

PHYSICS

PAPER—I

I. Mechanics:

- Vectors: Dots, Cross and triple products
- Gradient, Divergence, Curl and their applications
- Newtonian Laws of Motion
- Calculus-based approach to Kinematics, Forces and Dynamics
- Conservation Law of Energy
- Conservation of linear and angular momentum
- Dynamics of a Rigid body
- Spin and Precession
- Gyroscope
- Gravitation
- Planetary motion and Satellites
- Kepler's laws
- Centripetal forces
- Special theory of Relativity
- Michelson-Morley experiment and Einstein's postulates
- Lorentz transformation
- Time Dilation and Length Contraction
- Equivalence of mass and energy

II. Fluid Mechanics:

- Surface Tension
- Viscosity
- Elasticity
- Fluid motion
- Bernoulli's Theorem

III. Waves and Oscillations, Optics:

- Free oscillation with one and two degrees of freedom; forced and damped oscillations and phenomenon of resonance
- Simple harmonic motion
- Traveling waves and transmission of Energy
- Phase and Group velocity
- Standing Waves
- Basics of Sound Waves
- Reflection, Refraction, Interference, Diffraction and Polarization of waves
- Interferometer
- Newton's rings
- Diffraction Gratings and their Resolving Power
- Spectrometers
- Electromagnetic Wave Equation
- Normal and Anomalous dispersion
- Coherence
- Lasers and their applications

IV. Heat and Thermodynamics:

- Perfect gas & Real gas
- Van der Waals equation
- Three Laws of Thermodynamics
- Internal energy, Temperature & Entropy
- Thermal properties of simple systems
- Kinetic Theory of Gases
- Maxwellian distribution of molecular velocities
- Brownian motion
- Transport phenomena
- Classical Maxwell-Boltzmann Statistics and its application; Bose-Einstein and Fermi-Dirac Statistics.

PHYSICS

PAPER-II

I. Electricity and Magnetism:

- Electric field due to point charges
- Gauss' Law
- Electric Potential
- Poisson and Laplace's equations
- Dielectric medium and Polarization
- Capacitance
- Moving charges and resulting magnetic field
- Ampere's Law
- Magnetic properties of Matter
- Faraday's Law of Electromagnetic Induction
- Alternating current and RLC circuit
- Poynting Theorem and Poynting Vector
- Maxwell's equations in integral and differential form
- Scalar and Vector potential

II. Modern and Quantum Physics:

- Waves and Particles and De Broglie's Hypothesis
- Operators and quantum states; observables
- Time-dependent and independent Schrodinger equation
- Angular momentum & spin-1/2 particle in a magnetic field
- Wave mechanics; particle in a box; tunneling
- One-dimensional Harmonic Oscillator
- Heisenberg's uncertainty relationship and indeterminacy based on commutation properties of operators
- Bohr's theory and quantum numbers including electron spin
- Pauli's Exclusion Principle
- Spectra of simple systems with one or two valence electrons
- Photoelectric effect
- Compton scattering; pair production
- Lande g-factor and Zeeman Effect
- Raman Effect

III. Solid State Physics:

- Crystal Lattice and structure
- Bravais Lattice
- Free Electron model
- Band theory and electron in a periodic potential
- Fermi energy and density of states
- n-type and p-type semiconductors
- Physics of the Transistor and MOSFET
- Dielectric properties
- Magnetic properties and origin of magnetism

IV. Nuclear Physics:

- Structure of Nuclei
- Radioactivity, α , β and gamma decay
- Methods of detection of nuclear radiation
- Mass Spectrometer
- Accelerators
- Phenomenon of Fission
- Reactor and Nuclear Power
- Nuclear Fusion and its applications
- Elementary particles and their properties