

## **Physics-I** **(MECHANICS AND THERMODYNAMICS)**

### **Module -I**

Motion of a system of particles: center of mass (CM), velocity, acceleration, momentum of CM. equation of motion of CM. Kinetic energy and angular momentum of CM. Conservation of linear momentum and angular momentum for system of particles

### **Module-II**

Moment of Inertia, parallel axis theorem perpendicular axis theorem. Moment of inertia of cylinder and sphere. Routhe's Rule, Rotational kinetic energy and power, Acceleration due to gravity: Compound pendulum (Bar pendulum & Kater's Pendulum)

### **Module-III**

Gravitational force, field potential energy and potential, Gravitational potential and field at a point due to (1) a thin spherical shell (2) a solid sphere. Derivation of Kepler's laws of planetary motion from Gravitational force. Central force motion: Reduction of two body problems into an equivalent one body problem, General characteristics of central force motion.

### **Module-IV**

Elastic constants ( $Y$ ,  $K$  &  $\eta$ ), Relation between elastic constants Bending of beams, expression for bending moment, equation for bending, depression occurring at the free ends of a light, heavy cantilever. Viscosity of liquids: laminar flow through a narrow tube (Poiseuille's formula), Experimental determination of  $\eta$  for a liquid by Stokes method and rotation viscometer.

### **References:**

1. Properties of Matter: D.S.Mathur
2. Mechanics: K R.Simon
3. Mechanics: H.Goldstein
4. Mechanics Berkeley Series (Vol-I): Kittle, Knight, Ruderman, Helmholtz, Moyer
5. Properties of matter: Newman and Searle

## **Physics-II**

### **(ELECTRICITY, MAGNETISM AND ELECTRONICS)**

#### **Module -I**

Scalar and vector triple products: Differentiation of a vector with respect to a scalar. The Gradient operator. The divergence & the curl of a vector. Gauss divergence theorem, Stoke's theorem. Gauss law in electrostatics & applications (computation of field due to linear, spherical and plane charge distribution), differential form of Gauss law, the energy of a point charge, Energy density, dielectrics, field inside a dielectric, Dielectric constant.

#### **Module - II**

Magnetic field  $B$ , Lorentz's force law, Biot-Savart's law. Magnetic field due to straight, circular & solenoidal currents. The scalar and vector potential, Ampere's circuital law & its differential form. Differential form of electromagnetic induction, Maxwell's equations & physical

significance. Wave equation, Electromagnetic Waves, wave properties, speed. Growth & decay of currents in RC & LR circuits.

### **Module -III**

Rectifier: Half wave & full wave rectifier (Principle, circuit, operation & theory) Use of L &  $\Pi$  filters in rectifier circuit (qualitative idea), Amplifier: Classification of amplifiers, comparison. Voltage & power gain in CB, CE & CC configuration, RC coupled amplifier. Class B Push/Pull amplifier (Principle of amplification circuit description, operation, theory and frequency response curve).

### **Module -IV**

Necessity of feedback, positive & negative feedback, criteria for sustained oscillation. Hartley & Colpitt's oscillator (principle, circuit, operation, theory. & use), Modulation & Demodulation, Principle of modulation, AM. & FM (theory & differences between them.) .Digital electronics: Decimal and binary numbers and their inter conversion, logic gates-AND, OR, NOT, NAND, NOR gate, DTL & TTL circuit.

### **References:**

1. Introduction to Electrodynamics: D. J. Griffith
2. Electricity & Magnetism: Chattopadhyaya & Rakshit
3. Fundamentals of Electronics: Chattopadhyaya Rakshit and Saha
4. Principles of Electronics: V.K.Mehta
5. Foundation of electromagnetic theory: Ritz and Molford
6. Principle of electronics: B.V.N.Rao Vol -I and Vol II

## **Physics-III**

### **OPTICS**

#### **Module – I**

Simple harmonic oscillator, Damped harmonic oscillator, Power loss, Q-Factor, Under damped, Over damped motion, Critical damping, Forced vibration. Resonance, Sharpness of resonance. Mathematical description of travelling waves, Wave equation. Transverse waves in a stretched string longitudinal waves in a gaseous medium, Composition of simple harmonic Waves. Lissajous figures [Superposition of two orthogonal S.H.M (i) of equal frequencies (ii) in the frequency ratio 2:1]

#### **Module -II**

Interference: Conditions of interference, interference by division of wavefront, Biprism and determination of  $\lambda$ , Interference by a thin film with two (i) parallel and (ii) non-parallel refracting surfaces, Colour of a thin film. Newton's ring and determination of  $\lambda$  of monochromatic light,

#### **Module -III**

Diffraction of light, types of diffraction, Fraunhofer diffraction. Diffraction at single slit, Plane transmission grating, Fresnel diffraction, Fresnel half period zones, Zone plate (construction, theory, working), Comparison of zone plate with a convex lens.

#### **Module -IV**

Elementary Idea about polarized and unpolarised light, polarization by reflection and refraction, Malu's law. Brewster's law, Double refraction, ordinary and extraordinary rays, construction and uses of Nicol prism, Half wave and quarter wave plates, Mathematical analysis of linearly, circularly and elliptically polarized light, Construction and application of Polarimeter.

#### **References:**

1. Optics: Zenkins and White
2. Optics: A. Ghatak
3. Principle of Optics: B. K Mathur
4. Optics: Lunghrust
5. Geometrical and Physical optics: P.K.Chakraborty

## **Physics-IV**

### **(MODERN PHYSICS)**

#### **Module -II**

Atomic spectra. Series spectra of H-atom. Bohr theory of H-atom and explanation of series spectra. Correction of finite mass of the nucleus. Bohr's correspondence, Principle; Quantisation of angular momentum, Zeeman Effect, Raman Effect, Stark effect.

#### **Module -II**

Properties of atomic nucleus (mass, charge, spin, magnetic moment) mass defect, binding energy, packing fraction, elementary idea of nuclear force and its properties, liquid drop model (qualitative idea), Nuclear fission and fusion. Radioactive decay law, activity, half life and average life time of a nucleus.

#### **Module -III**

Introduction to Quantum mechanics, Compton effect, dual nature of radiation. Wave nature of particles: De Broglie hypothesis and wave particle duality. Super position of two waves, group velocity and phase velocity. Wave packet. Experimental confirmation of matter waves (Davisson-Germer experiment). The Heisenberg's uncertainty principle and its applications.

#### **Module -IV**

The time dependent Schrodinger equation in one and three dimension. The wave function, normalization, probability, Operators associated with dynamical variables. Linear operators. Commutation relations among co-ordinate and momentum operators, commutator algebra. Hermitian operators, Adjoint of an operator, parity operator. Eigen functions and eigen values of operators, Eigenvalue spectrum, degeneracy, Eigenvalues and Eigen functions of Hermitian

operators. The time independent Schrodinger equation and stationary states, constants of motion in quantum mechanics. Ehrenfests theorem, time independent. Schrodinger equation in one dimension and applications. Particle in a one dimensional box, Potential step, harmonic oscillator.

**References:**

1. Concept of Modern Physics: A. Beiser
2. Introduction to Quantum Mechanics: Powell and Craseman
3. Nuclear Physics: Kaplan
4. Atomic and Nuclear Physics: A.S. Gupta and Dipak Ghosh
5. Quantum Physics: S. Gasiorowicz (John Wiley)
6. Quantum Mechanics: Powell & Crasemann (Addison Wesley)
7. Molecular Physics: A. M. Matveev



4. Dispersive power of the material of a Prism using spectrometer
5. Diffraction pattern of grating using LASER source
6. Verification of Malus Law

**PH-222**

**PHYSICS LAB- IV**

**2 Credits [0-0-3]**

1. Determination of Plank's constant
- 2.