B.Sc. Part I (Curtailed Syllabus)

Paper-1 Mechanics and Special Relativity Theory

1.Mechanics:

Background of Vector Calculus, Concept of gradient, divergence and curl, line, surface and volume integral.

Frame of Reference, Galilean transformation, Galilean invariance, Inertial and Non-inertial frames, Pseudo forces, Rotating reference frame, Centrifugal force, Coriolis Force.

System of particles, Centre of Mass, Linear momentum, Centre of mass frame, Rotational motion in two and three dimensions, Angular momentum, Moment of inertia tensor, Central forces, Conservative forces, Potential energy, Gravitational potential and field due to a uniform spherical shell.

2. Motion Under a Central Force:

Two-particle central force problem reduced mass, lab and Center of mass co-ordinate systems, Motion in an inverse square field.

3. Mechanics of Non-rigid Bodies:

Strain and stress in an isotropic homogeneous medium, Elastic moduli and relations between them, Torsion of cylinders, Bending of beams.

4. Fluid Mechanics:

Ideal fluids, Equation of continuity, Streamline flow, Rotational and irrotational flows, Euler's equation of motion, Bernoulli's Theorem, Viscous fluids, Poiseuille's equation.

5. Special Theory of Relativity:

Inference of Michelson-Morley Experiments. Postulates of special relativity, Lorentz transformations, Length contraction, Time dilation, Simultaneity in relativity theory, Addition of velocities, Relativistic dynamics, Variation of mass with velocity, mass-energy relation.

Paper-II Thermal Physics

1. Thermodynamics:

Thermodynamic systems, Macroscopic and Microscopic Variables, Thermodynamical Equilibrium, Thermodynamical state, Zeroth law of thermodynamics and concept of Temperature.

Heat and Work and their path-dependence, Thermal processes, First law of thermodynamics and internal energy, Joule's law, Applications of first law.

Carnot cycle, Carnot Engine, Reversible and irreversible processes, Carnot's Theorem. Thermodynamical scale of temperature, Clausius-Clapeyron's equation, Specific heat of saturated vapour, Clausius theorem, Clausius inequality, Entropy, Calculation of entropy in various processes, Entropy and unavailable energy, Physical significance of entropy, Second Law of thermodynamics.

Conditions for natural changes, Thermodynamic potentials and Maxwell's equation, Applications of Maxwell's equations, Joule-Thomson effect, Inversion Temperature.

2. Kinetic Theory of Gases:

Maxwell-Boltzmann Law of distribution of molecular velocities, Evaluation of r.m.s. Velocity and average and most probable speeds, Mean free path.

3. Conduction of Heat:

Fourier equation for one-dimensional flow of heat and its steady-state solution.

4. Radiation :

Radiation as electromagnetic waves, Intensity and energy density, Pressure and energy density, Stefan-Boltzmann law, Solar constant and temperature of sun, Temperature of Non-black bodies, Distribution of energy in the spectrum of black body radiation, Adiabatic expansion of black-body radiation, Wein's distribution law, Wein's displacement law, Wein's formula, Rayleigh-Jean's law, Planck's law.

Paper-III Electrical Circuit and Basic Semiconductor Electronics:

1. Electrical Circuits:

Circuit parameters, R, L, and C, Kirchoff's Law for a loop and junction, Solutions by determinant and matrix method: application to T, π and bridge circuits, Norton and Thevenin's Theorem, Maximum power transfer Theorem.

Difference between steady state and transient, Growth and decay of current in an inductive circuit, Charging and discharging of a capacitor through a resistor and through inductor and resistor in series. Ballistic Galvanometer, Cs and Qs.

AC analysis (Vector treatment only): Complex impedance and phasor notations, Impedance and Admittance operators, vector diagram for voltage and current in LR, CR and LCR in series, Power consumed in the circuit, Series and parallel resonance, Q of a coil, Transformer – its equivalent circuit.

AC Bridges: Balance and sensitivity conditions for AC bridge, Measurement of L by Maxwell's bridge, Measurement of C by Schering's bridge.

2.Basic Semi-conductor Electronics:

Conduction in Solids: conductor, insulator and semi-conductor, insulator and semi-conductor, Electrons and holes as charge carriers, Intrinsic and extrinsic semi-conductors, Conductivity and mobility, Conduction by diffusion and drift.

P.N. Junction: Built-in-voltage and charge depletion region, Statement of diode equation and diode characteristics, Forward and reverse resistance, Zener diode: its characteristics. Filtering by RC and LC circuit. Regulation: voltage regulation using Zener diode.

BJT: NPN and PNP transistor action, characteristics in CB and CE configurations. Hybrid, alpha and beta parameters, their inter-relationships. Load line, Small signal hybrid equivalent circuit, CE amplifier, Middle frequency response, Practical amplifier circuit, Principles of feedback Barkhausen criteria for sustained oscillations. Qualitative discussion of collector tuned oscillator.

Modulation: Need for modulation, three types of modulation. Frequency spectrum and power in a.m. wave.

C.R.O.: working of cathode ray tube, block diagram of CRO, typical applications of CRO.

Paper I
Inertial and Gravitational mass, Principle of Equivalence
Solid sphere, Conservation Laws
Kepler's laws
Internal energy of a strained body
Viscosity by rotating cylinder method
Relativistic Doppler shift Aberration

Paper II
Refrigerator
Change of phase, First and second order phase transitions, and Ehrenfest's equations
Transport phenomenon
Periodic flow of heat (only sinusoidal heat current)
Emissive and Absorptive powers, Radiation in a hollow enclosure, Black-body radiation, Kirchoff's Law

Paper III
Measurement of capacity and of high resistance by leakage method
and parallel
Circuits of Hartley and Colpitts oscillator
A typical a.m. circuit. Linear diode detector