Trend of AIEEE Questions (2002-08)

AIEEE- the All India Entrance Test for admission into various engineering courses in different engineering colleges and institutes in the country has hit the imagination of the school going students more than any other entrance test conducted at this level. Every year, lakhs and lakhs of students toil hard to succeed in this exam.

Without argument, you need to be well versed with the pattern as well as the level of the questions asked in the exam. A CHAPTERWISE analysis of previous years' questions is called for here. With this objective in mind , we are giving below the chapter-wise analysis (break-up) of the questions asked in last **7 years' (2002-08)** of **AIEEE** in each of the subjects of **Physics, Chemistry** and **Mathematics**:

PHYSICS

Sl. No.	Chapters	Years						
		02	03	04	05	06	07	08
1.	Unit, Dimensions and Vectors	1	3	2	1	2		2
2.	Kinematics	3	3	4	5	1	2	
3.	Laws of Motion	7	8	4	4	3	1	1
4.	Work, Power and Energy	2	3	5	5	3	1	2
5.	Centre of Mass, Impulse and Momentum	1	0		3	3	1	2
6.	Rotation	4	3	3	2	2	3	1
7.	Gravitation	4	3	4	3			1
8.	Simple Harmonic Motion	4	5	5	4	3	3	
9.	Solids and Fluids	1	0	2	2	1		3
10.	Waves	3	2	1	2	2	2	3
11.	Heat and Thermodynamics	10	5	6	5	3	4	1
12.	Optics	4	4	4	6	1	2	4
13.	Current Electricity	7	8	8	7	7	1	4
14.	Electrostatics	5	5	4	5	2	5	4
15.	Magnetics	5	5	6	6	2	4	2
16.	Electromagnetic Induction	5	5	6	5	5	2	1
17.	Modern Physics	9	13	11	10	15	9	4
	Total No. of Questions	**75**	**75**	**75**	**75**	**55**	**40**	**35**
	Maximum Marks					**180**	**120**	**105**

CHEMISTRY

Sl. No.	Chapters	Years						
		02	03	04	05	06	07	08
1.	Mole Concept	1		2	1	1	2	
2.	Acid- Base Titrations	1	1	1	1			
3.	Redox Reactions	5		3	2	1		1
4.	Gaseous State	2	2	3	1	1	1	
5.	Thermochemistry		2	2	1	2		
6.	Thermodynamics	3	3		2	1	3	1
7.	Atomic Structure	2	3	3	2	3		2
8.	Chemical Bonding	7	3	3	5	6	4	2

9.	Chemical Equilibrium	2	4	4	3	2		1
10.	Ionic Equilibrium	4	4	1	2		3	3
11.	Electrochemistry	4	5	5	3	3	2	1
12.	Chemical Kinetics	6	3	1	3	3	2	1
13.	Colligative Properties	2	4	3	4	2	3	2
14.	Solid State	1		1	2	1		1
15.	Surface Chemistry		1		2	1		1
16.	General Organic Chemistry	5	3	4	4	3	2	2
17.	Stereochemistry	3		3	1		1	1
18.	Hydrocarbons	2	2	3	3	4	2	3
19.	Alkyl Halides			2	3	1		1
20.	Alcohols and Ethers		1	2	1	1	1	
21	Aldehydes and Ketones	1			1			
22.	Carboxylic Acids and Their Derivatives	2	2	4	1	2		
23.	Amines	2	2	1	1		2	
24.	Carbohydrates, Amino Acids and Polymers	3	4	3	4	2	1	2
25.	Aromatic Compounds	2	2	1	2	4	3	2
26.	Qualitative Analysis	1	1		1			
27.	Transition Elements and Co-ordination Chemistry	3	5	8	4	4	1	3
28.	Periodic Table and Representative Elements	6	17	8	9	6	5	3
29.	Metallurgy	3		2	3			1
30.	Nuclear Chemistry	2	1	2	3	1	2	
31.	Environmental Chemistry							1
	Total No. of Questions	**75**	**75**	**75**	**75**	**55**	**40**	**35**
	Maximum Marks					**180**	**120**	**105**

MATHEMATICS

Sl. No.	Chapters	Years						
		02	03	04	05	06	07	08
1	Sets, Relations and Functions	4	3	3	3	2	2	2
2	Complex Numbers and Quadratic Equations	3	6	7	8	3	1	3
3	Permutations and Combinations	3	4	2	2	1	1	2
4	Mathematical Induction			1	1			1
5	Binomial Theorem and Its Simple Applications	2	2	2	3	2	1	1
6	Sequences and Series	1	1	3	1	2	2	1
7	Exponential and Logarithmic Series	2	1	1	1		1	
8	Matrices and Determinants	3	3	3	5	2	3	3
9	Statistics and Probability	7	5	5	5	2	3	3
10	Trigonometry	12	5	5	3	3	2	2
11	Mathematical Reasoning							2
12	Coordinate Geometry	10	9	11	10	7	7	5
13	Limits, Continuity and Differentiability	9	8	8	9	6	4	2
14	Integral Calculus	7	7	7	7	4	4	3
15	Differential Equations	4	2	2	2	1	1	1
16	Three Dimensional Geometry	3	6	4	5	1	3	2
17	Vector Algebra	5	7	5	4	2	2	2
18	Statics		3	3	3	1	2	
19	Dynamics		3	3	3	1	1	
	Total No. of Questions	**75**	**75**	**75**	**75**	**40**	**40**	**35**
	Maximum Marks					**180**	**120**	**105**

PATTERN OF EXAMINATION

	Subjects	Type of Questions
Paper 1	Physics, Chemistry & Mathematics	Objective type questions with equal weightage to Physics, Chemistry & Mathematics
Paper 2	Mathematics–Part I Aptitude Test–Part II & Drawing Test–Part III	Objective type questions Objective type questions Two questions to test drawing aptitude

Requirement of papers for different courses is given in the table below :

Course	Papers
B.E/B. Tech	Paper 1
B. Arch/B. Planning	Paper 2

Eligibility Criteria : The minimum academic qualification for admission through AIEEE is a pass in the final examination of 10 + 2 (Class XII) or its equivalent referred to as the qualifying examination. Those appearing in 10+2 (Class XII) final or equivalent examination may also appear in AIEEE for consideration of provisional admission.

Subject combinations required in the qualifying examination for admission to B.E./B. Tech and B. Arch./B. Planning Courses shall be as under :

Course	Compulsory	Anyone of the Optional Subjects
B.E/B. Tech	Physics and Mathematics	Chemistry Bio-technology Computer Science Biology
B. Arch/B. Planning	Mathematics with 50% marks in aggregate at 10 + 2 level	

SYLLABUS

AIEEE

All India Engineering Exam

MATHEMATICS

Unit 1 Sets, Relations and Functions

Sets and their representation; Union, intersection and complement of sets and their algebraic properties; Power set; Relation, Types of relations, equivalence relations, functions;. one-one, into and onto functions, composition of functions.

Unit 2 Complex Numbers and Quadratic Equations

Complex numbers as ordered pairs of reals, Representation of complex numbers in the form $a + ib$ and their representation in a plane, Argand diagram, algebra of complex numbers, modulus and argument (or amplitude) of a complex number, square root of a complex number, triangle inequality, Quadratic equations in real and complex number system and their solutions. Relation between roots and coefficients, nature of roots, formation of quadratic equations with given roots.

Unit 3 Matrices and Determinants

Matrices, algebra of matrices, types of matrices, determinants and matrices of order two and three. Properties of determinants, evaluation of determinants, area of triangles using determinants. Adjoint and evaluation of inverse of a square matrix using determinants and elementary transformations. Test of consistency and solution of simultaneous linear equations in two or three variables using determinants and matrices.

Unit 4 Permutations and Combinations

Fundamental principle of counting, permutation as an arrangement and combination as selection. Meaning of $P(n, r)$ and $C(n, r)$, simple applications.

Unit 5 Mathematical Induction

Principle of Mathematical Induction and its simple applications.

Unit 6 Binomial Theorem and its Simple Applications

Binomial theorem for a positive integral index, general term and middle term, properties of binomial coefficients and simple applications.

Unit 7 Sequences and Series

Arithmetic and geometric progressions, insertion of arithmetic, geometric means between two given numbers. Relation between AM and GM. Sum upto n terms of special series: S_n, S_n^2, S_n^3. Arithmetico -Geometric progression.

Unit 8 Limit, Continuity and Differentiability

Real-valued functions, algebra of functions, polynomials, rational, trigonometric, logarithmic and exponential functions, inverse functions. Graphs of simple functions. Limits, continuity and differentiability. Differentiation of the sum, difference, product and quotient of two functions. Differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit 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.

Unit 9 Integral Calculus

Integral as an anti-derivative, Fundamental integrals involving algebraic, trigonometric, exponential and logarithmic functions, integration by substitution, by parts and by partial fractions. Integration using trigonometric identities.

Evaluation of simple integrals of the type

$$\int \frac{dx}{x^2 \pm a^2}, \quad \int \frac{dx}{\sqrt{x^2 \pm a^2}}, \quad \int \frac{dx}{a^2 - x^2},$$

$$\int \frac{dx}{\sqrt{a^2 - x^2}},$$

$\int \frac{dx}{ax^2+bx+c}$, $\int \frac{dx}{\sqrt{ax^2+bx+c}}$,
$\int \frac{(px+q)\,dx}{ax^2+bx+c}$, $\int \frac{(px+q)\,dx}{\sqrt{ax^2+bx+c}}$,
$\int \sqrt{a^2 \pm x^2}\,dx$, $\int \sqrt{x^2-a^2}\,dx$,

Integral as limit of a sum. Fundamental Theorem of Calculus. Properties of definite integrals. Evaluation of definite integrals, determining areas of the regions bounded by simple curves in standard form.

Unit 10 Differential Equations

Ordinary differential equations, their order and degree. Formation of differential equations. Solution of differential equations by the method of separation of variables, solution of homogeneous and linear differential equations of the type

$$\frac{dy}{dx} + P(x)y = Q(x)$$

Unit 11 Coordinate Geometry

Cartesian system of rectangular coordinates 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.

Straight lines : 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 line, equations of internal and external bisectors of angles between two lines, coordinates of centroid, orthocentre and circumcentre of a triangle, equation of family of lines passing through the point of intersection of two lines.

Circles, Conic Sections : Standard form of equation of a circle, general form of the equation of a circle, its radius and centre, equation of a circle when the end points of a diameter are given, points of intersection of a line and a circle with the centre at the origin and condition for a line to be tangent to a circle, equation of the tangent. Sections of cones, equations of conic sections (parabola, ellipse and hyperbola) in standard forms, condition for y = mx + c to be a tangent and point (s) of tangency.

Unit 12 Three Dimensional Geometry

Coordinates of a point in space, distance between two points, section formula, direction ratios and direction cosines, angle between two intersecting lines. Skew lines, the shortest distance between them and its equation. Equations of a line and a plane in different forms, intersection of a line and a plane, coplanar lines.

Unit 13 Vector Algebra

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.

Unit 14 Statistics and Probability

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, Baye's theorem, probability distribution of a random variate, Bernoulli trials and Binomial distribution.

Unit 15 Trigonometry

Trigonometrical identities and equations. Trigonometrical functions. Inverse trigonometrical functions and their properties. Heights and Distances.

Unit 16 Mathematical Reasoning

Statements, logical operations and, or, implies, implied by, if and only if. Understanding of tautology, contradiction, converse and contrapositive.

PHYSICS

The syllabus contains two Sections - A and B. Section - A pertains to the Theory Part having 80% weightage, while Section - B contains Practical Component (Experimental Skills) having 20% weightage.

SECTION A

Unit 1 Physics and Measurement

Physics, technology and society, S I units, Fundamental and derived units. Least count, accuracy and precision of measuring instruments, Errors in measurement, Significant figures.

Dimensions of Physical quantities, dimensional analysis and its applications.

Unit 2 Kinematics

Frame of reference. 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, position-time graphs, relations for uniformly accelerated motion.

Scalars and Vectors, Vector addition and subtraction, Zero vector, Scalar and Vector products, Unit vector, Resolution of a vector. Relative velocity, Motion in a plane, Projectile Motion, Uniform Circular Motion.

Unit 3 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. Law of conservation of linear momentum and its applications, Equilibrium of concurrent forces.

Static and Kinetic friction, laws of friction, rolling friction.

Dynamics of uniform circular motion: Centripetal force and its applications.

Unit 4 Work, Energy and Power

Work done by a constant force and a variable force; kinetic and potential energies, work-energy theorem, power.

Potential energy of a spring, conservation of mechanical energy, conservative and non-conservative forces; Elastic and inelastic collisions in one and two dimensions.

Unit 5 Rotational Motion

Centre of mass of a two-particle system, Centre of mass of a rigid body; Basic concepts of rotational motion; moment of a force, torque, angular momentum, conservation of angular momentum and its applications; moment of inertia, radius of gyration. Values of moments of inertia for simple geometrical objects, parallel and perpendicular axes theorems and their applications.

Rigid body rotation, equations of rotational motion.

Unit 6 Gravitation

The universal law of gravitation.

Acceleration due to gravity and its variation with altitude and depth.

Kepler's laws of planetary motion.

Gravitational potential energy; gravitational potential.

Escape velocity. Orbital velocity of a satellite. Geo-stationary satellites.

Unit 7 Properties of Solids and Liquids

Elastic behaviour, Stress-strain relationship, Hooke's Law, Young's modulus, bulk modulus, modulus of rigidity.

Pressure due to a fluid column; Pascal's law and its applications.

Viscosity, Stokes' law, terminal velocity, streamline and turbulent flow, Reynolds number. Bernoulli's principle and its applications.

Surface energy and surface tension, angle of contact, application of surface tension - drops, bubbles and capillary rise.

Heat, temperature, thermal expansion; specific heat capacity, calorimetry; change of state, latent heat.

Heat transfer-conduction, convection and radiation, Newton's law of cooling.

Unit 8 Thermodynamics

Thermal equilibrium, zeroth law of thermodynamics, concept of temperature. Heat, work and internal energy. First law of thermodynamics.

Second law of thermodynamics: reversible and irreversible processes. Carnot engine and its efficiency.

Unit 9 Kinetic Theory of Gases

Equation of state of a perfect gas, work done on compressing a gas.

Kinetic theory of gases - assumptions, concept of pressure. Kinetic energy and temperature: rms speed of gas molecules; Degrees of freedom, Law of equipartition of energy, applications to specific heat capacities of gases; Mean free path, Avogadro's number.

Unit 10 Oscillations and Waves

Periodic motion - period, frequency, displacement as a function of time. Periodic functions. Simple Harmonic Motion (SHM) and its equation; phase; oscillations of a spring - restoring force and force constant; energy in SHM - kinetic and potential energies; Simple pendulum - derivation of expression for its time period; Free, forced and damped oscillations, resonance.

Wave motion. Longitudinal and transverse waves, speed of a wave. Displacement relation for a progressive wave. Principle of superposition of waves, reflection of waves, Standing waves in strings and organ pipes, fundamental mode and harmonics, Beats,

Doppler effect in sound

Unit 11 Electrostatics

Electric charges: Conservation of charge, Coulomb's law-forces between two point charges, forces between multiple charges; superposition principle and continuous charge distribution.

Electric field: Electric field due to a point charge, Electric field lines, Electric dipole, Electric field due to a dipole, Torque on a dipole in a uniform electric field.

Electric flux, Gauss's law and its applications to find field due to infinitely long uniformly charged straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell.

Electric potential and its calculation for a point charge, electric dipole and system of charges; Equipotential surfaces, Electrical potential energy of a system of two point charges in an electrostatic field.

Conductors and insulators, Dielectrics and electric polarization, capacitor, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, Energy stored in a capacitor.

Unit 12 Current Electricity

Electric current, Drift velocity, Ohm's law, Electrical resistance, Resistances of different materials, V-I characteristics of Ohmic and nonohmic conductors, Electrical energy and power, Electrical resistivity, Colour code for resistors; Series and parallel combinations of resistors; Temperature dependence of resistance.

Electric Cell and its Internal resistance, potential difference and emf of a cell, combination of cells in series and in parallel. Kirchhoff's laws and their applications. Wheatstone bridge, Metre bridge. Potentiometer - principle and its applications.

Unit 13 Magnetic Effects of Current and Magnetism

Biot - Savart law and its application to current carrying circular loop.

Ampere's law and its applications to infinitely long current carrying straight wire and solenoid.

Force on a moving charge in uniform magnetic and electric fields. Cyclotron.

Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere. Torque experienced by a current loop in 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. Bar magnet as an equivalent solenoid, magnetic field lines; Earth's magnetic field and magnetic elements. Para-, dia- and ferro- magnetic substances.

Magnetic susceptibility and permeability, Hysteresis, Electromagnets and permanent magnets.

Unit 14 Electromagnetic Induction and Alternating Currents

Electromagnetic induction; Faraday's law, induced emf and current; Lenz's Law, Eddy currents. Self and mutual inductance.

Alternating currents, peak and rms value of alternating current/ voltage; reactance and impedance; LCR series circuit, resonance; Quality factor, power in AC circuits, wattless current.

AC generator and transformer.

Unit 15 Electromagnetic Waves

Electromagnetic waves and their characteristics. Transverse nature of electromagnetic waves.

Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays). Applications of e.m. waves.

Unit 16 Optics

Reflection and refraction of light at plane and spherical surfaces, mirror formula, Total internal reflection and its applications, Deviation and Dispersion of light by a prism, Lens Formula, Magnification, Power of a Lens, Combination of thin lenses in contact, Microscope and Astronomical Telescope (reflecting and refracting) and their magnifying powers.

Wave optics: wavefront and Huygens' principle, Laws of reflection and refraction using Huygen's principle. 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. Resolving power of microscopes and astronomical telescopes, Polarisation, plane polarized light; Brewster's law, uses of plane polarized light and Polaroids.

Unit 17 Dual Nature of Matter and Radiation

Dual nature of radiation. Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation; particle nature of light. Matter waves-wave nature of particle, de Broglie relation. Davisson-Germer experiment.

Unit 18 Atoms and Nuclei

Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum.

Composition and size of nucleus, atomic masses, isotopes, isobars; isotones. Radioactivity-alpha, beta and gamma particles/rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number, nuclear fission and fusion.

Unit 19 Electronic Devices

Semiconductors; semiconductor diode: I-V characteristics in forward and reverse bias; diode as a rectifier; I-V characteristics of LED, photodiode, solar cell and Zener diode; 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). Transistor as a switch.

Unit 20 Communication Systems

Propagation of electromagnetic waves in the atmosphere; Sky and space wave propagation, Need for modulation, Amplitude and Frequency Modulation, Bandwidth of signals, Bandwidth of Transmission medium, Basic Elements of a Communication System (Block Diagram only).

SECTION-B

Unit 21 Experimental Skills

Familiarity with the basic approach and observations of the experiments and activities:

1. Vernier callipers-its use to measure internal and external diameter and depth of a vessel.
2. Screw gauge-its use to determine thickness/diameter of thin sheet/wire.
3. Simple Pendulum-dissipation of energy by plotting a graph between square of amplitude and time.
4. Metre Scale - mass of a given object by principle of moments.
5. Young's modulus of elasticity of the material of a metallic wire.
6. Surface tension of water by capillary rise and effect of detergents.
7. Co-efficient of Viscosity of a given viscous liquid by measuring terminal velocity of a given spherical body.
8. Plotting a cooling curve for the relationship between the temperature of a hot body and time.
9. Speed of sound in air at room temperature using a resonance tube.
10. Specific heat capacity of a given (i) solid and (ii) liquid by method of mixtures.
11. Resistivity of the material of a given wire using metre bridge.
12. Resistance of a given wire using Ohm's law.
13. Potentiometer –
    (i) Comparison of emf of two primary cells.
    (ii) Determination of internal resistance of a cell.
14. Resistance and figure of merit of a galvanometer by half deflection method.
15. Focal length of:
    (i) Convex mirror
    (ii) Concave mirror, and
    (iii) Convex lens
    Using parallax method.
16. Plot of angle of deviation vs angle of incidence for a triangular prism.
17. Refractive index of a glass slab using a travelling microscope.
18. Characteristic curves of a p-n junction diode in forward and reverse bias.
19. Characteristic curves of a Zener diode and finding reverse break down voltage.
20. Characteristic curves of a transistor and finding current gain and voltage gain.
21. Identification of Diode, LED, Transistor, IC, Resistor, Capacitor from mixed collection of such items.
22. Using multimeter to:
    (i) Identify base of a transistor
    (ii) Distinguish between npn and pnp type transistor
    (iii) See the unidirectional flow of current in case of a diode and an LED.
    (iv) Check the correctness or otherwise of a given electronic component (diode, transistor or IC).

CHEMISTRY

SECTION-A

PHYSICAL CHEMISTRY

Unit 1 Some Basic Concepts in Chemistry

Matter and its nature, Dalton's atomic theory; Concept of atom, molecule, element and compound; Physical quantities and their measurements in Chemistry, precision and accuracy, significant figures, S.I. Units, dimensional analysis; Laws of chemical combination; Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae; Chemical equations and stoichiometry.

Unit 2 States of Matter

Classification of matter into solid, liquid and gaseous states.

Gaseous State:

Measurable properties of gases; Gas laws - Boyle's law, Charle's law, Graham's law of diffusion, Avogadro's law, Dalton's law of partial pressure; Concept of Absolute scale of temperature; Ideal gas equation, Kinetic theory of gases (only postulates); Concept of average, root mean square and most probable velocities; Real gases, deviation from Ideal behaviour, compressibility factor, van der Waals' equation, liquefaction of gases, critical constants.

Liquid State:

Properties of liquids - vapour pressure, viscosity and surface tension and effect of temperature on them (qualitative treatment only).

Solid State :

Classification of solids: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea); Bragg's Law and its applications; Unit cell and lattices, packing in solids (fcc, bcc and hcp lattices), voids, calculations involving unit cell parameters, imperfection in solids; Electrical, magnetic and dielectric properties.

Unit 3 Atomic Structure

Discovery of sub-atomic particles (electron, proton and neutron); Thomson and Rutherford atomic models and their limitations; Nature of electromagnetic radiation, photoelectric effect; Spectrum of hydrogen atom, Bohr model of hydrogen atom - its postulates, derivation of the relations for energy of the electron and radii of the different orbits, limitations of Bohr's model; Dual nature of matter, de-Broglie's relationship, Heisenberg uncertainty principle. Elementary ideas of quantum mechanics, quantum mechanical model of atom, its important features, ψ and $\psi 2$, concept of atomic orbitals as one electron wave functions; Variation of ψ and ψ 2 with r for 1*s* and 2*s* orbitals; various quantum numbers (principal, angular momentum and magnetic quantum numbers) and their significance; shapes of *s*, *p* and *d* - orbitals, electron spin and spin quantum number; Rules for filling electrons in orbitals – aufbau principle, Pauli's exclusion principle and Hund's rule, electronic configuration of elements, extra stability of half-filled and completely filled orbitals.

Unit 4 Chemical Bonding and Molecular Structure

Kossel - Lewis approach to chemical bond formation, concept of ionic and covalent bonds.

Ionic bonding: Formation of ionic bonds, factors affecting the formation of ionic bonds; calculation of lattice enthalpy.

Covalent bonding: Concept of electronegativity, Fajan's rule, dipole moment; Valence Shell Electron Pair Repulsion (VSEPR) theory and shapes of simple molecules.

Quantum mechanical approach to covalent bonding: Valence bond theory - Its important features, concept of hybridization involving *s*, *p* and *d* orbitals; Resonance.

Molecular orbital theory - Its important features, LCAOs, types of molecular orbitals (bonding, antibonding), sigma and pi-bonds, molecular orbital electronic configurations of homonuclear diatomic molecules, concept of bond order, bond length and bond energy.

Elementary idea of metallic bonding.

Hydrogen bonding and its applications.

Unit 5 Chemical Thermodynamics

Fundamentals of thermodynamics: System and surroundings, extensive and intensive properties, state functions, types of processes.

First law of thermodynamics : Concept of work, heat internal energy and enthalpy, heat capacity, molar heat capacity; Hess's law of constant heat summation; Enthalpies of bond dissociation, combustion, formation, atomization, sublimation, phase transition, hydration, ionization and solution.

Second law of thermodynamics : Spontaneity of processes; DS of the universe and DG of the system as criteria for spontaneity, DG° (Standard Gibbs energy change) and equilibrium constant.

Unit 6 Solutions

Different methods for expressing concentration of solution - molality, molarity, mole fraction, percentage (by volume and mass both), vapour pressure of solutions and Raoult's Law - Ideal and non-ideal solutions, vapour pressure - composition, plots for ideal and non-ideal solutions; Colligative properties of dilute solutions - relative lowering of vapour pressure, depression of freezing point, elevation of boiling point and osmotic pressure; Determination of molecular mass using colligative properties; Abnormal value of molar mass, van't Hoff factor and its significance.

Unit 7 Equilibrium

Meaning of equilibrium, concept of dynamic equilibrium.

Equilibria involving physical processes: Solid -liquid, liquid - gas and solid - gas equilibria, Henry's law, general characteristics of equilibrium involving physical processes.

Equilibria involving chemical processes: Law of chemical equilibrium, equilibrium constants (K_p and K_c) and their significance, significance of DG and DG° in chemical equilibria, factors affecting equilibrium concentration, pressure, temperature, effect of catalyst; Le-Chatelier's principle.

Ionic equilibrium: Weak and strong electrolytes, ionization of electrolytes, various concepts of acids and bases (Arrhenius, Bronsted - Lowry and Lewis) and their ionization, acid - base equilibria (including multistage ionization) and ionization constants, ionization of water, pH scale, common ion effect, hydrolysis of salts and pH of their solutions, solubility of sparingly soluble salts and solubility products, buffer solutions.

Unit 8 Redox Reactions and Electrochemistry

Electronic concepts of oxidation and reduction, redox reactions, oxidation number, rules for assigning oxidation number, balancing of redox reactions.

Eectrolytic and metallic conduction, conductance in electrolytic solutions, specific and molar conductivities and their variation with concentration: Kohlrausch's law and its applications.

Electrochemical cells - Electrolytic and Galvanic cells, different types of electrodes, electrode potentials including standard electrode potential, half - cell and cell reactions, emf of a Galvanic cell and its measurement; Nernst equation and its applications; Relationship between cell potential and Gibbs' energy change; Dry cell and lead accumulator; Fuel cells; Corrosion and its prevention.

Unit 9 Chemical Kinetics

Rate of a chemical reaction, factors affecting the rate of reactions: concentration, temperature, pressure and catalyst; elementary and complex reactions, order and molecularity of reactions, rate law, rate constant and its units, differential and integral forms of zero and first order reactions, their characteristics and half - lives, effect of temperature on rate of reactions - Arrhenius theory, activation energy and its calculation, collision theory of bimolecular gaseous reactions (no derivation).

Unit 10 Surface Chemistry

Adsorption : Physisorption and chemisorption and their characteristics, factors affecting adsorption of gases on solids - Freundlich and Langmuir adsorption isotherms, adsorption from solutions.

Catalysis : Homogeneous and heterogeneous, activity and selectivity of solid catalysts, enzyme catalysis and its mechanism.

Colloidal state : distinction among true solutions, colloids and suspensions, classification of colloids - lyophilic, lyophobic; multi molecular, macromolecular and associated colloids (micelles), preparation and properties of colloids - Tyndall effect, Brownian movement, electrophoresis, dialysis, coagulation and flocculation; Emulsions and their characteristics.

SECTION-B

INORGANIC CHEMISTRY

Unit 11 Classificaton of Elements and Periodicity in Properties

Modem periodic law and present form of the periodic table, *s*, *p*, *d* and *f* block elements, periodic trends in properties of elementsatomic and ionic radii, ionization enthalpy, electron gain enthalpy, valence, oxidation states and chemical reactivity.

Unit 12 General Principles and Processes of Isolation of Metals

Modes of occurrence of elements in nature, minerals, ores; Steps involved in the extraction of metals - concentration, reduction (chemical and electrolytic methods) and refining with special reference to the extraction of Al, Cu, Zn and Fe; Thermodynamic and electrochemical principles involved in the extraction of metals.

Unit 13 Hydrogen

Position of hydrogen in periodic table, isotopes, preparation, properties and uses of hydrogen; Physical and chemical properties of water and heavy water; Structure, preparation, reactions and uses of hydrogen peroxide; Classification of hydrides - ionic, covalent and interstitial; Hydrogen as a fuel.

Unit 14 *s*-Block Elements (Alkali and Alkaline Earth Metals)

Group - 1 and 2 Elements

General introduction, electronic configuration and general trends in physical and chemical properties of elements, anomalous properties of the first element of each group, diagonal relationships.

Preparation and properties of some important compounds - sodium carbonate, sodium chloride, sodium hydroxide and sodium hydrogen carbonate; Industrial uses of lime, limestone, Plaster of Paris and cement; Biological significance of Na, K, Mg and Ca.

Unit 15 *p*-Block Elements

Group-13 to Group 18 Elements

General Introduction: Electronic configuration and general trends in physical and chemical properties of elements across the periods and down the groups; unique behaviour of the first element in each group.

Groupwise study of the p– block elements

Group - 13

Preparation, properties and uses of boron and aluminium; Structure, properties and uses of borax, boric acid, diborane, boron trifluoride, aluminium chloride and alums.

Group-14

Tendency for catenation; Structure, properties and uses of allotropes and oxides of carbon, silicon tetrachloride, silicates, zeolites and silicones.

Group-15

Properties and uses of nitrogen and phosphorus; Allotropic forms of phosphorus; Preparation, properties, structure and uses of ammonia, nitric acid, phosphine and phosphorus halides, (PCl_3, PCl_5); Structures of oxides and oxoacids of nitrogen and phosphorus.

Group - 16

Preparation, properties, structures and uses of dioxygen and ozone; Allotropic forms of sulphur; Preparation, properties, structures and uses of sulphur dioxide, sulphuric acid (including its industrial preparation); Structures of oxoacids of sulphur.

Group - 17

Preparation, properties and uses of chlorine and hydrochloric acid; Trends in the acidic nature of hydrogen halides; Structures of Interhalogen compounds and oxides and oxoacids of halogens.

Group -18

Occurrence and uses of noble gases; Structures of fluorides and oxides of xenon.

Unit 16: *d*- and *f* – Block Elements

Transition Elements

General introduction, electronic configuration, occurrence and characteristics, general trends in properties of the first row transition elements - physical properties, ionization enthalpy, oxidation states, atomic radii, colour, catalytic behaviour, magnetic properties, complex formation, interstitial compounds, alloy formation; Preparation, properties and uses of $K_2Cr_2O_7$ and $KMnO_4$.

Inner Transition Elements

Lanthanoids : Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction.

Actinoids : Electronic configuration and oxidation states.

Unit 17 Coordination Compounds

Introduction to coordination compounds, Werner's theory; ligands, co-ordination number, denticity, chelation; IUPAC nomenclature of mononuclear coordination compounds, isomerism; Bonding-Valence bond approach and basic ideas of crystal field theory, colour and magnetic properties; Importance of coordination compounds (in qualitative analysis, extraction of metals and in biological systems).

Unit 18 Environmental Chemistry

Environmental pollution : Atmospheric, water and soil.

Atmospheric pollution : Tropospheric and stratospheric

Tropospheric pollutants : Gaseous pollutants: Oxides of carbon, nitrogen and sulphur, hydrocarbons; their sources, harmful effects and prevention; Green house effect and Global warming; Acid rain;

Particulate pollutants: Smoke, dust, smog, fumes, mist; their sources, harmful effects and prevention.

Stratospheric pollution : Formation and breakdown of ozone, depletion of ozone layer - its mechanism and effects.

Water pollution : Major pollutants such as, pathogens, organic wastes and chemical pollutants; their harmful effects and prevention.

Soil pollution : Major pollutants such as: Pesticides (insecticides,. herbicides and fungicides), their harmful effects and prevention.

Strategies to control environmental pollution.

Section-C

Organic Chemistry

Unit 19 Purification and Characterisation of Organic Compounds

Purification : Crystallization, sublimation, distillation, differential extraction and chromatography - principles and their applications.

Qualitative analysis : Detection of nitrogen, sulphur, phosphorus and halogens.

Quantitative analysis (basic principles only) : Estimation of carbon, hydrogen, nitrogen, halogens, sulphur, phosphorus.

Calculations of empirical formulae and molecular formulae; Numerical problems in organic quantitative analysis.

Unit 20 Some Basic Principles of Organic Chemistry

Tetravalency of carbon; Shapes of simple molecules - hybridization (s and *p*); Classification of organic compounds based on functional groups: $-C=C-$, $-C\equiv C-$ and those containing halogens, oxygen, nitrogen and sulphur; Homologous series; Isomerism - structural and stereoisomerism.

Nomenclature (Trivial and IUPAC)

Covalent bond fission : Homolytic and heterolytic: free radicals, carbocations and carbanions; stability of carbocations and free radicals, electrophiles and nucleophiles.

Electronic displacement in a covalent bond : Inductive effect, electromeric effect, resonance and hyperconjugation.

Common types of organic reactions - Substitution, addition, elimination and rearrangement.

Unit 21 Hydrocarbons

Classification, isomerism, IUPAC nomenclature, general methods of preparation, properties and reactions.

Alkanes : Conformations: Sawhorse and Newman projections (of ethane); Mechanism of halogenation of alkanes.

Alkenes - Geometrical isomerism; Mechanism of electrophilic addition: addition of hydrogen, halogens, water, hydrogen halides (Markownikoff's and peroxide effect); Ozonolysis, oxidation, and polymerization.

Alkynes : Acidic character; Addition of hydrogen, halogens, water and hydrogen halides; Polymerization.

Aromatic hydrocarbons : Nomenclature, benzene - structure and aromaticity; Mechanism of electrophilic substitution: halogenation, nitration, Friedel – Craft's alkylation and acylation, directive influence of functional group in mono-substituted benzene.

Unit 22 Organic Compounds Containing Halogens

General methods of preparation, properties and reactions; Nature of C-X bond; Mechanisms of substitution reactions.
Uses; Environmental effects of chloroform, iodoform, freons and DDT.

Unit 23 Organic Compounds Containing Oxygen

General methods of preparation, properties, reactions and uses.

Alcohols, Phenols and Ethers

Alcohols: Identification of primary, secondary and tertiary alcohols; mechanism of dehydration.
Phenols: Acidic nature, electrophilic substitution reactions: halogenation, nitration and sulphonation, Reimer - Tiemann reaction.
Ethers: Structure.
Aldehyde and Ketones: Nature of carbonyl group;
Nucleophilic addition to >C=O group, relative reactivities of aldehydes and ketones; Important reactions such as - Nucleophilic addition reactions (addition of HCN, NH_3 and its derivatives), Grignard reagent; oxidation; reduction (Wolff Kishner and Clemmensen); acidity of α - hydrogen, aldol condensation, Cannizaro reaction, Haloform reaction; Chemical tests to distinguish between aldehydes and ketones.

Carboxylic Acids

Acidic strength and factors affecting it.

Unit 24 Organic Compounds Containing Nitrogen

General methods of preparation, properties, reactions and uses.
Amines: Nomenclature, classification, structure, basic character and identification of primary, secondary and tertiary amines and their basic character.
Diazonium Salts: Importance in synthetic organic chemistry.

Unit 25 Polymers

General introduction and classification of polymers, general methods of polymerization - addition and condensation, copolymerization; Natural and synthetic rubber and vulcanization; some important polymers with emphasis on their monomers and uses - polythene, nylon, polyester and bakelite.

Unit 26 Biomolecules

General introduction and importance of biomolecules.
Carbohydrates : Classification: aldoses and ketoses; monosaccharides (glucose and fructose), constituent monosaccharides of oligosaccharides (sucrose, lactose, maltose) and polysaccharides (starch, cellulose, glycogen).
Proteins : Elementary Idea of α - amino acids, peptide bond, polypeptides; Proteins: primary, secondary, tertiary and quaternary structure (qualitative idea only), denaturation of proteins, enzymes.
Vitamins : Classification and functions.
Nucleic Acids : Chemical constitution of DNA and RNA.
Biological functions of nucleic acids.

Unit 27 Chemistry in Everyday Life

Chemicals in medicines : Analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamins - their meaning and common examples.
Chemicals in food : Preservatives, artificial sweetening agents - common examples.
Cleansing agents : Soaps and detergents, cleansing action.

Unit 28 Principles Related To Practical Chemistry

- Detection of extra elements (N,S, halogens) in organic compounds; Detection of the following functional groups: hydroxyl (alcoholic and phenolic), carbonyl (aldehyde and ketone), carboxyl and amino groups in organic compounds.
- Chemistry involved in the preparation of the following:

Inorganic compounds: Mohr's salt, potash alum.
Organic compounds: acetanilide, *p*-nitroacetanilide, aniline yellow, iodoform.

- Chemistry involved in the titrimetric excercises - Acids bases and the use of indicators, oxalic-acid vs $KMnO_4$, Mohr's salt vs $KMnO_4$.
- Chemical principles involved in the qualitative salt analysis:

Cations - Pb^{2+}, Cu^{2+}, Al^{3+}, Fe^{3+}, Zn^{2+}, Ni^{2+}, Ca^{2+}, Ba^{2+}, $Mg2+$, NH_4^+.
Anions- CO_3^{2-}, S^{2-}, So_4^{2-}, No^{2-}, No^{33-}, Cl^-, Br, I.
(Insoluble salts excluded).

- Chemical principles involved in the following experiments:

1. Enthalpy of solution of $CuSO_4$
2. Enthalpy of neutralization of strong acid and strong base.
3. Preparation of lyophilic and lyophobic sols.
4. Kinetic study of reaction of iodide ion with hydrogen peroxide at room temperature.