PAPER- FIRST

No. of Questions : 150 **Time : 03 Hrs**

Unit I : Kinematics

Frame of reference, Motion in a straight line, Uniform and non - uniform motion, Uniformly accelerated motion, velocity-time, position-time graphs, relations for uniformly accelerated motion, Elementary concepts of differentiation and integration for describing motion, Scalar and vector quantities: Position and displacement vectors, general vectors and notation, equality of vectors, Relative velocity, Unit vector, Resolution of a vector in a plane – rectangular components, Motion in a plane, Cases of uniform velocity and uniform acceleration-projectile motion, Uniform circular motion.

Unit II : Laws of Motion

Concept of force, Inertia, Newton's first law of motion, Newton's second law of motion, impulse, Newton's third law of motion, Law of conservation of linear momentum and its applications, Static and kinetic friction, laws of friction, rolling friction, Dynamics of uniform circular motion, Centripetal force and its examples.

Unit III : Work, Energy and Power

Work, kinetic energy, work-energy theorem, power, Potential energy of a spring, conservative forces, conservation of mechanical energy, non-conservative forces, elastic and inelastic collisions in one and two dimensions.

Unit IV : Classical Mechanics

D' Alembert's principle, Central force motions, Kepler's laws and equations, Artificial Satellite, Lagrange and Possion bracket, Canonical transformations, Hamilton – Jacobi equation, Action angle variable, Lagrangian and Hamiltonian formalism and equations of motion, Special theory of relativity - Lorentz transformations, relativistic kinematics and mass–energy equivalence.

Unit V : Oscillations and Waves

Periodic motion, Periodic functions. Simple harmonic motion (S.H.M) and its equation, phase, oscillations of a spring-restoring force and force constant,energy in S.H.M.-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 wave motion, 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.

Unit VI : Gravitation

Keplar's laws of planetary motion, law of gravitation, Acceleration due to gravity and its variation with altitude and depth, Gravitational potential energy, gravitational potential, Escape velocity, Orbital velocity of a satellite, Geo-stationary satellites.

Unit VII : Electrostatics

Electric Charges; Coulomb's law, Electric field, electric field due to a point charge, charge distribution and dipole, torque on a dipole in uniform electric field, Electric flux, Gauss's theorem and its applications. Electric potential, potential difference, Electric field as a negative gradient of electric potential, electric potential due to a point charge, a dipole, charge distribution and system of charges, equipotential surfaces, electrical potential energy of a system of two point charges and electric dipole in an electrostatic field.

Conductors and insulators, Dielectrics and electric polarisation, capacitors and capacitance, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor. Van de Graaff generator.

Unit VIII : Electric Conduction

Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current, Lorentz – Drude theory of electrical conduction, Wiedmann – Franz's law, Ohm's law, electrical energy and power, electrical resistivity and conductivity. Carbon resistors, colour code for carbon resistors, temperature dependence of resistance, Kirchhoff's laws and its applications.

Unit IX : Magnetic Effects of Current and Magnetism

Biot – Savart law and its application, Ampere's law and its applications, 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, moving coil galvanometer 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 a magnetic dipole along its axis and perpendicular to its axis, Torque on a magnetic dipole in a uniform magnetic field; magnetic field lines; Para-, dia- and ferro – magnetic substances with examples, Electromagnets and factors affecting their strengths.

Unit X : 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 and voltage, reactance and impedance, LCR series and parallel circuit, resonance, power in AC circuits, wattless current, AC generator and transformer.

Unit XI : Mathematical Methods of Physics

Vector algebra and vector calculus, Gauss, Stokes and Green's theorem, Matrices: orthogonal, unitary and Hermitian matrices, Eigen values and eigen vectors of matrics, Special functions (Legendre, Bessel, Hermite and Laguerre functions), Tensor: covariant, contravariant and mixed tensors, Epsilon, Christoffel and Ricci tensor.

Physics

PAPER- SECOND

No. of Questions : 150 **Time : 03 Hrs**

Unit I : Electromagnetic waves

Displacement current, Electromagnetic waves and their characteristics, Transverse nature of electromagnetic waves, Electromagnetic spectrum, Maxwell's equations in free space and linear isotropic media, boundary conditions on the fields at interfaces, Scalar and vector potentials, gauge invariance, Electromagnetic waves in free space, Poynting vector, Poynting theorem, energy and momentum of electromagnetic waves.

Unit II : Optics

Reflection of light, spherical mirrors, mirror formula, Refraction of light, total internal reflection and its applications, optical fibres, refraction at spherical surfaces, lenses, thin lens formula, lensmaker's formula, Magnification, power of a lens, combination of thin lenses in contact, Refraction and dispersion of light through a prism, Scattering of light – blue colour of the sky and reddish appearance of the sun at sunrise and sunset.

Optical instruments: Human eye, image formation and accommodation, correction of eye defects using lenses, Microscopes and astronomical telescopes and their magnifying powers.

Wave optics: wave front and Huygens' principle, reflection and refraction of plane wave at a plane surface using wave fronts, Proof of laws of reflection and refraction using Huygens' 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 polarised light, Brewster's law, uses of plane polarised light and Polaroids.

Unit III : Thermodynamics

Zeroth law of thermodynamics, Heat, work and internal energy, First and Second law of thermodynamics, reversible and irreversible processes, Heat engines and refrigerators, Third law of thermodynamics.

Unit IV : Behaviour of Perfect Gas and Kinetic Theory

Equation of state of a perfect 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 and application to specific heats of gases, Mean free path, Avogadro's number.

Unit V : Dual Nature of Matter and Radiation

Dual nature of radiation, Photoelectric effect, Hertz and Lenard's observations, Einstein's equation of photoelectric effect, particle nature of light, Matter waves, wave nature of particles, de Broglie relation, Davisson - Germer experiment, Wave - particle duality, Wave functions in coordinate and momentum representations, Commutator and Heisenberg's uncertainty principle, Dirac's notation for state vectors, Schrödinger equation (time - dependent and time -independent), Eigen value problems (particle in a box, harmonic oscillator, etc.), Tunneling through a barrier.

Unit VI : 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 and their properties, radioactive decay

law, Mass-energy relation, mass defect, binding energy per nucleon and its variation with mass number, nuclear fission, nuclear reactor, nuclear fusion.

Unit VII : Atomic and Molecular Physics

Quantum states of an electron in an atom, Electron spin, Hund's rule, Pauli exclusion principle, Stern - Gerlach experiment, Zeeman, Paschen - Back and Stark effect, X- ray spectroscopy, Lasers, spontaneous and stimulated emission, Einstein A and B coefficients, Optical pumping, population inversion, rate equation, Modes of resonators and coherence length.

Unit VIII : Nuclear and Particle Physics

Basic nuclear properties: size, shape and charge distribution, spin and parity, Binding energy, semi - empirical mass formula, liquid drop model, Nature of the nuclear force, Particle accelerators and detectors, Classification of elementary particles, Fundamental interactions, Elementary particles and their quantum numbers, symmetries and conservation laws, Lepton and Baryon numbers, Gellmann - Nishijima formula, Quark model.

Unit IX : Electronic Devices

Semiconductors; semiconductor diode, diode as a rectifier, 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 and oscillator, Number system: binary, octal, hexadecimal, BCD code, Gray code. Boolean algebra, De Morgan's law, Logic circuits: OR-gate, AND- gate, NOT- gate, NAND - gate, NOR - gate and XOR - gate, Digital techniques and applications (registers, counters, comparators and similar circuits), Operational amplifiers and their applications.

Unit X : Communication Systems

Elements of a communication system, bandwidth of signals, bandwidth of transmission medium, Propagation of electromagnetic waves in the atmosphere, sky and space wave propagation, Need for modulation, Production and detection of an amplitude-modulated wave, Computer and communications, Need for communication networks, Internet, World Wide Web, Communication protocols, Local Area Network.

Unit XI : Condensed Matter Physics

Bravais lattices. Reciprocal lattice, Diffraction and the structure factor, Bonding of solids, Elastic properties, phonons, lattice specific heat, Free electron theory and electronic specific heat, Response and relaxation phenomena, Drude model of thermal conductivity, band theory of solids: metals, insulators and semiconductors, Superconductivity.

भौतिक शास्त्र

प्रश्नपत्र – प्रथम