B.Sc. I-Physics

SEMESTER I

PAPER I

Mechanics

Unit-1:

Laws of motion, motion in an uniform field, radial and transverse components of velocity and acceleration, inertial and non-inertial frames, uniform rotating frame, centripetal acceleration, coriolis force and acceleration and its applications.

Unit-2:

Motion under central force, inverse square law, Kepler's law, gravitational law, gravitational field and potential, gravitational field due to a thin spherical shell, gravitational shell, gravitational self energy.

Unit-3:

Conservation of energy, law of conservation of energy, work-energy theorem, conservative forces, potential energy, conservation of energy of a particle, motion of a body near the surface of earth.

Unit-4:

Conservation of linear and angular momentum, centre of mass, determination of centre of mass of a thin triangular plate, semi-circular lamina, right circular cone and of a solid hemisphere, elastic and inelastic collision, single and multi stage rockets.

B.Sc. I-Physics

SEMESTER I

PAPER II

Oscillation and Waves

Unit-1:

Oscillation: Simple harmonic motion, differential equation and its solution, average value of kinetics and potential energy in S.H.M examples of simple harmonic motion; spring mass system, simple and compound pendulum and tensional pendulum.

Unit-2:

Coupled oscillations: motion of two coupled oscillations, normal modes and normal coordinates, equation of motion and normal modes of transverse oscillations of (N) coupled oscillations, Damped and Forced oscillations.

Unit-3:

Fourier series and Weaves in media: Fourier series, Fourier analysis of square, saw tooth and triangular wave, equation and speed of longitudinal wave (sound waves) in gases, energy density, energy flux, transverse waves in stretched strings.

Unit-4:

Superposition of waves: Superposition principle, interference of waves, beats, superposition of N-harmonic waves, wave packet, wave velocity and group velocity.

B.Sc. I-Physics

SEMESTER I

PAPER III

Vector and Electrostatics

Unit-1:

Scalars and vectors dot and cross products, gradient of a scalar field and its geometrical interpretation, divergence and curl of a vector field.

Unit-2:

Line, surface and volume integrals, flux of a vector field, Gauss's and Stokes theorem.

Unit-3:

Coulomb's law in vacuum expressed in vector form, calculation of E for simple distributions, work done on a charge in an electrostatic field expressed as a line integral, conservative nature of the electric field, electric potential, torque on a dipole in an uniform electric field, Gauss's law and its application for finding E for symmetric charge distributions, screening of E field by a conductor.

Unit-4:

Capacitors electrostatic field energy, force per unit area of the surface of a conductor in an electric field, dielectrics, parallel plate capacitors with a dielectric, dielectric constant, polarization and polarization vectors, displacement vector D.

B.Sc. I-Physics

SEMESTER II

PAPER I

Properties of Matter

Unit-1:

Rigid body motion, rotational motion, moments of inertia, radius of gyration, theorems on moment on inertia, calculation of moment of inertia of a uniform rod, rectangular lamina, cuboids, circular ring, disc, solid cylinder, thin spherical shell, hollow sphere and solid sphere, Moment of inertia of flywheel.

Unit-2:

Elasticity small deformations, Hooke's law, elastic constants for an isotropic solid, beam supported at ends, cantilever, torsion of a cylinder, bending moment and shearing forces.

Unit-3:

Kinematics of moving fluids, equation of continuity, Euler's equation, Bernoulli's theorem, viscous fluids, streamline and turbulent flow, Poiseiulle's law, capillary tube flow, Reynolds's number, stroke's law.

Unit-4:

Surface tension, molecular interpretation of surface tension, surface energy, pressure on a curved liquid surface, Jaeger's method to determine surface tension of liquids.

B.Sc. I-Physics

SEMESTER II

PAPER II

Kinetic theory of gases

Unit-1:

Ideal gas: Kinetic model, expression for pressure, Maxwell's law of distribution of velocities, deduction of gas laws, interpretation of temperature, estimation of rms speeds, Avogadro's number, equipartition of energy, specific heat of monatomic gases extension to diatomic and triatomic gases, behaviour at low temperature, Brownian motion.

Unit-2:

Transportation phenomenon in gases; molecular collision, mean free path and collision cross-section, estimates of molecular diameter and mean free path, transport of mass, momentum, energy and interrelationship, dependence of pressure and temperature.

Unit-3:

Real gas; Van der waall's gas, equation of state, nature of van der waall's forces, comparison with experimental P-V curves, the critical constants, joule expansion of ideal gas, and of Van der Waall's gas, Joule coefficient, estimate of J-T cooling.

Unit-4:

Liquification of gases; Boyle temperature and inversion temperature, principle of regenerative cooling and of cascade cooling, liquifiction of hydrogen and helium, cooling due to adiabatic demagnetization, production and measurement of very low temperature.

B.Sc. I-Physics

SEMESTER II

PAPER III

Magnetostatics and Electric Current

Unit-1:

Force on a moving charge, Lorentz force equation, and definition of B, Force on a straight conductor carrying current in a uniform magnetic field, torque on a current loop, magnetic dipole moment, and angular momentum.

Unit-2:

Biot-Sevart law, calculation of H in simple geometrical situations, Ampere's law $V.B=0$, $V\times B=\mu_0 J$.

Unit-3:

Steady current, current density J, non-steady currents and continuity equation, Kirchhoff's law and analysis of multiloop circuits, rise and decay of current in LR and CR circuits, decay constants, transients in LCR circuits.

Unit-4:

AC circuits; Complex number ad their application in solving AC circuit problems, complex impedance and reactance, series and parallel resonance, Q factor and sharpness of resonance, power consumed by an AC circuit, power factor.

B.Sc. II-Physics

SEMESTER III

PAPER I

Heat and Thermodynamics

Unit-1:

The concept of heat and temperature, thermal equilibrium and Zeroth law of thermodynamics, equivalence of work and heat, word done by and on the system, first law of thermodynamics, internal energy as a state function, and other application.

Unit-2:

Reversible and irreversible changes, Carnot cycle and its efficiency, refrigeration cycles, Carnot's theorem and second law of thermodynamics, different versions of second law practical cycles used in internal combustion engines, entropy, principal of increase of entropy, the thermodynamic scale of temperature, impossibility of attaining the absolute zero, Third law of thermodynamics.

Unit-3:

Thermodynamic intensive and extensive variables, maxwell's general relations, application to Joule-Thomson cooling, Van der Waal's gas.

Unit-4:

Clausius theorem, Clausius-Clapeyron latent heat equation, thermodynamic potentials and equilibrium of thermodynamical systems, relation with thermodynamical variables e.g. Helmholtz function, Gibb's function, Enthalpy.

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SEMESTER III

PAPER II

General Optics

Unit-1:

Fermat's principle, principle of extreme path, the aplanatic points of a sphere, general theory of image formation, cardinal points of an optical system, general relationship, Newton's formulae and lens formula.

Unit-2:

Eyepieces (Ramsden and Huygens), condition for achromatism of two thin lenses separated by finite distance, telephoto lens.

Unit-3:

The principal of superposition's, two-slit interference, coherence requirement for the sources, phase difference and path difference, analytical treatment of interference, theory of interference fringes.

Unit-4:

Newton's rings, determination of wavelength of sodium light and refractive index of a liquid using Newton's rings, Michelson interferometer, application for precision determination of wavelength, wavelength difference and width of the spectral lines, Fabray-Perot interferometer and etalon.

B.Sc. II-Physics

SEMESTER III

PAPER III

Semiconductor Physics

Unit-1:

Semiconductors: Intrinsic semiconductor, doping, extrinsic semiconductors, electrons and holes. N-Type semiconductors, conductivity, mobility, Fermi level; position of Fermi level in intrinsic semiconductors, concentration of holes and electrons in intrinsic semiconductors.

Unit-2:

Junction diode: P-N junction diode, biasing, depletion layer; width and potential barrier, diode as circuit element , load line, concept of rectification; half and full wave rectifier, ripple factor, Zener and avalanche breakdown, Zener diode, voltage stabilization.

Unit-3:

Transistor: Biasing, formation of BJT, working and principle of P-N-P and N-P-N transistor, CB, CE and CC configurations and their characteristics, early effect, Q-point and stabilization.

Unit-4:

Field Effects Transistor: JFET, Volt-ampere curves, biasing JFET, ac operation of JFET, depletion and enhancement modes, MOSFET.

B.Sc. II-Physics

SEMESTER IV

PAPER I

Relativity and Modern Physics

Unit-1:

Reference systems inertial frames, Galilean transformation, Michelson-Morely experiment ether hypothesis.

Unit-2:

Postulates for special theory of relativity, Lorentz transformation, length contraction, time dilation, velocity addition theorem, variation of mass with velocity, mass-energy equivalence, particle with zero rest mass.

Unit-3:

Black body spectrum, photoelectric effect, Planck's radiation law, Einstein's explanation of photoelectric effect, Compton Effect.

Unit-4:

Wave particle duality and uncertainty principles: de Broglie's hypothesis for matter waves, the concept of wave and group velocities.

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SEMESTER IV

PAPER II

Optics

Unit-1:

Fresnel diffraction: Fresnel half-period zones plates, straight edge, rectilinear propagation; Fraunhofer diffraction; diffraction a slit, intensity distribution, diffraction at a circular aperture.

Unit-2:

Rayleigh criterion, resolving power of a telescope and microscope, concave grating and Rowland mountings, resolving power of prism.

Unit-3:

Polarization by reflection and refraction, Brewster's law, double refraction, Huygen's explanation of double refraction in uniaxial crystals.

Unit-4:

Double image, polarizing prisms, elliptically and circularly polarized light, optical activity, Fresnel's explanation of rotation, specific rotation.

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SEMESTER IV

PAPER III

Electronics

Unit-1:

Circuit Analysis-Network theorems-Superposition, Thevenin's Norton's and maximum power transfer, reciprocity.

Unit-2:

Hybrid parameters, hybrid equivalent circuit of transistor in CE configuration, RC Coupled CE transistor amplifier and its frequency response.

Unit-3:

Classification of amplifier, power amplifiers (distortion and efficiency), transformer coupled amplifier, phushpull amplifier, tuned voltage amplifier.

Unit-4:

Amplifiers, concept of feedback, stabilization of gain by negative feedback, effect of feedback on output and input resistance, reduction for non-linear distortion by negative feedback.

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SEMESTER V

PAPER I

Quantum mechanics

Unit-1:

Failure of classical physics to explain photoelectric effect and black body radiation, need for quantum mechanics, operator methods in quantum mechanics, operator algebra, null operator, inverse operator, commutator, eigen value and eigen functions, states momentum operator, velocity operator linear operators, hermitian operators, properties of hermitian operator and numerical problems, postulates of quantum mechanics and principle of superposition of states, uncertainty relation.

Unit-2:

The Schrodinger's wave equations (time dependent and independent) and its solutions, wave functions and its interpretation, normalization of wave functions, expectations value and Ehrenfest's theorem.

Unit-3:

Application of Schrodinger wave equation (one dimensional potential barrier, single step barrier, particle in infinitely deep box, rectangular potential barrier, a square well potential), linear harmonic oscillator.

Unit-4:

Application of Schrödinger wave equation (Potential problems in three dimension and hydrogen atom, a three dimension linear harmonic oscillator, spherical symmetric system and the Schrodinger equation for the hydrogen atom, n, l and m quantum numbers and their physical significance.

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SEMESTER V

PAPER II

Atomic and Nuclear Physics

Unit-1:

Energy levels and optical spectra of alkali metal atoms, screening constants for s, p, d and f states, electron spin, spin orbit interaction (using vector atom model) and doublet fine structure (of alkali atoms only).

Unit-2:

Many electron atoms: Coupling cases of two valence electron atoms: L-S and J-J coupling, Energy level of alkaline earth atoms and their singlet and triplet fine structure, spectral terms of alkali and alkaline earth atoms.

Unit-3:

Discrete set of electronic energies of molecules, salient features of rotational spectra, molecule as a rigid rotator (pure rotational spectra), determination of inter-nuclear distance, transition rule for pure rotational spectra, non-rigid rotator, isotope effect.

Unit-4:

Vibrational spectra (IR spectra): Salient features of vibrational spectra, molecule as a harmonic oscillator, anharmonic oscillator, selection rule for vibrational-rotational transition, Raman effect, Stoke and anti-stoke lines, quantum explanation of Raman spectra.

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SEMESTER V

PAPER III

Solid State Physics

Unit-1:

Crystal structure space lattice and basis, fundamental translations vectors, unit cell Weigener-Seitz cell, seven crystal system, common crystal structures (s.c., b.s.c., f.c.c and h.c.p. latticies), Miller indices, Reciprocal lattices.

Unit-2:

Crystal diffraction, X-ray spectra: weak spectra, continuous X-Ray spectrum and its dependence on voltage, Duane and Hunts law, X-Rays, Mosley's law, x-ray absorption spectrum, doublet structure of X-ray spectra, Bragg's law and Laue pattern.

Unit-3:

Thermal properties: Lattice vibration, mono and di atomic molecules-acoustic and optical modes.

Unit-4:

Band structures: Electrons in periodic potential, Kronig penny model, Brillion zone.

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SEMESTER V

PAPER IV

Electromagnetic Theory

Unit-1:

Gauss law of electromagnetic and magnetostatics, Ampere's law, Electromagnetic induction, Faraday's law, electromotive force, integral and differential form of Faraday's law.

Unit-2:

Electromagnetic waves and Maxwell's equation, Maxwell's equation in integral and differential forms, Derivation of Maxwell's equation, significance of Maxwell's equation, Vector and scalar potentials, gauge transformation .

Unit-3:

Wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, continuity equation, wave equation in dielectric media, concept of displacement current, Poynting theorem.

Unit-4:

Boundary condition at the surface of discontinuity, Reflection and refraction of electromagnetic waves at the interface of non-conducting (dielectric) media, polarization by reflection, electromagnetic wave in conducting media.

B.Sc. III-Physics

SEMESTER VI

PAPER I

Nuclear and Particle Physics

Unit-1:

Nuclei and properties, Q-value binding energy, deuteron binding energy, n-n, p-p, n-p scattering, charge independence of nuclear force, α-decay, Geiger Nuttal law.

Unit-2:

Nuclear reactions, compound nucleus, direct reactions, interaction of charged particles with matter, nuclear detectors, Geiger-Muller counters.

Unit-3:

Models: liquid drop model, magic numbers, shell models, fission and fusion.

Unit-4:

Elementary particle: classifications, Fermions, Bosons, fundamental interactions, Baryonic, leptonic number, strangeness, Gell Mann Nishijinia reaction, Quarks including charm, bottom top.

B.Sc. III-Physics

SEMESTER VI

PAPER II

Statistical Mechanics

Unit-1:

Microscopic and macroscopic system, Probability, phase space representation, microstates and microstates, thermodynamical probability, postulate of equal a priori probability, minimum size of phase space, division of phase space into cells and density of states. Number of states in energy range E and E+ΔE, Liouville's theorem and its consequences.

Unit-2:

Ensembles: Micro, canonical and grand canonical, ensemble average, fluctuation in ensembles, density of phase point in classical ensembles, statistical equilibrium, conditions for equilibrium between two macroscopic systems, relation between entropy and probability, expression for total probability, partition function, entropy, energy and specific heat related to partition function.

Unit-3:

Most probable distribution, degrees of freedom, law of equipartition of energy, mean energy of harmonic oscillator, thermodynamic potential using partition function, M-B distribution law.

Unit-4:

Quantum statistics: B-E statistics, F-D statistics and applications, free electron gas, B-E condensations, and properties of liquid helium.

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SEMESTER VI

PAPER III

Opto-electronic and Photonic devices

Unit-1:

Photo diode (principle, construction and characteristics), Light Emitting Diode (construction and application as numerical displays), Solar cell (basic parameter, efficiency, open circuit voltage and short circuit current).

Unit-2:

Laser characteristic, difference between ordinary and laser source, stimulated and spontaneous emission, stimulated absorption, Einstein's A and B coefficients, population inversion, condition for laser action, pumping.

Unit-3:

Laser Source: Application of Ruby laser, He-Ne Laser and CO_2 Laser, construction, working and energy level schemes.

Unit-4:

Holography: basic concept of holography, construction of a hologram and reconstruction of image, important features of holograms and use of holography.

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SEMESTER VI

PAPER IV

Electronic devices and Digital Electronics

Unit-1:

Unijunction transistor, construction, characteristics and its application as relaxation oscillator, Silicon controlled rectifier (SCR), construction, character tics and its application as phase control rectifier.

Unit-2:

Operational amplifier using block diagram, basic parameters, inverting and non0-inverting amplifier.

Unit-3:

Oscillators, condition for oscillation, feedback requirement for oscillations, basic oscillator circuit, Hartley, oscillator, Colpitt oscillator.

Unit-4:

Logic circuits: AND, OR, NOT, NAND, NOR, XOR and XNOR gates, truth tables, Boolean algebra, Half and full address and subtractors.