

PHYSICS

Grade: XI

Teaching hours : 150T + 50P

Full marks : 100 (75T + 25P)

Nature of Course : Theory + Practical

Pass marks : 27T + 8P

I. Introduction

The curriculum in Physics is designed to provide students with an understanding of the scientific laws and principles of the physical world. As expected this curriculum will provide an opportunity to the students to see physics as a contribution to life in modern society.

The course demands emphasis on conceptual understanding of the physical phenomena. This will involve the proper utilization of suitable mathematical models and equations. The applications of the physics together with the social and environmental aspects need to be emphasized whenever possible. The students are expected to actively participate in the learning process through experimentation supplemented by demonstration, discussions and problem solving.

The practical component of this course is designed to supplement learning through the application of the learned theory. The students will handle simple apparatus to do simple measurements, verifies physical laws and apply their knowledge of physics to real life example.

II. Objectives

General objectives

The general objectives of this course are:

- To provide students with sufficient understanding and knowledge of the fundamental principles of physics and their applications;
- To develop the skills of experimenting, observing, interpreting data evaluating evidence and formulating generalizations and models; and
- To explain the social, economic, environmental and other implications of physics and appreciate the advancement of physics and its applications as essential for the growth of national economy.

Specific Objective

Upon completion of this course, the students will be able to :

- Describe physics as coherent and developing framework of knowledge based on fundamental theories of the structure and process of the physical world;
- Explain phenomena in terms of theories and models;
- Apply quantitatively and qualitatively the knowledge and understanding of physical principles and theories;
- Translate information from one form to another;
- Present information in the language of physics or other appropriate form; and
- Design simple experiment to develop relations among physical quantities and draw conclusions.

III. Course contents

70 teaching hours

Unit – 1 Mechanics

- Physical Quantities – Need for measurements; system of units; S.I. unit; Precision and significant figures; Dimensions; Main uses of dimensional equations.
- Vectors – Graphical presentation of vectors; Addition and subtraction of vectors: Parallelogram, triangle and polygon laws of vectors; Resolution of vectors; Unit vectors;
- Kinematics – Uniform and non-uniform motion; average velocity and acceleration. Instantaneous velocity and acceleration; Equation of motion (graphical treatment) ; Motion of a freely falling body; Relative velocity; Projectile motion.

4. Laws of Motion – Newton’s laws of motion; Inertia, force, linear momentum, Impulse, Conversion of linear momentum; Free-body diagrams; Solid frictions: Laws of solid friction and their verifications; Application of Newton’s laws: Particles on equilibrium,
5. Work, and Energy – Work; work done by a constant force and a variable force; power; Energy: Kinetic energy ; work – energy theorem, Potential energy; conservation of energy; Conservative and non-conservative forces; elastic and inelastic collision. (4 hrs)
6. Circular Motion – Angular displacement, velocity and acceleration; Relation between angular and linear velocity and acceleration; Centripetal acceleration, centripetal force; Conical pendulum; Motion in a vertical circle; Motion of cars and cyclist round a banked
7. Gravitation- Newton’s laws of gravitation; acceleration due to gravity, g ; Mass and weight; gravitational field strength, variation in value of ‘ g ’ due to altitude, depth and rotation of earth; Weightlessness; Motion of satellites: Orbital velocity, height and time period of a satellite, geostationary satellite, potential and kinetic energy of a satellite; Gravitational potential: Gravitational potential energy; Escape velocity; Black holes (9 hrs)
8. Equilibrium – Moment of forces; Torque; Torque due to a couple; Center of mass; Center
9. Rotational Dynamics- Rotation of rigid bodies; Equation of angular motion; Relation between linear and angular kinematics; Kinetic energy of rotation of rigid bodies; moment of inertia: Radius of gyration, Moment of inertia of a uniform rod: Torque and angular acceleration for a rigid body; Work and power in a rotational motion; angular momentum; Conservation of angular momentum. (8 hrs)
10. Elasticity- Hooke’s law: Force constant, Verification of Hooke’s law; Stress; Strain, Elasticity and plasticity; Elastic modulus: Young modulus and its determination, Bulk modulus, Shear modulus, Poisson’s ratio Elastic potential energy. (6 hrs)
11. Periodic motion- Oscillatory motion; Circle of reference; Equation of Simple Harmonic Motion (SHM); Energy in SHM; Application of SHM; Motion of a body suspended from coiled spring, angular SHM; simple pendulum; Damped oscillation; Forced oscillation and
12. Fluid Mechanics- Fluid statics: Density ; Pressure in a fluid; Archimedes Principle; Buoyancy Surface tension: Molecular theory of Surface tension; Surface energy: angle of contact and capillarity; Measurement of coefficient of surface tension by capillary tube method.

Fluid Dynamics: Newton’s formula for viscosity in a liquid; Newton’s formula for viscosity in a liquid; Coefficient of viscosity; Laminar and turbulent flow; Poiseuille’s formula (method of dimensions); stokes law and its applications; Measurement of viscous liquid; Equation of continuity; Bernoulli’s equation and its applications.

Unit-2 Heat and thermodynamics

1. Heat and temperature-Concept of temperature; Thermal equilibrium, Thermal expansion: linear expansion, cubical expansions and their relation: Measurement of linear expansivity, Liquid Expansion: Absolute and apparent expansion of liquid, Measurement of absolute expansivity by Dulong and petit method. (5 hrs)
2. Quantity of heat: Heat capacity and specific heat capacity; Newton’s law of cooling; Measurement of specific heat capacity of solids by the method of mixture and of liquids by the method cooling. Change of phases: Latent heat; Specific latent heat of fusion, and vaporization and their measurements by the method of mixture. (5 hrs)
3. Thermal properties of matter – Equation of state: Ideal gas equation; P-V diagram; Molecular properties of matter; Kinetic- molecular model of an ideal gas: Derivation of pressure exerted by gas, average translation kinetic energy of a gas molecule; Boltzman constant, Root mean square speed; Heat capacities: heat capacities of gases.
4. Hygrometry- Saturated and unsaturated vapor pressure; Behavior of saturated vapor; Boiling point; Triple point and critical point; Dew point, Absolute humidity; Relative humidity and its determination. (3 hrs)

5. Transfer of heat- Conduction, Thermal conductivity and its determination by Sealre's method; Convection: convective coefficient Radiation: Ideal radiator ; Black body radiation; Stefan-Boltzmann law
6. First law of thermodynamics- Thermodynamic systems; Work done during volume change, Heat and work; Internal energy and first law of thermodynamics; Thermodynamic processes: Adiabatic, Isochoric, Isothermal, Isobaric processes; Heat capacities of ideal gas at constant pressure and volume and relation between them; Isothermal and adiabatic processes for an idea gas. (9 hrs)
7. Second law of thermodynamics – direction of thermodynamic processes ; Second law of thermodynamics; Heat engines; Internal combustion engines: Otto Cycle, Diesel cycle; Carnot cycle; Kelvin temperature scale; Refrigerators; Entropy and disorder

Unit – 3 Geometric Optics

1. Photometry, Reflection at curved mirrors – Convex and concave mirrors; Image in Spherical mirrors, Mirrors formula; Real and virtual images. (2hrs)
2. Refraction at plane surfaces – Laws of refraction: Refractive index; Relation between refractive indices; Lateral shift; Total internal reflection and its applications; critical
3. Refraction through prisms – Minimum deviation; Relation between angle of prism, minimum deviation and refractive index; Deviation in small angle
4. Lenses – Spherical lenses; thin lens formula; Lens maker's formula; Power of a lens; Combination of thin lenses in contact.
5. Dispersion – Spectrum ; Spectrometer; Pure spectrum; Dispersive power; Achromatic lenses; Condition for achromatic lenses in contact, Chromatic aberration Spherical aberration; Scattering of light – blue color of the sky. (3hrs)
6. Optical instruments – The human eye; Defects of vision and their correction; Visual angle; Angular magnification; Magnifier; Camera; Compound microscope, Astronomical Telescope (Reflection and refractive type) .

Unit – 4 Electrostatics

1. Electrostatics – Electric charge: Electric charges; Conductors and insulators; Charging by induction, Coulomb's law – Force between two point charges, Force between multiple electric charges. (3hrs)
2. Electric filed – Electric fields; Calculation electric field due to point charges; Field lines. Gauss Law; Electric Flux; Gauss Law and its application: Filed of a charged sphere, line charge, plane sheet of charge. (7hrs)
3. Potential: Potential and potential difference, Potential due to a point charge; Equipotential lines and surfaces; Potential gradient; Potential energy, Electron volt. (3hrs)
4. Capacitance and dielectrics – capacitance and capacitor; Charging and discharging of capacitor through a resistor; Parallel plate capacitor; Combination of capacitors; Energy of charged capacitor; Effect of a dielectric; Molecular theory of induced charges; Polarization and displacement.

A student will perform 20 experiments and 4 activities from the given list:

General instruction : Students are expected to learn general ideas of errors, order of accuracy and graphical analysis.

List of Experiments

A. Mechanics

1. Use of Vernier calipers:
 - a. Determination of the length, the internal external diameter of a given tube and calculation of its volume and density.

- b. Determination of the volume and density of a given rectangular block and verification of the results using a graduated cylinder.
- c. Determination of the internal diameter, depth and volume of a beaker or calorimeter.
2. Use of Spherometer:
 - a. Determination of the thickness of a given rectangular thin glass plate and calculation of its area using a graduated cylinder.
 - b. Determination of the radii of curvatures of a watch glass.
 - c. Determination of the focal length of a spherical mirror.
3. Use of a Screw gauge:
 - a. Determination of the diameter of a tube (or of a rod) and a small spherical bob and calculation of their densities.
 - b. Determination of the length, volume and density of a tangle of wire.
4. Determination of the coefficient of friction for the two surfaces by (i) the horizontal plane method and (ii) an inclined plane method.
5. Verification of the principle of moments and the determination of a mass of a given body
6. Use of simple pendulum:
 - a. Determination of the length of a seconds pendulum and the value of 'g' in the laboratory.
 - b. Verification of law of length and determination of the value of 'g' in the laboratory by log – log plot of time period versus length of the pendulum
7. Verification of Archimedes' Principle and determination of the specific gravity of a solid heavier than and insoluble in water
8. Determination of the specific gravity of
 - a) A liquid
 - b) A solid lighter than insoluble in water
 - c) A solid heavier than soluble water
9. Use of Young's modulus apparatus
 - a. Verification of Hooke's Law
 - b. Determination of the atmospheric pressure in the laboratory without reading a barometer and verification of the result by reading a barometer.
10. Use of young's modulus apparatus
 - a. Verification of Hooke's Law
 - b. Determination of Young's modulus of elasticity of the material of a given wire
11. Determination of the surface tension of water by capillary tube method
12. Determination of the coefficient of viscosity of liquid by Stoke's method

B. Heat

1. Calibration of a given thermometer and determination of the correct temperature of tap water.
2. Use of Pullinger's apparatus Determination of the linear and cubical expansivity of a rod
3. Use of Regnault's apparatus:
 - a. Determination of the specific heat capacity of a solid by the method of mixture.
 - b. Determination of the specific heat capacity of a liquid by the method of mixture.
4. Determination of the specific heat capacity of a liquid by the method of cooking.
5. Determination of latent heat of fusion of ice.
6. Determination of latent heat of vaporization of water.
7. Determination of the melting point of a solid by
 - (i) Cooling curve method
 - (ii) Capillary tube method
8. Determination of the thermal conductivity of a good conductor by Searle's method.