

**Physics General ( Full Marks: 300 )**

1 <sup>st</sup> Semester	Paper – I (Full Marks: 75) (Th.-50, Pr.-25)	Unit-1: Classical Mechanics & GPM Unit-2: Heat & Thermodynamics Unit-3: Lab (Practicals)	30 Marks 20 Marks 25 Marks
2 <sup>nd</sup> Semester	Paper – II (Full Marks: 75) (Th.-50, Pr.-25)	Unit-1: Vibrations and Waves Unit-2: Geometrical Optics Unit-3: Physical Optics Unit-4: Lab (Practicals)	15 Marks 15 Marks 20 Marks 25 Marks
3 <sup>rd</sup> Semester	Paper – III (Full Marks: 75) (Th.-50, Pr.-25)	Unit-1: Electricity & Magnetism Unit-2: Lab (Practicals)	50 Marks 25 Marks
4 <sup>th</sup> Semester	Paper – IV (Full Marks: 75) (Th.-50, Pr.-25)	Unit-1: Electronics Unit-2: Modern Physics Unit-3: Lab (Practicals)	20 Marks 30 Marks 25 Marks

Theory Total :  $50 + 50 + 50 + 50 = 200$

Practical Total :  $25 + 25 + 25 + 25 = 100$

Practical Papers :

In practical classes all data should be recorded directly in the Laboratory Note Book (L.N.B.) and signed regularly by the attending teachers. This Note Book must be submitted at the time of final practical examination. No separate fair L.N.B. need be maintained.

## Paper – I

### Unit - 1 : Classical Mechanics and General Properties of Matter (30 Marks)

(30 Periods)

- 1. Dimensions of Physical Quantities** : Principle of dimensional homogeneity and its applications.
- 2. Vectors** : Axial and polar vectors, dot product and cross product, scalar triple product and vector triple product. Scalar and vector fields -- gradient, divergence and curl, statement of divergence theorem, statement of Stokes' theorem.
- 3. Curvilinear Coordinates**: Spherical polar and cylindrical coordinates, Expression for volume element and del operator in those coordinates. Expression for displacement, velocity and acceleration in Plane polar, Spherical polar and cylindrical polar coordinates.
- 4. Mechanics of a Particle**: Conservation theorem for the linear momentum, Conservation theorem for the angular momentum, Energy conservation theorem.  
Mechanics of a system of Particles: Conservation theorem for the linear momentum, total angular momentum and energy. Internal forces do no work in a rigid body.
- 5. Dynamics of rigid bodies**: Moment of inertia and radius of gyration - their physical significance, theorems of parallel and perpendicular axes, rotational kinetic energy, calculation of moment of inertia for some simple symmetric systems. Physical significance of moment of inertia.
- 6. Gravitation** : Gravitational potential and intensity due to thin uniform spherical shell and solid sphere of uniform density, escape velocity and its applications.
- 7. Elasticity** : Elastic moduli and their interrelations, torsion of a cylinder, bending moment, cantilever, simply supported beam with concentrated load at the centre, strain energy.

### Unit – 2 : Heat and Thermodynamics (20 Marks)

(20 Periods)

- 1. Kinetic Theory of Gases** : Pressure exerted by perfect gas, Maxwell's law of distribution of molecular velocities - r m s, mean and most probable velocities, degrees of freedom, principle of equipartition of energy - application in simple cases. Equation of state , Van der Waals equation, critical constants.
- 2. Conduction of Heat** : Steady state and variable state, thermal and thermometric conductivity, Fourier equation for one-dimensional heat flow and its solution, Ingen Hausz's experiment, cylindrical flow of heat.
- 3. Radiation** : Nature of radiant heat, emissive and absorptive power, Kirchhoff's law, black body radiation, Stefan's law, Newton's law of cooling, Rayleigh Jeans law and its drawback. Planck's distribution law (qualitative), Wien's displacement law, pyrometer - principle.
- 4. Thermodynamics** : Basic concepts (equilibrium state, state function, exact and inexact differential), internal energy as state function. First law of thermodynamics and its applications. Reversible and irreversible processes, second law of thermodynamics, Carnot cycle and its efficiency, entropy and its physical interpretation, Change in entropy for various processes.

### Unit – 3 : Lab – S-1 (Practicals)

1. Determination of modulus of rigidity of the material of a wire by dynamical method.
2. Determination of moment of inertia of a metallic cylinder/rectangular bar about an axis passing through its c.g.
3. Determination of the coefficient of linear expansion of a metallic rod using an optical lever.
4. Determination of the pressure coefficient of air.
5. Determination of Young's modulus of the material of a beam by the method of flexure (single length only).
6. Determination of the coefficient of viscosity of water by Poiseuille's method (the diameter of the capillary tube to be measured by travelling vernier microscope).

## Paper – II

### Unit – 1 : Vibrations and Waves (15 Marks)

(15 Periods)

1. **Simple Harmonic Motion** : Differential equation and its solution, examples of SHM.
2. **Superposition of Simple Harmonic Motion** : Analytical treatment, Lissajous figures, natural, damped and forced vibration, resonance, sharpness of resonance.
3. **Wave Motion** : Plane progressive wave - energy and intensity. Bel, decibel and phon. Superposition of waves, beats. Velocity of longitudinal wave in solid and in gas, velocity of transverse wave in string, Doppler effect.

### Unit – 2 : Geometrical Optics (15 Marks)

(15 Periods)

1. **Reflection and Refraction** : Fermat's Principle, laws of reflection and refraction at a plane and spherical surface, refraction at a spherical surface, lens formula. Combination of thin lenses - equivalent focal length. Matrix method in paraxial optics.
2. **Optical Instruments** : Dispersion and dispersive power, chromatic aberration and its remedy, different types of Siedel aberration (qualitative) and their remedy. Eye-piece : Ramsden and Huygen's type. Astronomical telescope and compound microscope - their magnifying power.

### Unit-3: Physical Optics (20 marks)

(20 Periods)

1. **Light as an electromagnetic wave** : Maxwell's equations, properties of electromagnetic waves.
2. **Interference of light** : Young's experiment, intensity distribution, conditions of interference, interference in thin films, Newton's ring and its application.
3. **Diffraction** : Fresnel and Fraunhofer class, Fresnel's half-period zones, zone plate. Fraunhofer diffraction due to a single slit and plane transmission grating (elementary theory), resolving power.
4. **Polarisation** : Different states of polarisation, Brewster's law, double refraction, retardation plate, polaroid, optical activity. Fresnel's theory.

### Unit – 4 : Lab – S-2 (Practicals)

1. Determination of the frequency of a tuning fork with the help of a sonometer (either by using the relevant formula or by using the  $n-l$  curve).
2. Determination of the resistance of a suspended coil galvanometer by the method of half deflection and to calculate the figure of merit of the galvanometer (using the same data).
3. Determination of the refractive index of the material of a lens and that of a liquid using a convex lens and a plane mirror.
4. Determination of the focal length of a concave lens by auxiliary lens method or by combination method.
5. Determination of the refractive index of the material of a prism by drawing the  $i-\delta$  curve using spectrometer.
6. Determination of the surface tension of water by capillary rise method and verification of Jurin's law.

## Paper – III

### Unit – 1 : Electricity and Magnetism (50 Marks)

(50 Periods)

1. **Electrostatics** : Quantisation of charge and Millikan's oil-drop experiment, Coulomb's law, intensity and potential --- example of point charge, Gauss' theorem --- simple applications, potential and field due to an electric dipole, mechanical force on the surface of a charged conductor. Dielectric medium, polarization, electric displacement. Capacitors- cylindrical and spherical.

2. **Steady Current** : Network analysis --- Kirchoff's laws, Thevnin and Norton's theorem, Wheatstone bridge, meter bridge, potentiometer.

3. **Thermoelectricity** : Seebeck, Peltier, and Thomson effects, laws of thermoelectricity, thermoelectric curve - neutral and inversion temperature, thermoelectric power.

4. **Magnetic effect of current** : Biot and Savart's law, ampere's circuital law , magnetic field due to a straight conductor, circular coil, solenoid, endless solenoid, Magnetic field due to a small current loop -- concept of magnetic dipole, Ampere's equivalence theorem.

5. **Magnetic materials** : Intensity of magnetization, relation between **B**, **H**, and **M** -- illustration in the case of bar magnet, magnetic susceptibility -- dia, para and ferromagnetic materials, statement of Curie's law. Hysteresis in a ferromagnetic material, hysteresis loss.

6. **Varying currents** : growth and decay of currents in L-R circuit; charging and discharging of capacitor in C-R circuit. LCR circuit.

7. **Electromagnetic Induction & Alternating Current** : Self and mutual induction, Calculation of coefficients for simple cases. Mean and r.m.s. values of current and emf with sinusoidal wave form; LR, CR and series LCR circuits, reactance, impedance, phase-angle, power dissipation in AC circuit-power factor, vector diagram, resonance in a series LCR circuit, Q-factor, principle of ideal transformer.

### Unit – 2 : Lab – S-3 (Practicals)

1. Determination of the horizontal component of earth's magnetic field using a deflection and an oscillation magnetometer.

2. Determination of (i) an unknown resistance and (ii) resistance per unit length of an wire by Carey Foster method.

3. Determination of the reduction factor of a tangent galvanometer using a copper voltmeter.

4. Measurement of current flowing through a resistor by using a potentiometer. Verify the result with the help of a milliammeter.

5. To determine the wavelength of a monochromatic light by Newton's ring method.

6. To calibrate a polarimeter and hence to determine the concentration of sugar solution.

## Paper – IV

### Unit – 1 : Electronics (20 Marks)

(20 Periods)

1. **Diodes and Transistors** : P-N junction diode, Various opto-electronic devices-Photo-diode, LED, Solar cell, semiconductor laser, bridge rectifier, filter circuits, Zener diode, voltage regulator, Transistors --  $\alpha$  and  $\beta$  and their interrelations; output characteristics in CE mode, single stage CE amplifier -- approximate expressions of current and voltage gain with the help of 'Load Line'.

2. **Digital Electronics** : Boolean algebra, Boolean identities, De Morgan's theorems, OR, AND, NOT, NAND, NOR gates, EX-OR and Ex-NOR gates, NOR and NAND as universal gates.

### Unit – 2 : Modern Physics (30 Marks)

(30 Periods)

1. **Special Theory of Relativity** : Postulates of STR, Lorentz transformation and its consequences- (i) Length contraction; (ii) Time dilation; (iii) Velocity addition; (v) Mass-energy equivalence.

2. **Quantum theory of radiation** : Planck's concept --- radiation formula (statement only) --qualitative discussion of photo-electric effect and Compton effect in support of quantum theory; Raman effect.

3. **Basic Quantum Mechanics** : Wave nature of material particles, wave-particle duality, wavelength of de Broglie waves, Heisenberg uncertainty principle, Schrodinger equation, Particle in a 1D box, Linear harmonic oscillator- energy eigen values, wavefunction and its probabilistic interpretation. Bohr's theory of hydrogen spectra -- concept of quantum number, Pauli exclusion principle.

4. **Solid State Physics** : Crystalline nature of solid, diffraction of X-ray, Bragg's law; Moseley's law -- explanation from Bohr's theory.

5. **Nuclear Physics** : Binding energy of nucleus, binding energy curve and stability; Radioactivity, successive disintegration, radioactive equilibrium, radioactive dating, radioisotopes and their uses, nuclear transmutation, fission and fusion, nuclear reactor.

6. **Laser Physics**: Population inversion, Spontaneous and stimulated emission, Einstein's A, B Coefficients, Applications of Laser.

### Unit – 3 : Lab – S-4 (Practicals)

1. Determination of the temperature coefficient of the material of a coil using a Carey-Foster bridge (3 sets of readings for both temperatures to be taken, also the resistance per unit length of the wire to be measured).

2. To draw the I-V characteristic of i) resistor and ii) a P-N junction diode in forward bias condition. (Plot both the characteristic curves on the same graph paper.) Estimate from the graphs i) the resistance of the resistor and ii) the dynamic resistance of the diode for three different currents. One current should correspond to the intersecting point of the two curves.

3. To draw the I-V characteristics of a bridge rectifier : (i) without using any filter and (ii) using a capacitive filter. (Percentage voltage regulation to be calculated for each case at a specified load current).

4. To draw the reverse characteristics of a Zener diode & to study its voltage regulation characteristics using a variable load. (Breakdown region to be identified on the graph and Percentage voltage regulation to be calculated for two load currents.)

5. To draw the output characteristics of a transistor in C-E configuration (for at least 5 base currents ) and hence to determine the A.C. current gain from the active region of the characteristics.

6. To verify the truth tables of OR and AND logic gates using diodes and construction of AND, OR and NOT gates using NOR / NAND IC gates on breadboard.

7. To draw the resonance curve of a series LCR circuit and hence to determine the Quality factor of the circuit.