengths (AU, light year, parsec, nanometer, A^0) .Accuracy and precision of measuring instruments. Errors in measurement, Combination of errors, significant figures. Dimension of physical quantities, Dimension analysis of physical quantities- Conversion of physical quantities from one system of units to another. Concepts of vectors and scalars, Components of vectors, Unit vectors, Addition(triangles law, parallelogram law, polygons law), Subtraction and Multiplication (vector & scalar) of vectors. Lami's theorem. Frame of reference. Equations of linear motion for uniformly accelerated bodies (by calculus and graphical method). Newton's laws of motion, impulse momentum theorem Conservation of energy and momentum, laws of friction, sliding and rolling friction. Motion in a plane: projectile motion, Circular Motion- radial and tangential acceleration, Centripetal force, Banking of tracks, Work , energy, power: work done by constant and variable force, work energy theorem, potential energy of a spring, motion in a vertical circle, elastic and inelastic collision in one and two dimensions. Kepler's laws of Planetary Motion (Statements only). Newton's law of Gravitation. Gravitational field and potential, variation of g with altitude and depth. Earth satellites- Orbital and Escape velocities. Geo stationary satellites. Moment of inertia, radius of gyration, theorems of moment of inertia, Moment of Inertia for rod, ring and circular disc. Center of mass of two particle system and rigid body, motion of center of mass, moment of force, torque, angular momentum, laws of conservation of angular momentum and its applications.

Heat & Thermodynamics: Concept of heat and temperature, Scales of Temperature (Celsius, Fahrenheit, Kelvin), Definition of mechanical equivalent of heat (J), Thermal energy, Heat Capacity, Specific heat of solids and liquids, Latent heat, principle of calorimetry , thermal expansion of solids, liquids and gases. Heat transfer-Thermal conductivity of solids, Steady state, determination of thermal conductivity by Searles method. Kirchhoff's laws of heat radiation, Stefan's law of heat radiation, Wien's law, Newton's Law of cooling.

Kinetic Theory of gases- Pressure of an ideal gas, mean and RMS speed, Kinetic interpretation of temperature, Degrees of freedom, Law of equipartition of energy. Concept of mean free path.

Zeroth law of thermodynamics, first Law of thermodynamics, Specific heats of a gaseous system, Relation between Cp and Cv, Work done during Isothermal and Adiabatic processes, Carnot's conceptual heat engine and its efficiency ,co efficient of performance of refrigerator, Second law of thermodynamics, Absolute Scale of Temperature.

Characteristics of Materials: Elastic and Plastic behaviors of solids, Elastic limit, Hooke's law. Young's modulus, Shear and Bulk modulus, Poisson's ratio.

Liquids : Pressure due to liquid column, Pascal's law and its applications**.** Surface Tension and Surface Energy, Excess pressure across a spherical liquid surface, angle of contact and expression for capillary rise. Streamlined and turbulent flow, equation of continuity, Bernoulli's equation and its application, Viscosity- coefficient of viscosity and its variation with temperature and pressure., Stokes law and terminal speed

Electricity & Magnetism : Coulombs law and conservation of charge, electric flux, Gauss law and its applications**.** Electric field intensity and Potential at a point in an electric field, Relation between them, electric potential and field due to an electric dipole, torque and potential energy of a dipole in external electric field. Capacitance- dielectric constant and its effect on capacitance. Series and parallel grouping of capacitances, Energy stored in a charged capacitor, dielectrics and electric polarization .Electric current, drift velocity and mobility of charge carriers. Ohm's law, Variation of resistance of metallic conductors with temperature, Kirchhoff's laws and its application to a balanced Wheatstone bridge .Internal resistance of a cell , potential difference and emf of a cell. Combination of Cells and resistors- series and parallel. Heating effect of electric current and Joule's law, Electric power and electric energy.

Magnetic Permeability and Susceptibility of materials, Properties of dia, para and ferro magnetic materials. magnetic elements of Earth. Biot–Savart's and Amperes law- Magnetic Field due to a st conductor and circular coil.. Moving coil galvanometer (dead beat only). Force on a moving charge and current carrying conductor in a uniform magnetic field. Force between two parallel current carrying st conductors .Torque, experienced by a current loop, moving coil galvanometer and its conversion to ammeter and voltmeter. Faraday's laws of electromagnetic induction, Lenz's law, emf induced in a rotating coil in a magnetic field. Self and Mutual induction, Alternating current: Phase relation between Voltage and Current in pure resistive, pure capacitive, pure inductive and series LCR circuits. Power factors, wattles current. Principle of transformer, elementary idea on electromagnetic waves. electromagnetic spectrum, basic idea of displacement current.

Wave motion: Simple harmonic motion, oscillation of a loaded spring , simple pendulum , qualitative ideas about free, damped and forced oscillations. wave propagation, characteristics of wave motion, longitudinal and transverse waves, superposition of waves:- Stationary waves, Beats. Open and closed organ pipes, velocity of sound in air- effect of pressure, temperature and humidity on it. Doppler Effect, laws of transverse vibration of string (Statement only).

Optics: Reflection and refraction at curved surfaces. Spherical mirror and thin lens formula and refraction through prism. Total internal reflection, Dispersion, Huygens principle (statement only), Young's double slit experiment .Interference in light.

Optical instruments: simple magnifier, compound microscope and astronomical telescope.

Electronic Devices: Thermionic emission, Statement of Richardson's equation and Child's Law, Vacuum triode- construction and characteristics, relationship between valve constants, Descriptive idea of energy bands:- conductors, insulators and semi conductors, Intrinsic and extrinsic semiconductors, p-type and n-type semiconductors. PN junction, PNP and NPN transistor, PN Junction as a rectifier. Working of solar cells, photo diodes and LED .Elementary idea about OR, AND, NOT, NOR , NAND ,XOR, XNOR gates.

Atomic and Nuclear Physics: Bohrs atomic model, expression for radius, velocity , energy , frequency of an electron in nth orbit .Rydberg constant and Hydrogen spectra .Einstein photoelectric equation, dual nature of radiation and Debroglie wavelength. mass energy equivalence relation (Statement only).Atomic nucleus, nuclear forces, nuclear mass, binding energy, mass defect, artificial radio activity, radio isotopes and their uses. Nuclear fission, energy released during nuclear fission, chain reaction, controlled chain reaction, nuclear fusion, energy generation in the Sun, radiation hazards.

C.   CHEMISTRY (+ 2 Level) - (40 Questions)

General Behaviour of Matter:

Solid State: Characteristics, Classification, Solubility, Melting points, Crystal structure of simple ionic compounds. Radius ratio and coordination number: density calculation, lattice points and voids.
Liquid State: Characteristics, Boiling and Freezing points, Viscosity, Surface tension, Osmosis and Osmotic Pressure, Raoult's law, Lowering of vapour pressure, Depression of freezing points, Elevation of boiling points, Anomalous molecular masses; Association and dissociation.
Solutions: Types of solutions, concentration and different ways of expressing concentration (percentage, ppm, strength, normality, molarity, molality and formality); Interrelations
Gaseous State: Gas laws, Kinetic model of gases, ideal gas equation, Van der waals' equation, compressibility factor, Average, root mean square and most probable velocities.

Basic Concepts of Chemistry (Atoms and molecules): Symbols, Valency, Atomic mass, Molecular mass, Avogadro's law, Mole concept, Equivalent mass of acid base salt Oxidant and Reductant. Percentage composition, empirical and molecular formula, chemical reactions and calculations based on stoichiometry.

Structure of atoms and molecules: Fundamentals particles and their properties, Rutherford and Bohr's models of atom, Hydrogen spectrum, defects of Bohr's model, dual nature of matter de-Broglie theory of matter wave, Heisenberg's uncertainty principle. Energy levels, Shells and Sub-shells, s,p and d orbitals, Quantum numbers, Pauli's exclusion principle, Aufbau-principle, Hund's rule, Electronic configuration of atoms, Extra stability of half filled and filled subshells.
Chemical bonds: Ionic, Covalent, Coordinate and Hydrogen bond, Hybridisation- sp, sp^2, sp^3, dsp^2, dsp^3, d^2sp^3 shapes of molecules, VSEPR theory, Molecular Orbital Theory of simple diatomic molecules.
Periodic classification: Periodic table and periodic laws, s, p, d and f block elements, Periodicity in properties such as atomic and ionic radii, ionization enthalpy, electron gain enthalpy, electronegativity and oxidation states.

Chemical energetics, equilibrium and kinetics:
Energetics: Internal energy, Enthalpy, Heats of reactions, Bond energy, Hess's law, Idea on enthalpy, entropy and free energy, spontaneity and conditions of equilibrium.

Equilibria : Reversible reaction, Law of mass action, Equilibrium constant Kp, Kc, Kx and their relation. Relationship between Equilibrium constant, reaction quotient and Gibbs energy. application of Equilibrium constant to ammonia synthesis and dissociation of HI, Decomposition and thermal dissociation. Theory of acids and bases, Dissociation of weak acids and bases, Ostwald's dilution law, Ionic product of water, Common ion effect, Solubility product and their applications, pH, Hydrolysis of salts, Buffer solutions.

Kinetics : Rate of chemical reaction, Factors affecting the rate, Rate constant, Order and Molecularity of a reaction, Simple zero and First order reaction, Half life period, Arrehnius equation and Activation Energy, Collision theory (qualitative idea only)

[Types of chemical reaction : Neutralisation and oxidation– Reduction reaction, Equivalent mass, Oxidation number, Balancing chemical reactions, by Ion electron method, Reactions involving $KMnO_4$, $K_2Cr_2O_7$, $Na_2S_2O_3$, oxalate etc.]

Non-metals: Group study, Preparation, Properties and uses of compounds of the elements. hydrogen (ortho and para hydrogen, isotopes of hydrogen, D_2O and H_2O_2). Dihydrogen as fuel. Allotropes of carbon. Nitrogen family (NH_3 and HNO_3). Oxygen, ozone and sulphur. Oxygen family (O_2, O_3, H_2S, SO_2, H_2SO_4 and its manufacturer by contact process). Halogens, Hydrogen halides and Interhalogen compounds. Zero group elements: Electronic configuration occurrence, physical and chemical properties and uses.

Electrochemistry: Electrolysis, Electrical Conductivity (Specific, Equivalent and molar), Faraday's laws, Kohlrausch law, Galvanic cell, Cell reaction, Nernst equation, Standard electrode potential, Electro chemical series, e.m.f. of simple cells. Fuel cells.

Surface Chemistry: Colloids: Preparation, purification, properties and uses. Emulsion, Adsorption: Types and applications.

Metals and metallurgy: Occurrence of metal, Minerals and ores, flux, slag, calcination, roasting, smelting (by reduction of oxides) and refining. General trends in the characteristics. Principles of extraction of Na, Mg, Ca, Al, Cu and Fe and their oxides, hydroxides, chlorides, nitrates and sulfates.

Organic chemistry:

Introductory: Functional Groups and organic radicals, Nomenclature by IUPAC system (substitutive method) , Isomerism (Structural and stereoisomenism – optical and geometrical) EZ & RS nomenclature, Electron mobility – Inductive effect, Resonance, Electromeric effect and Hyperconjugation; their applications. Types of organic reactions – addition, substitution, elimination reactions. Idea of electrophiles and nuclephiles; Reaction intermediates – idea of carbocations, carbanion & free radicals; their stabilities.

Aliphatic compounds: Methods of preparation and properties of alkanes, alkenes, alkynes (acidity of terminal alkynes), haloalkanes, alcohols, ether, aldehydes, ketones, carboxylic acids, acid derivatives (acid chlorides, esters and amides), nitroalkanes and amines.

Aromatic compounds: Aromaticity (Huckel's rule), Aromatic hydrocarbon (Preparation and reactions – Substitution, addition, ozonolysis) Directive influence of functional group. Phenols (Preparation and reactions) : Aldehydes (Preparations and reactions); Acids (Preparation and reactions). Amines (Preparation and reactions); Diazonium salts (synthetic application).

Biochemistry: Biological importance of organic compounds such as carbohydrates, amino acids, proteins, Vitamins and nucleic acids (only by metabolic process).

Chemistry in the service of mankind: Polymers (nylon, terylene, neoprene, buna-S, PVC, Teflon &bakelite). Biodegradable Polymer Medicine-analgesic, antipyretic, antibiotic, antacid and antiseptic (structure and preparation not required).

Environmental chemistry: Source, effect and control measures of air and water pollution.