

23. SYLLABI : NEE-II (PCM) Engineering & Technology /

NEE-II (PCB) Forestry

(Syllabi for Class –XII PCM and PCB applicants seeking admission in B.Tech Courses (AE/CE/CSE/ECE/EE/ME) and B.Sc.(Hons) in Forestry, respectively).

Full Marks : 150

Time: 3 Hours

SECTIONS :

Section-A	Physics	45 marks. (Common for Class -XII PCM as well as PCB Candidates)
Section-B	Chemistry	45 marks. (Common for Class -XII PCM as well as PCB Candidates)
Section-C	Mathematics	60 marks. (for Class -XIIPCM Candidates)
Section-C	Biology	60 marks. (for Class -XIIPCB Candidates)

Section-A PHYSICS

45 marks

Physical World and Measurement: Physics scope and excitement, physics, technology and society, Forces in nature, Conservation laws, Examples of Gravitational, electromagnetic and Nuclear forces from daily-life experiences (qualitative only). Need for measurement, Units of measurement, systems of units, SI units, Fundamental and derived units, length, mass and time measurement, Accuracy and precision of measuring instruments. Errors in measurement, significant figures. Dimensions of Physical quantities. Dimensional analysis and application. Elementary concept of differentiation and integration for describing motion.

Kinematics: Uniform motion in a straight line, Position time graph, speed and velocity, Uniform and non-uniform motion, average speed and instantaneous velocity . Uniformly accelerated motion, velocity time graph, relations for uniformly accelerated motion (Graphical method). Scalar and vector quantities, position and displacement vectors, Equality of vectors, multiplications of vectors by real number, Addition and subtraction of vectors, Unit vector, Resolution of a vector in a plane. Rectangular components, Scalar and Vector products of two vectors, vectors in 3 dimensions (elementary idea only) Motion in a plane, Uniform velocity and uniform acceleration, projectile motion, uniform circular motion.

Laws of Motion: Force and inertia, Newton's first law of motion, Momentum, Newton's second law of motion, Impulse , Newton's third law of motion, conservation law of linear momentum and its application, Equilibrium of concurrent forces, Friction, static and dynamic friction, laws of friction, rolling and sliding friction, lubrication. Dynamics of uniform circular motion, centripetal force, Vehicle on a level road, Vehicle on a banked road. Inertial and non-inertial frames (Idea only).

Work, Energy and Power: Work done by a constant force and variable force, kinetic energy, Potential energy, work-energy theorem, power. Potential energy of a spring, conservative and non-conservative forces, conservation of mechanical energy (kinetic and potential energies), collisions, Elastic and inelastic collision in 1 dimension and 2 dimensions. Different forms of Energies in nature, Mass-Energy equivalence (Qualitative Idea).

Motion of system of particles and Rigid Body: Centre of mass of two particle system, generalization to N-particles, momentum conservation and center of mass motion, Application to familiar systems, Centre of mass of a rigid body.

Gravitation : The universal law of Gravitation, Gravitational constant, Acceleration due to gravity and its variation with altitude, latitude, depth and rotation of earth, Mass of the earth, Gravitational potential energy near the surface of earth, gravitational potential, Escape Velocity. Orbital Velocity of a Satellite. Weightlessness, Motion of Satellites, geostationary and polar satellites, Kepler's laws of planetary motion. Proof of second and third law, (for circular orbit) Inertial and gravitational mass. Moment of force, torque, angular momentum, Physical meaning of angular momentum, conservation of angular momentum with some examples (Planetary motion). Equilibrium of rigid bodies, rigid body rotation and equation of rotational motion. Moment of Inertia & its physical significance, radius of gyration, parallel and perpendicular axis theorem (statement only) M.I. of circular ring, disc, cylinder and thin straight rod.

Rolling of a cylinder without slipping. Examples of binary system in nature (Binary Stars, Earth-moon system, diatomic molecules).

Mechanics of Solids and Fluids: States of matter, inter atomic and inter molecular forces.

a) **Solids :** Elastic behavior, stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, modulus of rigidity & some practical examples.

b) **Fluids:** Pressure due to fluid column, Pascal's law and its application (hydraulic lift and brakes) Effect of gravity on fluid pressure . Buoyancy, flotation, and Archimedes principle, Viscosity, Stoke's law, terminal velocity, stream line flow, trubulent flow. Reynold's number. Bernoulli's theorem and its applications.

c) Surface energy and surface tension, angle of contact, application of surface tension, excess pressure inside a liquid drop and bubble, capillary rise and action of detergent.

Heat and Thermodynamics: Kinetic theory of gases-assumptions, concept of pressure, kinetic energy and temperature, r.m.s. speed, degree of freedom, law of equipartition of energy (statement only), mean free path and Avogadro's number.

Thermal equilibrium and temperature (Zeroth law of thermodynamics) Heat, work and internal energy, thermal expansion-thermometry. First law of thermodynamics, specific heat, specific heat of gas at constant volume and pressure (mono atomic, diatomic gases). Specific heat of solids (Dulong and Petits' law).

Thermodynamic variables and equation of state, phase diagram; ideal gas equation, isothermal and adiabatic processes, reversible and irreversible processes carnot's engine and refrigerator or heat pump. Efficiency and co-efficient of performance, second law of thermodynamics (statement only); and some practical applications.

Transfer of heat-Conduction, convection and radiation. Thermal conductivity of solids, Black body radiation, Kirchhoff's laws, Wein's displacement law, Stefan's law (statement only) Newton's law of cooling, solar constant and determination of surface temperature of sun using Stefan's law.

Oscillations: Periodic motion- period, frequency, displacement as a function of time and periodic functions. Simple Harmonic Motion (SHM) and its equation, Expression for velocity and acceleration of SHM. Oscillations of a spring, restoring force and force constant, Energy in SHM-Kinetic and potential energies, Simple pendulum- derivation of its time period, Free, forced and damped oscillations (qualitative idea only), resonance, coupled oscillations.

Waves: Longitudinal and transverse wave, wave motion, Displacement relation for progressive wave. Principle of superposition of waves, Reflection of waves, Standing waves in strings and pipes, fundamental and higher harmonics, Beats, Doppler's effect, speed of sound in media.

Electrostatics: Frictional electricity, charges and their conservation, coulomb's law, Forces between two point electric charges. Forces between multiple electric charges; Superposition principle and continuous charge distribution. Electric fields and its physical significance, electric field due to a point charge, electric field lines, electric field due to a dipole and behavior of a dipole in a uniform electric field. Electric potential-physical meaning, potential difference, electric potential due to a point charge, a dipole and system of charges; Equipotential surfaces, Electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field. Electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell. Conductors and insulators, presence of free charges and bound charges inside a conductor, Dielectrics and electric polarization, general concept of a capacitor and capacitance : Combination of capacitors in series and parallel, energy stored in a capacitor, capacitance of a parallel plate capacitor with and without dielectric medium between the plates; Van de Graff generator.

Current Electricity: Electric current, flow of electric charge in a metallic conductor, drift velocity and mobility and their relation with electric current, ohm's law, electrical resistance, V-I characteristics, Exception, of ohm's law (Non-linear V-I characteristics), Electrical resistivity and conductivity, classification of materials in terms of conductivity; Superconductivity (elementary idea); Carbon resistors, colour code for carbon resistors, combination of resistances- series and parallel.

Temperature dependence of resistance, Internal resistance of a cell, Potential difference and e.m.f. of a cell, combinations of cells in series and in parallel. Kirchhoff's laws - illustration by simple application. Wheatstone bridge and its Applications for temperature Measurements. Metre bridge-special case of whetstone's bridge. Potentiometer- principle and application to measure potential difference, and for comparing e.m.f. of two cells.

Electric power, thermal effects of current and Joule's law, Chemical Effects of Current: Faraday's laws of electrolysis; Electrochemical Cells- Primary (Voltaic Leclanche, Dry Daniel,) and secondary-rechargeable cells (lead accumulators, alkali accumulators) solid state cells. Thermoelectricity- origin, elementary idea of Seebeck effect; Thermocouple. Thermo e.m.f. neutral and inversion temperatures. Measurement of temperature using a thermocouple.

Magnetic effects of current & magnetism: Concept of magnetic field, Oersted's experiment, Biot-Savart law, magnetic field due to an infinitely long current carrying straight wire and a circular loop: Ampere's circuital law and its application to straight and toroidal solenoids; Force on a moving charge in uniform magnetic and electric fields, cyclotron; Force on a current carrying conductor in a uniform magnetic field, Forces between two parallel current-carrying conductors, definition of ampere. Torque experienced by a current loop in a uniform magnetic field, moving coil galvanometer-its current sensitivity and conversion to ammeter and voltmeter. Current loop as a magnetic dipole and its magnetic dipole moment, magnetic dipole moment of a revolving electron, Magnetic field intensity due to magnetic dipole (bar magnet) along the axis and perpendicular to the axis; Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; Bar magnet as an equivalent solenoid, Magnetic field lines. Earth's magnetic fields and magnetic elements: Para, dia and ferromagnetic substances with examples. Electromagnets and permanent magnets.

Electromagnetic Induction & Alternating currents: Electromagnetic Induction, Faraday's Laws, Induced e.m.f. and current, Lenz's law, Eddy currents, Self and mutual inductance. Alternating currents peak and r.m.s. values of Alternating current/voltage, reactance and impedance; LC oscillations, LCR series circuit (Phasor diagram) Resonant circuits and Q-factor, Power in AC circuits, Wattless current. AC generator and transformer.

Electromagnetic Waves: Electromagnetic waves and their characteristics (qualitative idea only); Transverse nature of electromagnetic waves.

Electromagnetic spectrum (Radio-microwaves, infrared, optical, Ultraviolet, gamma rays) including elementary facts about their uses, Propagation of electromagnetic waves in atmosphere.

Optics : Refraction of light, total internal reflection and its application, spherical lenses, thin lens formula, lens maker's formula; Magnification, Power of a lens, combination of these lenses in contact; Refraction and dispersion of light due to a prism, Scattering of light. Blue colour of the sky and reddish appearance of the sun at sun-rise and sun set.

Optical Instruments – Compound Microscope, astronomical telescope (refraction and reflection type) and their magnifying powers.

Wave front and Huygens's principle; Reflection and refraction of plane wave at a plane surface using wave fronts (qualitative idea); Interference- Young's double slit experiment and expression for fringe width, Coherent sources and sustained interference of light; Diffraction due to a single slit, width of central maximum, difference between interference and diffraction.

Resolving power of microscope and telescope, Polarization-plane polarized light, Brewster's Law, Use of plane polarized light and Polaroid.

Dual Nature of Matter and Radiation: Photo-Electric effect, Einstein's Photo-electric equation, Particle nature of light, Photo Cell, Matter waves, Wave nature of particles, De-Broglie relation, de Broglie wave length of an electron. Davisson-Germer Experiment.

Atomic Nucleus: Alpha-particle scattering experiment, size of the nucleus, composition of the nucleus, protons and neutrons, Nuclear instability- Radioactivity-Alpha, Beta and Gamma particles/rays and their properties, radioactive decay law, simple explanation of decay, beta-decay and gamma-decay. Mass-energy relation, mass defect, binding energy per nucleon, its variation with mass number. Nature of nuclear forces, nuclear reaction, Nuclear fission and Nuclear fusion.

Solid and Semi-conductor Devices: Energy bands in solids (qualitative idea only), difference between metals, insulators and semiconductors using band theory; intrinsic and extrinsic semi-conductors, p-n junction, semi-conductor diode-characteristics in forward and reverse bias, diode as a rectifier, solar cell, photodiode. LED, Zener diode as a voltage regulator, Junction transistor, transistor action, characteristics of a transistor. Transistor as an amplifier (common emitter configuration) and oscillator. Logic gates (OR, AND, NOT, NAND and NOR); Elementary ideas about IC.

SECTION-B CHEMISTRY

45 marks

Some Basic concepts of chemistry: Nature of matter, properties of matter and their measurements, Law of Chemical combination, Dalton's Atomic Theory, Atomic and molecular masses, Mole concept, Stoichiometry and stoichiometric calculations.

Structure of Atoms and Chemical Bonding: Constituent of the atom, electronic structure of atom, understanding electron behavior, Bohr's model of hydrogen and hydrogen like atoms, spectrum of hydrogen, Dual behavior of matter, de Broglie equation, Heisenberg's uncertainty principle; Quantum numbers, shapes of orbital, Aufbau principle, Pauli's exclusion principle, Hund's rule of maximum multiplicity; Electronic configuration of elements up to atomic numbers 30. Chemical bonding: Lewis structure, Hybridization and VSEPR theory with reference to BeCl_2 , BF_3 , CH_4 , CCl_4 , NH_3 , H_2O , NH_4^+ , H_3O^+ , PCl_5 , SF_6 , C_2H_4 and C_2H_2 . Molecular orbital theory with reference to simple homodiatomic molecules up to atomic number 10. Hydrogen bond. Dipole moment in simple molecules.

States of Matter: The gaseous state: Kinetic molecular theory of ideal gases. Laws governing the ideal behavior of gases, deviation from the ideal behavior; van der Waals equation of state for real gases. Concept of critical constants, Liquefaction of gases.

Solid State: Structure of simple ionic compounds, Close-packed structure, ionic radii; Silicates, Imperfections in solids, properties of crystalline solids and amorphous solids.

Solutions: Types of solution, Vapor pressure of solution and Raoult's law, Ideal and non-ideal solutions. Colligative properties, Abnormal molecular masses.

Chemical Thermodynamics: Some basic concepts; Energy changes during a chemical reaction, Internal energy and Enthalpy. Enthalpy of reaction, First law of thermodynamics, Concept of Entropy and Free energy, Spontaneity of a process, Second and Third law of thermodynamics.

Chemical Equilibrium: Equilibria involving physical changes and chemical systems, Law of Mass action and its application to equilibrium. Le-Chatelier's principle and its applications. Ionic Equilibria; Ostwald's dilution law; Arrhenius, Bronsted-Lowry and Lewis concept of acids and bases. pH scale, Buffer solutions and Solubility product.

Chemical Kinetics: Rate of reaction, Instantaneous rate of a reaction, Molecularity and order of a reaction, Factors affecting the rate of a reaction, Elementary and complex reactions, Determination of the order of a reaction, Dependence of reaction rate on temperature and catalyst, Photochemical reactions, Mechanism of a reaction.

Surface Chemistry: Adsorption, Colloidal solutions, Emulsions. Homogeneous and heterogeneous catalysis.

Redox Reactions: Oxidation and reduction as an electron transfer process, Oxidation number, balancing of redox equations.

Electrochemistry: Electrolytic conductance, Equivalent and molar conductivities, Galvanic cell, Electrode potential and EMF of a Galvanic cell, Dependence of EMF on concentration and temperature Electrochemical cell and free energy, Electrolysis, Quantitative aspect of electrolysis, Faraday's Laws, and Criteria for product formation; Some commercial batteries, Corrosion.

s-Block Elements: General trends, characteristics of compounds of Alkali and Alkaline earth metals. Anomalous behaviour of Lithium and Beryllium. Some important compounds of Sodium and Calcium. Chemistry of Hydrogen, Water and Hydrogen peroxide.

p-Block Elements: General trends. Anomalous behaviour of Boron and Carbon. Allotropy: Different allotropes of Carbon, Sulphur, Phosphorus, and Tin. Chemistry of some important compounds of Boron, Carbon, Silicon, Nitrogen, Phosphorus, Oxygen, Sulphur, and Halogens. Characteristics of Group-18 elements, and Chemistry of Xenon. Metallurgy of Aluminium.

d- & f-Block Elements: General trends, Characteristic properties of transition and inner transition elements. General properties of first row transition metal compounds. Metallurgy of Iron and Copper. Manufacture of steel, Chemistry of some heavy metals like Silver, Gold, Zinc, Mercury, and Compounds such as Potassium permanganate and Potassium dichromate.

Co-ordination and Organo-metallic Compounds: Co-ordination compounds, Isomerism and bonding in co-ordination compounds; Stability of co-ordination compounds in solution; Importance of co-ordination compounds. Organo-metallic compounds.

Organic Chemistry: Classification and nomenclature of organic compounds, Isomerism and stereochemistry. Fundamental concepts in organic reaction mechanism, Methods of purification; Qualitative and quantitative analysis of organic compounds; Modern methods of structure elucidation.

Hydrocarbons: Preparation and properties of alkanes, alkenes and alkynes; Aromatic hydrocarbons, aromaticity. Preparation, properties and structure of Benzene.

Organic compounds with functional group: General methods of preparation, physical and chemical properties and important uses of haloalkanes, haloarenes, polyhalogen compounds, alcohols, phenols, ethers, aldehydes, ketones, carboxylic acids and derivatives of carboxylic acids, cyanides, isocyanides, amines, nitro and azo compounds.

Polymers: Nomenclature and classification of polymers, Types of polymerization, Molecular mass of polymers; Some commercially important polymers.

Bio-molecules: Structure and function of carbohydrates, proteins, nucleic acids, lipids and vitamins.

Nuclear Chemistry: Discovery of radioactivity and nature of radiation from radio active substances; Chemical equations for nuclear changes, Radioactive series, Rate of radioactive decay, Artificial transmutation radioactivity, Synthetic elements, Nuclear fission, Nuclear fusion. Applications of radioactivity and radio-isotopes.

Chemistry in Everyday life: Dyes, Chemicals in medicines, Chemistry of rocket propellants, Chemicals in food, Soaps and Detergents.

SECTION-C MATHEMATICS (for PCM Candidates)

60 marks

Algebra:

Sets: Sets and their representations, finite and infinite sets, subsets, empty or null set, universal set, equal sets, power set and complement of a set, union and intersection of sets and their algebraic properties, difference of sets, Venn diagrams, application of sets.

Relations and functions: ordered pairs, Cartesian product of sets, relations, domain, co-domain and range, into and onto functions, one one into and one one onto functions, constant function, identity function, composition of functions, invertible functions, Binary operations.

Complex Numbers: Complex number in the form $(a+ib)$, representation of complex numbers by points in plane, Argand diagram, algebra of complex numbers, real and imaginary parts of a complex number, triangle inequality, modulus and argument (or amplitude) of a complex number, conjugate, square root of a complex number, cube root of unity, polar representation of a complex number.

Theory of quadratic equation: Solution of a quadratic equation in the complex number system by (i) factorization (ii) using formula, relation between roots & coefficients, the nature of roots, formation of quadratic equations with given roots, Symmetric functions of roots, Equations reducible to quadratic forms.

Sequences and series: Sequence and examples of finite and infinite sequences, Arithmetic progression (A.P.)- first term, common difference and nth term, sum to n terms of an A.P., Arithmetic mean (A.M.), insertion of A.M. between any two given numbers, Geometric progression (G.P.)-first term, common ratio and nth term, Sum to n terms and infinite number of terms of a G.P., recurring decimal numbers as G.P., Geometric Mean (G.M.) insertion of G.M. between any two given numbers, Harmonic progression, Harmonic mean(H.M),relationship among A.M., G.M. and H.M, arithmetico-geometric series, special cases of $\sum n$, $\sum n^2$, $\sum n^3$, exponential series concept of e as the sum of an infinite series, proof of $2 < e < 3$, exponential function (e^x) as the infinite series, logarithmic series- infinite series for $\log_e(1+x)$, $\log_e(1-x)$ and related problems.

Permutations and combinations: Fundamental principle of counting, the factorial notation, Permutation as an arrangement, meaning of $P(n,r)$, combination, meaning of $C(n,r)$, application of permutations & combinations.

Mathematical Induction: The principle of mathematical Induction, simple applications.

Binomial theorems: Statement of binomial theorem, proof of the binomial theorem for positive integral exponent using the principle of mathematical induction, general and middle terms in binomial expansions,

Binomial theorem for any index (without proof), application of binomial theorem for approximation and properties of binomial coefficients.

Mathematical logic: Mathematical Logic statement, Venn diagrams, negation, basic logical connectives and compound statement including the negations, truth tables, duality algebra of statements and applications of logic in solving simple problems. Matrices and determinants: Types of matrices, Equality of matrices, operations of addition, scalar multiplication and multiplication of matrices, statements of important results on operations of matrices and their verification by numerical problems only, linear equations in matrix notation, determinants, determinant of a square matrix, properties of determinants, minors & cofactors of determinants, applications of determinants in (i) finding area of a triangle (ii) Solving a system of linear equations, Cramer's rule, transpose, adjoint and inverse of a matrix, consistency and inconsistency of system of linear equations, application of matrices in solving simultaneous linear equations in two or three variables.

Boolean Algebra: Boolean algebra as an algebraic structure, principle of duality, Boolean function, conditional and biconditional statements, valid arguments, switching circuits, application of Boolean algebra to switching circuits.

Trigonometry:

Trigonometric functions of sum and difference of numbers, Trigonometric functions of multiples and submultiples of numbers, conditional identities for the angles of a triangle, Solution of trigonometric equations, solution of triangles, concept of inverse trigonometric functions and their use to reduce expression to simplest form.

Vectors: Vectors & scalars, Magnitude and direction of a vector, types of vectors, position vector of a point dividing a line segment in a given ratio, components of a vector, addition of vectors, multiplication of a vector by a scalar, scalar (dot) product of vectors, projection of a vector on a line, Vector (cross) product of two vectors, application of dot & cross products in (i) finding area of a triangle and a parallelogram (ii) problems of plane geometry and trigonometry (iii) finding work done by a force (iv) vector moment of a vector about a point, scalar triple product and its applications, Moment of a vector about a line, coplanarity of three vectors or four points using scalar triple product, vector triple product.

Coordinate Geometry: Two Dimension: (i) Area of a triangle, condition for the collinearity of three points, centroid and in-centre of a triangle, locus and its equation.

The straight line and pair of straightlines – Various forms of equations of a line, intersection of lines, angles between two lines, condition for concurrency of three lines, distance of a point from a line, coordinates of orthocentre and Circumcentre of a triangle, equation of family of lines passing through the point of intersection of two lines, homogeneous equation of second degree in x & y , angle between pair of lines through the origin, combined equation of the bisectors of the angles between a pair of lines, condition for the general second degree equation to represent a pair of lines, point of intersection and angle between two lines represented by $S=0$ and the factors of S .

Circles: Standard form of the equation of a circle, general form of the equation of a circle, its radius and center, equation of a circle in the parametric form, equation of a circle when the end points of a diameter are given, points of intersection of a line and a circle in the center at the origin and condition of a line to be tangent to the circle, length of tangent, equation of the tangent, equation of a family of circles through the intersection of two circles, condition for two intersecting circles to be orthogonal.

Conic sections- Sections of cones, equations of conic sections (parabola, ellipse, hyperbola) in standard forms, conditions for $y=mx+c$ to be a tangent and points of tangency.

Geometry of Three Dimension (3D): Coordinate axes, planes in three dimensional space, coordinates of a point in space, distance between two points, section formula, d.c.'s. and d.r.'s. of a line joining two points, projection of the join of two points on a given line, angle between two lines whose d.r.'s. are given, Cartesian and vector equation of a line through (i) a point and parallel to a given vector (ii) through two points, coplanarity of three points, coplanar & skew line, shortest distance between two lines, condition for the intersection of two lines, Cartesian & vector equation of a plane (i) when the normal vector and the distance of the plane from the origin is given (ii) passing through a point and perpendicular to given vector (iii) passing through a point and parallel to two given lines through the intersection of two other planes (iv) Containing two lines (v) Passing through three points, Angle between two lines (ii) two planes (iii) a line and a plane. Condition of coplanarity of two lines in vector and Cartesian form, Length of perpendicular of a point from a plane by both vector and Cartesian methods, vector and Cartesian equation of a sphere, its center and radius, diameter form of the equation of a sphere.

Calculus: Function, Limits and Continuity: Concept of real function, its domain and range, types of functions, limit of a function, meaning and related notations, left and right hand limits, fundamental theorems on limits, limit at infinity and infinite limits, continuity of a function (i) at a point (ii) over an open/closed intervals, Sum, product and quotient of continuous functions, continuity of special functions-polynomial, trigonometric, exponential, logarithmic, inverse trigonometric functions.

Differentiation: Derivative of a function, its geometrical and physical significance, Relationship between continuity and differentiability, derivative of some simple functions from first principle, derivative of sum, difference, product and quotient of functions, derivative of polynomial, trigonometric, exponential, logarithmic, inverse trigonometric and implicit functions, derivative of functions expressed in parametric form, chain rule and differentiation by substitution, Derivatives of second order.

Application of Derivatives: Rate of change of quantities, tangents and normals, increasing and decreasing functions and sign of the derivatives, maxima & minima, greatest and least values, Rolle's theorem and mean value theorem (without proof), curve sketching of simple curves.

Indefinite integrals: Integration as inverse of differentiation, properties of integrals, integration by substitution, by parts, partial fractions and their use in integration, integration of rational and irrational functions, integration of trigonometric functions of the type

$$\int \frac{dx}{a + b \cos x}, \int \frac{dx}{a + b \sin x} \text{ and } \int \sin^m x \cos^n x dx.$$

Definite Integrals: Definite integral as limit of a sum, fundamental theorems of integral calculus (without proof), evaluation of definite integrals by (i) substitution (ii) using properties of definite integrals, application of definite integrals in finding the areas bounded by a curve, circle, parabola and ellipse in standard form between two ordinates and x-axis, area between two curves (line and circle, line & parabola, line & ellipse).

Differential Equations: Definition, order and degree, general and particular solution, formation of a differential equation whose general solution is given, solution of differential equation by the method of separation of variables, homogeneous differential equations, linear differential equation of the type $\frac{dy}{dx} + py = Q(x)$ whose $p(x)$ & $Q(x)$ are functions of x , Solution of second order differential equations.

Statics and Dynamics: Elementary Statics- Introduction, basic concepts, laws of mechanics, force, resultant of forces acting at point, parallelogram Law of forces, resolved parts of a force, equilibrium of a particle under three concurrent forces, triangle law of forces and its converse, Lami's theorem and its converse, two parallel forces, Like and unlike parallel forces, couple and its moment.

Elementary Dynamics: Basic concept. like displacement, speed, velocity, average speed, instantaneous speed, acceleration and retardation, resultant of two velocities, Motion of a particle along a line when moving with constant acceleration, motion of a particle under gravity, projectile motion, the path of a projectile, its horizontal range, velocity at any instant, greatest height and time of flight.

Probability: Random experiment and associated sample space events as subsets of sample space, occurrence of an event, impossible events, sure events, combination of events through the operations "and", "or", "not" and their set representation, meaning of equally likely outcomes, definition of probability of an event as the ratio of the number of favorable equally likely outcomes to the total number of outcomes, equally likely events, addition rule for mutually exclusive events, Conditional probability, independent-events, independent experiments, Calculation of probability of events associated with the independent experiments $P(A \text{ or } B)$, $P(A \text{ and } B)$, Baye's theorem and its application, recall of concept of random variables and its probability distribution, mean and variance of random variables, Binomial and Poisson's distributions, their mean, variance and application of these distributions in commerce and industry.

SECTION-C BIOLOGY (For PCB Candidates)

60 Marks

Origin and Evolution of life: Theories and evidences of origin of life, Concept of species, speciation and isolation; Homeostasis; Scope of biology; Classification-artificial, natural and phylogenetic; Binomial nomenclature; Status of bacteria and virus.

Cell biology : Ultra structure of cell; cell organelles and their function; Cell division; Karyotype analysis; Chromosomal basis and other patterns of inheritance; Linkages and crossing over; Mutation and chromosomal aberrations; Gene mapping; Human genetics; Structure of RNA and its role in protein synthesis; Gene expression and its regulation; Nuclear basis of differentiation and development; Oncogenes; DNA as a genetic material; Recombinant DNA technology; Gene bank; DNA fingerprinting; Genomics-principles and applications; Transgenic plants, animals and microbes.

Physiology of plants and animals: Plant water relations; Transpiration; Photosynthesis; Respiration, glycolysis, Krebs's cycle, compensation point, Respiratory Quotient; Food and Vitamins; Inter- and intra-cellular digestion; Role of hormones and enzymes in digestion; malnutrition; Respiration and circulation in animals; Blood, its composition and related disorder; Osmoregulation and excretion.

Reproduction and growth in plants and animals: Vegetative, micropropagation and sexual reproduction; Flowering-Photoperiodism, Vernalization; Pollination; Double fertilization; Parthenogenesis and Parthenocarpy; Reproduction in animal-embryonic development, growth, repair, aging and death; Movement and locomotion in plants and animals; Nervous coordination in animal; Phytochromes; seed germination; Role of growth regulators in seed dormancy.

Ecology and Environment: Organism and the environment; Population, community, ecosystem and biosphere; Major biomes; Ecological succession; Productivity; Energy flow in ecosystem; Nutrient cycling; Natural resources and its conservation; Biodiversity; Environmental pollution; Global environmental changes; Environmental ethics and legislation.

Morphology of plants and animals: Morphology and modification of root, stem and leaf; Inflorescence, flower, fruit, seed structure and types; Description of family poaceae, liliaceae, fabaceae, solanaceae and asteraceae; Meristematic and permanent tissues; Anatomy of root, stem and leaf; Secondary growth; Animal tissues-structure and function of epithelial, connective, muscular and nervous tissues; Salient features of earthworm, cockroach and rat.

Application of biology: Human population growth and factors; Common problem of drug, Alcohol and tobacco; Mental and addictive disorder; Common human diseases; Technology for medical application; Plant tissue culture and its application; Bioenergy; Biopesticide; Biopiracy; Bioethics; Domestication and improvement of plants and animals; Biomedical technologies such as radiography, angiography, sonography, ECG, EEG, ELISA test; Types, detection and diagnosis of cancer.

24. SYLLABI : NEE-II (PCM) Science

(Syllabi for Class –XII PCM applicants seeking admission in 4 years B.Sc. in Physics/Chemistry/Mathematics.

Full Marks : 150

Time: 3 Hours

SECTIONS :

Section-A	Physics	50 marks.
Section-B	Chemistry	50 marks.
Section-C	Mathematics	50 marks.

Section-A PHYSICS

50 marks

Physical World and Measurement: Physics scope and excitement, physics, technology and society, Forces in nature, Conservation laws, Examples of Gravitational, electromagnetic and Nuclear forces from daily-life experiences (qualitative only). Need for measurement, Units of measurement, systems of units, SI units, Fundamental and derived units, length, mass and time measurement, Accuracy and precision of measuring instruments. Errors in measurement, significant figures. Dimensions of Physical quantities. Dimensional analysis and application. Elementary concept of differentiation and integration for describing motion.

Kinematics: Uniform motion in a straight line, Position time graph, speed and velocity, Uniform and non-uniform motion, average speed and instantaneous velocity . Uniformly accelerated motion, velocity time graph, relations for uniformly accelerated motion (Graphical method). Scalar and vector quantities, position and displacement vectors, Equality of vectors, multiplications of vectors by real number, Addition and subtraction of vectors, Unit vector, Resolution of a vector in a plane. Rectangular components, Scalar and Vector products of two vectors, vectors in 3 dimensions (elementary idea only) Motion in a plane, Uniform velocity and uniform acceleration, projectile motion, uniform circular motion.

Laws of Motion: Force and inertia, Newton's first law of motion, Momentum, Newton's second law of motion, Impulse , Newton's third law of motion, conservation law of linear momentum and its application, Equilibrium of concurrent forces, Friction, static and dynamic friction, laws of friction, rolling and sliding friction, lubrication. Dynamics of uniform circular motion, centripetal force, Vehicle on a level road, Vehicle on a banked road. Inertial and non-inertial frames (Idea only).

Work, Energy and Power: Work done by a constant force and variable force, kinetic energy, Potential energy, work-energy theorem, power. Potential energy of a spring, conservative and non-conservative forces, conservation of mechanical energy (kinetic and potential energies), collisions, Elastic and inelastic collision in 1 dimension and 2 dimensions. Different forms of Energies in nature, Mass-Energy equivalence (Qualitative Idea).

Motion of system of particles and Rigid Body: Centre of mass of two particle system, generalization to N-particles, momentum conservation and center of mass motion, Application to familiar systems, Centre of mass of a rigid body.

Gravitation : The universal law of Gravitation, Gravitational constant, Acceleration due to gravity and its variation with altitude, latitude, depth and rotation of earth, Mass of the earth, Gravitational potential energy near the surface of earth, gravitational potential, Escape Velocity. Orbital Velocity of a Satellite. Weightlessness, Motion of Satellites, geostationary and polar satellites, Kepler's laws of planetary motion. Proof of second and third law, (for circular orbit) Inertial and gravitational mass. Moment of force, torque, angular momentum, Physical meaning of angular momentum, conservation of angular momentum with some examples (Planetary motion). Equilibrium of rigid bodies, rigid body rotation and equation of rotational motion. Moment of Inertia & its physical significance, radius of gyration, parallel and perpendicular axis theorem (statement only) M.I. of circular ring, disc, cylinder and thin straight rod. Rolling of a cylinder without slipping. Examples of binary system in nature (Binary Stars, Earth-moon system, diatomic molecules).

Mechanics of Solids and Fluids: States of matter, inter atomic and inter molecular forces.

a) **Solids :** Elastic behavior, stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, modulus of rigidity & some practical examples.

b) **Fluids:** Pressure due to fluid column, Pascal's law and its application (hydraulic lift and brakes) Effect of gravity on fluid pressure . Buoyancy, flotation, and Archimedes principle, Viscosity, Stoke's law, terminal velocity, stream line flow, trubulent flow. Reynold's number. Bernoulli's theorem and its applications.

c) Surface energy and surface tension, angle of contact, application of surface tension, excess pressure inside a liquid drop and bubble, capillary rise and action of detergent.

Heat and Thermodynamics: Kinetic theory of gases-assumptions, concept of pressure, kinetic energy and temperature, r.m.s. speed, degree of freedom, law of equipartition of energy (statement only), mean free path and Avogadro's number.

Thermal equilibrium and temperature (Zeroth law of thermodynamics) Heat, work and internal energy, thermal expansion-thermometry. First law of thermodynamics, specific heat, specific heat of gas at constant volume and pressure (mono atomic, diatomic gases). Specific heat of solids (Dulong and Petits' law).

Thermodynamic variables and equation of state, phase diagram; ideal gas equation, isothermal and adiabatic processes, reversible and irreversible processes carnot's engine and refrigerator or heat pump. Efficiency and co-efficient of performance, second law of thermodynamics (statement only); and some practical applications.

Transfer of heat-Conduction, convection and radiation. Thermal conductivity of solids, Black body radiation, Kirchhoff's laws, Wein's displacement law, Stefan's law (statement only) Newton's law of cooling, solar constant and determination of surface temperature of sun using Stefan's law.

Oscillations: Periodic motion- period, frequency, displacement as a function of time and periodic functions. Simple Harmonic Motion (SHM) and its equation, Expression for velocity and acceleration of SHM. Oscillations of a spring, restoring force and force constant, Energy in SHM-Kinetic and potential energies, Simple pendulum- derivation of its time period, Free, forced and damped oscillations (qualitative idea only), resonance, coupled oscillations.

Waves: Longitudinal and transverse wave, wave motion, Displacement relation for progressive wave. Principle of superposition of waves, Reflection of waves, Standing waves in strings and pipes, fundamental and higher harmonics, Beats, Doppler's effect, speed of sound in media.

Electrostatics: Frictional electricity, charges and their conservation, coulomb's law, Forces between two point electric charges. Forces between multiple electric charges; Superposition principle and continuous charge distribution. Electric fields and its physical significance, electric field due to a point charge, electric field lines, electric field due to a dipole and behavior of a dipole in a uniform electric field. Electric potential-physical meaning, potential difference, electric potential due to a point charge, a dipole and system of charges; Equipotential surfaces, Electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field. Electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell. Conductors and insulators, presence of free charges and bound charges inside a conductor, Dielectrics and electric polarization, general concept of a capacitor and capacitance : Combination of capacitors in series and parallel, energy stored in a capacitor, capacitance of a parallel plate capacitor with and without dielectric medium between the plates; Van de Graff generator.

Current Electricity: Electric current, flow of electric charge in a metallic conductor, drift velocity and mobility and their relation with electric current, ohm's law, electrical resistance, V-I characteristics, Exception, of ohm's law (Non-linear V-I characteristics), Electrical resistivity and conductivity, classification of materials in terms of conductivity; Superconductivity (elementary idea); Carbon resistors, colour code for carbon resistors, combination of resistances- series and parallel.

Temperature dependence of resistance, Internal resistance of a cell, Potential difference and e.m.f. of a cell, combinations of cells in series and in parallel. Kirchhoff's laws - illustration by simple application. Wheatstone bridge and its Applications for temperature Measurements. Metre bridge-special case of whetstone's bridge. Potentiometer- principle and application to measure potential difference, and for comparing e.m.f. of two cells.

Electric power, thermal effects of current and Joule's law, Chemical Effects of Current: Faraday's laws of electrolysis; Electrochemical Cells- Primary (Voltaic Lechlanche, Dry Daniel,) and secondary-

rechargeable cells (lead accumulators, alkali accumulators) solid state cells. Thermoelectricity- origin, elementary idea of Seebeck effect; Thermocouple. Thermo e.m.f. neutral and inversion temperatures. Measurement of temperature using a thermocouple.

Magnetic effects of current & magnetism: Concept of magnetic field, Oersted's experiment, Biot-Savart law, magnetic field due to an infinitely long current carrying straight wire and a circular loop: Ampere's circuital law and its application to straight and toroidal solenoids; Force on a moving charge in uniform magnetic and electric fields, cyclotron; Force on a current carrying conductor in a uniform magnetic field, Forces between two parallel current-carrying conductors, definition of ampere. Torque experienced by a current loop in a uniform magnetic field, moving coil galvanometer-its current sensitivity and conversion to ammeter and voltmeter. Current loop as a magnetic dipole and its magnetic dipole moment, magnetic dipole moment of a revolving electron, Magnetic field intensity due to magnetic dipole (bar magnet) along the axis and perpendicular to the axis; Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; Bar magnet as an equivalent solenoid, Magnetic field lines. Earth's magnetic fields and magnetic elements: Para, dia and ferromagnetic substances with examples. Electromagnets and permanent magnets.

Electromagnetic Induction & Alternating currents: Electromagnetic Induction, Faraday's Laws, Induced e.m.f. and current, Lenz's law, Eddy currents, Self and mutual inductance. Alternating currents peak and r.m.s. values of Alternating current/voltage, reactance and impedance; LC oscillations, LCR series circuit (Phasor diagram) Resonant circuits and Q-factor, Power in AC circuits, Wattless current. AC generator and transformer.

Electromagnetic Waves: Electromagnetic waves and their characteristics (qualitative idea only); Transverse nature of electromagnetic waves.

Electromagnetic spectrum (Radio-microwaves, infrared, optical, Ultraviolet, gamma rays) including elementary facts about their uses, Propagation of electromagnetic waves in atmosphere.

Optics : Refraction of light, total internal reflection and its application, spherical lenses, thin lens formula, lens maker's formula; Magnification, Power of a lens, combination of these lenses in contact; Refraction and dispersion of light due to a prism, Scattering of light. Blue colour of the sky and reddish appearance of the sun at sun-rise and sun set.

Optical Instruments – Compound Microscope, astronomical telescope (refraction and reflection type) and their magnifying powers.

Wave front and Huygens's principle; Reflection and refraction of plane wave at a plane surface using wave fronts (qualitative idea); Interference- Young's double slit experiment and expression for fringe width, Coherent sources and sustained interference of light; Diffraction due to a single slit, width of central maximum, difference between interference and diffraction.

Resolving power of microscope and telescope, Polarization-plane polarized light, Brewster's Law, Use of plane polarized light and Polaroid.

Dual Nature of Matter and Radiation: Photo-Electric effect, Einstein's Photo-electric equation, Particle nature of light, Photo Cell, Matter waves, Wave nature of particles, De-Broglie relation, de Broglie wave length of an electron. Davisson-Germer Experiment.

Atomic Nucleus: Alpha-particle scattering experiment, size of the nucleus, composition of the nucleus, protons and neutrons, Nuclear instability- Radioactivity-Alpha, Beta and Gamma particles/rays and their properties, radioactive decay law, simple explanation of decay, beta-decay and gamma-decay. Mass-energy relation, mass defect, binding energy per nucleon, its variation with mass number. Nature of nuclear forces, nuclear reaction, Nuclear fission and Nuclear fusion.

Solid and Semi-conductor Devices: Energy bands in solids (qualitative idea only), difference between metals, insulators and semiconductors using band theory; intrinsic and extrinsic semi-conductors, p-n junction, semi-conductor diode-characteristics in forward and reverse bias, diode as a rectifier, solar cell, photodiode. LED, Zener diode as a voltage regulator, Junction transistor, transistor action, characteristics of a transistor. Transistor as an amplifier (common emitter configuration) and oscillator. Logic gates (OR, AND, NOT, NAND and NOR); Elementary ideas about IC.

SECTION-B CHEMISTRY

50 marks

Some Basic concepts of chemistry: Nature of matter, properties of matter and their measurements, Law of Chemical combination, Dalton's Atomic Theory, Atomic and molecular masses, Mole concept, Stoichiometry and stoichiometric calculations.

Structure of Atoms and Chemical Bonding: Constituent of the atom, electronic structure of atom, understanding electron behavior, Bohr's model of hydrogen and hydrogen like atoms, spectrum of hydrogen, Dual behavior of matter, de Broglie equation, Heisenberg's uncertainty principle; Quantum numbers, shapes of orbital, Aufbau principle, Pauli's exclusion principle, Hund's rule of maximum multiplicity; Electronic configuration of elements up to atomic numbers 30. Chemical bonding: Lewis structure, Hybridization and VSEPR theory with reference to BeCl_2 , BF_3 , CH_4 , CCl_4 , NH_3 , H_2O , NH_4^+ , H_3O^+ , PCl_5 , SF_6 , C_2H_4 and C_2H_2 . Molecular orbital theory with reference to simple homodiatomic molecules up to atomic number 10. Hydrogen bond. Dipole moment in simple molecules.

States of Matter: The gaseous state: Kinetic molecular theory of ideal gases. Laws governing the ideal behavior of gases, deviation from the ideal behavior; van der Waals equation of state for real gases. Concept of critical constants, Liquefaction of gases.

Solid State: Structure of simple ionic compounds, Close-packed structure, ionic radii; Silicates, Imperfections in solids, properties of crystalline solids and amorphous solids.

Solutions: Types of solution, Vapor pressure of solution and Raoult's law, Ideal and non-ideal solutions. Colligative properties, Abnormal molecular masses.

Chemical Thermodynamics: Some basic concepts; Energy changes during a chemical reaction, Internal energy and Enthalpy. Enthalpy of reaction, First law of thermodynamics, Concept of Entropy and Free energy, Spontaneity of a process, Second and Third law of thermodynamics.

Chemical Equilibrium: Equilibria involving physical changes and chemical systems, Law of Mass action and its application to equilibrium. Le-Chatelier's principle and its applications. Ionic Equilibria; Ostwald's dilution law; Arrhenius, Bronsted-Lowry and Lewis concept of acids and bases. pH scale, Buffer solutions and Solubility product.

Chemical Kinetics: Rate of reaction, Instantaneous rate of a reaction, Molecularity and order of a reaction, Factors affecting the rate of a reaction, Elementary and complex reactions, Determination of the order of a reaction, Dependence of reaction rate on temperature and catalyst, Photochemical reactions, Mechanism of a reaction.

Surface Chemistry: Adsorption, Colloidal solutions, Emulsions. Homogeneous and heterogeneous catalysis.

Redox Reactions: Oxidation and reduction as an electron transfer process, Oxidation number, balancing of redox equations.

Electrochemistry: Electrolytic conductance, Equivalent and molar conductivities, Galvanic cell, Electrode potential and EMF of a Galvanic cell, Dependence of EMF on concentration and temperature Electrochemical cell and free energy, Electrolysis, Quantitative aspect of electrolysis, Faraday's Laws, and Criteria for product formation; Some commercial batteries, Corrosion.

s-Block Elements: General trends, characteristics of compounds of Alkali and Alkaline earth metals. Anomalous behaviour of Lithium and Beryllium. Some important compounds of Sodium and Calcium. Chemistry of Hydrogen, Water and Hydrogen peroxide.

p-Block Elements: General trends. Anomalous behaviour of Boron and Carbon. Allotropy: Different allotropes of Carbon, Sulphur, Phosphorus, and Tin. Chemistry of some important compounds of Boron, Carbon, Silicon, Nitrogen, Phosphorus, Oxygen, Sulphur, and Halogens. Characteristics of Group-18 elements, and Chemistry of Xenon. Metallurgy of Aluminium.

d- & f-Block Elements: General trends, Characteristic properties of transition and inner transition elements. General properties of first row transition metal compounds. Metallurgy of Iron and Copper. Manufacture of steel, Chemistry of some heavy metals like Silver, Gold, Zinc, Mercury, and Compounds such as Potassium permanganate and Potassium dichromate.

Co-ordination and Organo-metallic Compounds: Co-ordination compounds, Isomerism and bonding in co-ordination compounds; Stability of co-ordination compounds in solution; Importance of co-ordination compounds. Organo-metallic compounds.

Organic Chemistry: Classification and nomenclature of organic compounds, Isomerism and stereochemistry. Fundamental concepts in organic reaction mechanism, Methods of purification; Qualitative and quantitative analysis of organic compounds; Modern methods of structure elucidation.

Hydrocarbons: Preparation and properties of alkanes, alkenes and alkynes; Aromatic hydrocarbons, aromaticity. Preparation, properties and structure of Benzene.

Organic compounds with functional group: General methods of preparation, physical and chemical properties and important uses of haloalkanes, haloarenes, polyhalogen compounds, alcohols, phenols, ethers, aldehydes, ketones, carboxylic acids and derivatives of carboxylic acids, cyanides, isocyanides, amines, nitro and azo compounds.

Polymers: Nomenclature and classification of polymers, Types of polymerization, Molecular mass of polymers; Some commercially important polymers.

Bio-molecules: Structure and function of carbohydrates, proteins, nucleic acids, lipids and vitamins.

Nuclear Chemistry: Discovery of radioactivity and nature of radiation from radio active substances; Chemical equations for nuclear changes, Radioactive series, Rate of radioactive decay, Artificial transmutation radioactivity, Synthetic elements, Nuclear fission, Nuclear fusion. Applications of radioactivity and radio-isotopes.

Chemistry in Everyday life: Dyes, Chemicals in medicines, Chemistry of rocket propellants, Chemicals in food, Soaps and Detergents.

SECTION-C MATHEMATICS

50 marks

Algebra:

Sets: Sets and their representations, finite and infinite sets, subsets, empty or null set, universal set, equal sets, power set and complement of a set, union and intersection of sets and their algebraic properties, difference of sets, Venn diagrams, application of sets.

Relations and functions: ordered pairs, Cartesian product of sets, relations, domain, co-domain and range, into and onto functions, one one into and one one onto functions, constant function, identity function, composition of functions, invertible functions, Binary operations.

Complex Numbers: Complex number in the form $(a+ib)$, representation of complex numbers by points in plane, Argand diagram, algebra of complex numbers, real and imaginary parts of a complex number, triangle inequality, modulus and argument (or amplitude) of a complex number, conjugate, square root of a complex number, cube root of unity, polar representation of a complex number.

Theory of quadratic equation: Solution of a quadratic equation in the complex number system by (i) factorization (ii) using formula, relation between roots & coefficients, the nature of roots, formation of quadratic equations with given roots, Symmetric functions of roots, Equations reducible to quadratic forms.

Sequences and series: Sequence and examples of finite and infinite sequences, Arithmetic progression (A.P.)- first term, common difference and nth term, sum to n terms of an A.P., Arithmetic mean (A.M.), insertion of A.M. between any two given numbers, Geometric progression (G.P.)-first term, common ratio and nth term, Sum to n terms and infinite number of terms of a G.P., recurring decimal numbers as G.P., Geometric Mean (G.M.) insertion of G.M. between any two given numbers, Harmonic progression, Harmonic mean(H.M.),relationship among A.M., G.M. and H.M, arithmetico-geometric series, special cases of $\sum n$, $\sum n^2$, $\sum n^3$, exponential series concept of e as the sum of an infinite series, proof of $2 < e < 3$, exponential function (e^x) as the infinite series, logarithmic series- infinite series for $\log_e(1+x)$, $\log_e(1-x)$ and related problems.

Permutations and combinations: Fundamental principle of counting, the factorial notation, Permutation as an arrangement, meaning of $P(n,r)$, combination, meaning of $C(n,r)$, application of permutations & combinations.

Mathematical Induction: The principle of mathematical Induction, simple applications.

Binomial theorems: Statement of binomial theorem, proof of the binomial theorem for positive integral exponent using the principle of mathematical induction, general and middle terms in binomial expansions,

Binomial theorem for any index (without proof), application of binomial theorem for approximation and properties of binomial coefficients.

Mathematical logic: Mathematical Logic statement, Venn diagrams, negation, basic logical connectives and compound statement including the negations, truth tables, duality algebra of statements and applications of logic in solving simple problems. Matrices and determinants: Types of matrices, Equality of matrices, operations of addition, scalar multiplication and multiplication of matrices, statements of important results on operations of matrices and their verification by numerical problems only, linear equations in matrix notation, determinants, determinant of a square matrix, properties of determinants, minors & cofactors of determinants, applications of determinants in (i) finding area of a triangle (ii) Solving a system of linear equations, Cramer's rule, transpose, adjoint and inverse of a matrix, consistency and inconsistency of system of linear equations, application of matrices in solving simultaneous linear equations in two or three variables.

Boolean Algebra: Boolean algebra as an algebraic structure, principle of duality, Boolean function, conditional and biconditional statements, valid arguments, switching circuits, application of Boolean algebra to switching circuits.

Trigonometry:

Trigonometric functions of sum and difference of numbers, Trigonometric functions of multiples and submultiples of numbers, conditional identities for the angles of a triangle, Solution of trigonometric equations, solution of triangles, concept of inverse trigonometric functions and their use to reduce expression to simplest form.

Vectors: Vectors & scalars, Magnitude and direction of a vector, types of vectors, position vector of a point dividing a line segment in a given ratio, components of a vector, addition of vectors, multiplication of a vector by a scalar, scalar (dot) product of vectors, projection of a vector on a line, Vector (cross) product of two vectors, application of dot & cross products in (i) finding area of a triangle and a parallelogram (ii) problems of plane geometry and trigonometry (iii) finding work done by a force (iv) vector moment of a vector about a point, scalar triple product and its applications, Moment of a vector about a line, coplanarity of three vectors or four points using scalar triple product, vector triple product.

Coordinate Geometry: Two Dimension: (i) Area of a triangle, condition for the collinearity of three points, centroid and in-centre of a triangle, locus and its equation.

The straight line and pair of straightlines – Various forms of equations of a line, intersection of lines, angles between two lines, condition for concurrency of three lines, distance of a point from a line, coordinates of orthocentre and Circumcentre of a triangle, equation of family of lines passing through the point of intersection of two lines, homogeneous equation of second degree in x & y , angle between pair of lines through the origin, combined equation of the bisectors of the angles between a pair of lines, condition for the general second degree equation to represent a pair of lines, point of intersection and angle between two lines represented by $S=0$ and the factors of S .

Circles: Standard form of the equation of a circle, general form of the equation of a circle, its radius and center, equation of a circle in the parametric form, equation of a circle when the end points of a diameter are given, points of intersection of a line and a circle in the center at the origin and condition of a line to be tangent to the circle, length of tangent, equation of the tangent, equation of a family of circles through the intersection of two circles, condition for two intersecting circles to be orthogonal.

Conic sections- Sections of cones, equations of conic sections (parabola, ellipse, hyperbola) in standard forms, conditions for $y=mx+c$ to be a tangent and points of tangency.

Geometry of Three Dimension (3D): Coordinate axes, planes in three dimensional space, coordinates of a point in space, distance between two points, section formula, d.c's. and d.r's. of a line joining two points, projection of the join of two points on a given line, angle between two lines whose d.r's. are given, Cartesian and vector equation of a line through (i) a point and parallel to a given vector (ii) through two points, coplanarity of three points, coplanar & skew line, shortest distance between two lines, condition for the intersection of two lines, Cartesian & vector equation of a plane (i) when the normal vector and the distance of the plane from the origin is given (ii) passing through a point and perpendicular to given vector (iii) passing through a point and parallel to two given lines through the intersection of two other planes (iv) Containing two lines (v) Passing through three points, Angle between two lines (ii) two planes (iii) a line and a plane. Condition of coplanarity of two lines in vector and Cartesian form, Length of perpendicular of a point from a plane by both vector and Cartesian methods, vector and Cartesian equation of a sphere, its center and radius, diameter form of the equation of a sphere.

Calculus: Function, Limits and Continuity: Concept of real function, its domain and range, types of functions, limit of a function, meaning and related notations, left and right hand limits, fundamental theorems on limits, limit at infinity and infinite limits, continuity of a function (i) at a point (ii) over an open/closed intervals, Sum, product and quotient of continuous functions, continuity of special functions-polynomial, trigonometric, exponential, logarithmic, inverse trigonometric functions.

Differentiation: Derivative of a function, its geometrical and physical significance, Relationship between continuity and differentiability, derivative of some simple functions from first principle, derivative of sum, difference, product and quotient of functions, derivative of polynomial, trigonometric, exponential, logarithmic, inverse trigonometric and implicit functions, derivative of functions expressed in parametric form, chain rule and differentiation by substitution, Derivatives of second order.

Application of Derivatives: Rate of change of quantities, tangents and normals, increasing and decreasing functions and sign of the derivatives, maxima & minima, greatest and least values, Rolle's theorem and mean value theorem (without proof), curve sketching of simple curves.

Indefinite integrals: Integration as inverse of differentiation, properties of integrals, integration by substitution, by parts, partial fractions and their use in integration, integration of rational and irrational functions, integration of trigonometric functions of the type

$$\int \frac{dx}{a + b \cos x}, \int \frac{dx}{a + b \sin x} \text{ and } \int \sin^m x \cos^n x dx.$$

Definite Integrals: Definite integral as limit of a sum, fundamental theorems of integral calculus (without proof), evaluation of definite integrals by (i) substitution (ii) using properties of definite integrals, application of definite integrals in finding the areas bounded by a curve, circle, parabola and ellipse in standard form between two ordinates and x-axis, area between two curves (line and circle, line & parabola, line & ellipse).

Differential Equations: Definition, order and degree, general and particular solution, formation of a differential equation whose general solution is given, solution of differential equation by the method of separation of variables, homogeneous differential equations, linear differential equation of the type $\frac{dy}{dx} + py = Q(x)$ whose $p(x)$ & $Q(x)$ are functions of x , Solution of second order differential equations.

Statics and Dynamics: Elementary Statics- Introduction, basic concepts, laws of mechanics, force, resultant of forces acting at point, parallelogram Law of forces, resolved parts of a force, equilibrium of a particle under three concurrent forces, triangle law of forces and its converse, Lami's theorem and its converse, two parallel forces, Like and unlike parallel forces, couple and its moment.

Elementary Dynamics: Basic concept. like displacement, speed, velocity, average speed, instantaneous speed, acceleration and retardation, resultant of two velocities, Motion of a particle along a line when moving with constant acceleration, motion of a particle under gravity, projectile motion, the path of a projectile, its horizontal range, velocity at any instant, greatest height and time of flight.

Probability: Random experiment and associated sample space events as subsets of sample space, occurrence of an event, impossible events, sure events, combination of events through the operations "and", "or", "not" and their set representation, meaning of equally likely outcomes, definition of probability of an event as the ratio of the number of favorable equally likely outcomes to the total number of outcomes, equally likely events, addition rule for mutually exclusive events, Conditional probability, independent-events, independent experiments, Calculation of probability of events associated with the independent experiments $P(A \text{ or } B)$, $P(A \text{ and } B)$, Baye's theorem and its application, recall of concept of random variables and its probability distribution, mean and variance of random variables, Binomial and Poisson's distributions, their mean, variance and application of these distributions in commerce and industry.