

**PHYSICS (Code No. 042)**  
**COURSE STRUCTURE**  
**Class XI – 2021-22 (Theory)**

**Time: 3 hrs.**

**Max Marks: 70**

		No. of Periods	Marks
Unit-I	Physical World and Measurement	10	23
	Chapter-1: Physical World		
	Chapter-2: Units and Measurements		
Unit-II	Kinematics	24	
	Chapter-3: Motion in a Straight Line		
	Chapter-4: Motion in a Plane		
Unit-III	Laws of Motion	14	
	Chapter-5: Laws of Motion		
Unit-IV	Work, Energy and Power	12	17
	Chapter-6: Work, Energy and Power		
Unit-V	Motion of System of Particles and Rigid Body	18	
	Chapter-7: System of Particles and Rotational Motion		
Unit-VI	Gravitation	12	
	Chapter-8: Gravitation		
Unit-VII	Properties of Bulk Matter	24	20
	Chapter-9: Mechanical Properties of Solids		
	Chapter-10: Mechanical Properties of Fluids		
	Chapter-11: Thermal Properties of Matter		
Unit-VIII	Thermodynamics	12	
	Chapter-12: Thermodynamics		
Unit-IX	Behaviour of Perfect Gases and Kinetic Theory of Gases	08	
	Chapter-13: Kinetic Theory		
Unit-X	Oscillations and Waves	26	10
	Chapter-14: Oscillations		
	Chapter-15: Waves		
Total		160	70

## **Unit I: Physical World and Measurement**

**10 Periods**

### **Chapter–1: Physical World**

Physics-scope and excitement; nature of physical laws; Physics, technology and society.

### **Chapter–2: Units and Measurements**

Need for measurement: Units of measurement; systems of units; SI units, fundamental and derived units. Length, mass and time measurements; accuracy and precision of measuring instruments; errors in measurement; significant figures.

Dimensions of physical quantities, dimensional analysis and its applications.

## **Unit II: Kinematics**

**24 Periods**

### **Chapter–3: Motion in a Straight Line**

Frame of reference, Motion in a straight line: Position-time graph, speed and velocity.

Elementary concepts of differentiation and integration for describing motion, uniform and non-uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, velocity - time and position-time graphs.

Relations for uniformly accelerated motion (graphical treatment).

### **Chapter–4: Motion in a Plane**

Scalar and vector quantities; position and displacement vectors, general vectors and their notations; equality of vectors, multiplication of vectors by a real number; addition and subtraction of vectors, relative velocity, Unit vector; resolution of a vector in a plane, rectangular components, Scalar and Vector product of vectors.

Motion in a plane, cases of uniform velocity and uniform acceleration projectile motion, uniform circular motion.

## **Unit III: Laws of Motion**

**14 Periods**

### **Chapter–5: Laws of Motion**

Intuitive concept of force, Inertia, Newton's first law of motion; momentum and Newton's second law of motion; impulse; Newton's third law of motion.

Law of conservation of linear momentum and its applications.

Equilibrium of concurrent forces, Static and kinetic friction, laws of friction, rolling friction, lubrication.

Dynamics of uniform circular motion: Centripetal force, examples of circular motion (vehicle on a level circular road, vehicle on a banked road).

## **Unit IV: Work, Energy and Power**

**12 Periods**

### **Chapter–6: Work, Energy and Power**

Work done by a constant force and a variable force; kinetic energy, work energy theorem, power.

Notion of potential energy, potential energy of a spring, conservative forces: conservation of mechanical energy (kinetic and potential energies); non conservative forces: motion in a vertical circle; elastic and inelastic collisions in one and two dimensions.

## **Unit V: Motion of System of Particles and Rigid Body**

**18 Periods**

### **Chapter–7: System of Particles and Rotational Motion**

Centre of mass of a two-particle system, momentum conservation and centre of mass motion. Centre of mass of a rigid body; centre of mass of a uniform rod. Moment of a force, torque, angular momentum, law of conservation of angular momentum and its applications.

Equilibrium of rigid bodies, rigid body rotation and equations of rotational motion, comparison of linear and rotational motions.

Moment of inertia, radius of gyration, values of moments of inertia for simple geometrical objects (no derivation). Statement of parallel and perpendicular axes theorems and their applications.

## **Unit VI: Gravitation**

**12 Periods**

### **Chapter–8: Gravitation**

Kepler's laws of planetary motion, universal law of gravitation. Acceleration due to gravity and its variation with altitude and depth.

Gravitational potential energy and gravitational potential, escape velocity, orbital velocity of a satellite, Geo-stationary satellites.

## **Unit VII: Properties of Bulk Matter**

**24 Periods**

### **Chapter–9: Mechanical Properties of Solids**

Elastic behaviour, Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, shear modulus of rigidity, Poisson's ratio; elastic energy.

### **Chapter–10: Mechanical Properties of Fluids**

Pressure due to a fluid column; Pascal's law and its applications (hydraulic lift and hydraulic brakes), effect of gravity on fluid pressure.

Viscosity, Stokes' law, terminal velocity, streamline and turbulent flow, critical velocity, Bernoulli's theorem and its applications.

Surface energy and surface tension, angle of contact, excess of pressure across a curved surface, application of surface tension ideas to drops, bubbles and capillary rise.

### **Chapter–11: Thermal Properties of Matter**

Heat, temperature, thermal expansion; thermal expansion of solids, liquids and gases, anomalous expansion of water; specific heat capacity;  $C_p$ ,  $C_v$  - calorimetry; change of state - latent heat capacity.

Heat transfer-conduction, convection and radiation, thermal conductivity, qualitative ideas of Blackbody radiation, Wein's displacement Law, Stefan's law, Greenhouse effect.

## **Unit VIII: Thermodynamics**

**12 Periods**

### **Chapter–12: Thermodynamics**

Thermal equilibrium and definition of temperature (zeroth law of thermodynamics), heat, work and internal energy. First law of thermodynamics, isothermal and adiabatic processes.

Second law of thermodynamics: reversible and irreversible processes, Heat engine and refrigerator.

Unit IX: Behaviour of Perfect Gases and Kinetic Theory of Gases 08 Periods

### **Chapter–13: Kinetic Theory**

Equation of state of a perfect gas, work done in compressing a gas.

Kinetic theory of gases - assumptions, concept of pressure. Kinetic interpretation of temperature; rms speed of gas molecules; degrees of freedom, law of equi-partition of energy (statement only) and application to specific heat capacities of gases; concept of mean free path, Avogadro's number.

## **Unit X: Oscillations and Waves**

**26 Periods**

### **Chapter–14: Oscillations**

Periodic motion - time period, frequency, displacement as a function of time, periodic functions.

Simple harmonic motion (S.H.M) and its equation; phase; oscillations of a loaded spring- restoring force and force constant; energy in S.H.M. Kinetic and potential energies; simple pendulum derivation of expression for its time period. Free, forced and damped oscillations (qualitative ideas only), resonance.

### **Chapter–15: Waves**

Wave motion: Transverse and longitudinal waves, speed of travelling wave, displacement relation for a progressive wave, principle of superposition of waves, reflection of waves, standing waves in strings and organ pipes, fundamental mode and harmonics, Beats, Doppler effect.

## PRACTICALS

**Total Periods: 60**

The record, to be submitted by the students, at the time of their annual examination, has to include:

- Record of at least 12 Experiments [with 6 from each section], to be performed by the students.
- Record of at least 6 Activities [with 3 each from section A and section B], to be performed by the students.
- Report of the project to be carried out by the students.

### EVALUATION SCHEME

**Time Allowed: Three hours**

**Max. Marks: 30**

Two experiments one from each section	7 + 7 Marks
Practical record (experiment and activities)	5 Marks
One activity from any section	3 Marks
Investigatory Project	3 Marks
Viva on experiments, activities and project	5 Marks
<b>TOTAL</b>	<b>30 Marks</b>

## SECTION–A

### Experiments

1. To measure diameter of a small spherical/cylindrical body and to measure internal diameter and depth of a given beaker/calorimeter using Vernier Callipers and hence find its volume.
2. To measure diameter of a given wire and thickness of a given sheet using screw gauge.
3. To determine volume of an irregular lamina using screw gauge.
4. To determine radius of curvature of a given spherical surface by a spherometer.
5. To determine the mass of two different objects using a beam balance. 6. To find the weight of a given body using parallelogram law of vectors.
6. Using a simple pendulum, plot its L-T<sup>2</sup> graph and use it to find the effective length of second's pendulum.
7. To study variation of time period of a simple pendulum of a given length by taking bobs of same size but different masses and interpret the result.
8. To study the relationship between force of limiting friction and normal reaction and to find the coefficient of friction between a block and a horizontal surface.
9. To find the downward force, along an inclined plane, acting on a roller due to gravitational pull of the earth and study its relationship with the angle of inclination  $\theta$  by plotting graph between force and  $\sin\theta$ .

### Activities

1. To make a paper scale of given least count, e.g., 0.2cm, 0.5 cm.
2. To determine mass of a given body using a metre scale by principle of moments.
3. To plot a graph for a given set of data, with proper choice of scales and error bars.
4. To measure the force of limiting friction for rolling of a roller on a horizontal plane.
5. To study the variation in range of a projectile with angle of projection.
6. To study the conservation of energy of a ball rolling down on an inclined plane (using a double inclined plane).
7. To study dissipation of energy of a simple pendulum by plotting a graph between square of amplitude and time.

## SECTION-B

### Experiments

1. To determine Young's modulus of elasticity of the material of a given wire.
2. To find the force constant of a helical spring by plotting a graph between load and extension.
3. To study the variation in volume with pressure for a sample of air at constant temperature by plotting graphs between P and V, and between P and  $1/V$ .
4. To determine the surface tension of water by capillary rise method.
5. To determine the coefficient of viscosity of a given viscous liquid by measuring terminal velocity of a given spherical body.
6. To study the relationship between the temperature of a hot body and time by plotting a cooling curve.
7. To determine specific heat capacity of a given solid by method of mixtures.
8. To study the relation between frequency and length of a given wire under constant tension using sonometer.
9. To study the relation between the length of a given wire and tension for constant frequency using sonometer.
10. To find the speed of sound in air at room temperature using a resonance tube by two resonance positions.

### Activities

1. To observe change of state and plot a cooling curve for molten wax.
2. To observe and explain the effect of heating on a bi-metallic strip.
3. To note the change in level of liquid in a container on heating and interpret the observations.
4. To study the effect of detergent on surface tension of water by observing capillary rise.
5. To study the factors affecting the rate of loss of heat of a liquid.
6. To study the effect of load on depression of a suitably clamped metre scale loaded at (i) its end (ii) in the middle.
7. To observe the decrease in pressure with increase in velocity of a fluid.

## Practical Examination for Visually Impaired

### Students Class XI

**Note:** Same Evaluation scheme and general guidelines for visually impaired students as given for Class XII may be followed.

#### A. Items for Identification/Familiarity of the apparatus for assessment in practicals (All experiments)

Spherical ball, Cylindrical objects, vernier calipers, beaker, calorimeter, Screw gauge, wire, Beam balance, spring balance, weight box, gram and milligram weights, forceps, Parallelogram law of vectors apparatus, pulleys and pans used in the same 'weights' used, Bob and string used in a simple pendulum, meter scale, split cork, suspension arrangement, stop clock/stop watch, Helical spring, suspension arrangement used, weights, arrangement used for measuring extension, Sonometer, Wedges, pan and pulley used in it, 'weights' Tuning Fork, Meter scale, Beam balance, Weight box, gram and milligram weights, forceps, Resonance Tube, Tuning Fork, Meter scale, Flask/Beaker used for adding water.

#### B. List of Practical

1. To measure diameter of a small spherical/cylindrical body using vernier calipers. 2. To measure the internal diameter and depth of a given beaker/calorimeter using vernier calipers and hence find its volume.
2. To measure diameter of given wire using screw gauge.
3. To measure thickness of a given sheet using screw gauge.
4. To determine the mass of a given object using a beam balance. 6. To find the weight of given body using the parallelogram law of vectors. 7. Using a simple pendulum plot L-T and L-T<sup>2</sup> graphs. Hence find the effective length of second's pendulum using appropriate length values.
8. To find the force constant of given helical spring by plotting a graph between load and extension.
9.
  - (i) To study the relation between frequency and length of a given wire under constant tension using a sonometer.
  - (ii) To study the relation between the length of a given wire and tension, for constant frequency, using a sonometer.
10. To find the speed of sound in air, at room temperature, using a resonance tube, by observing the two resonance positions.

**Note:** The above practicals may be carried out in an experiential manner rather than recording observations.



**Prescribed Books:**

1. Physics Part-I, Textbook for Class XI, Published by NCERT
2. Physics Part-II, Textbook for Class XI, Published by NCERT
3. Laboratory Manual of Physics, Class XI Published by NCERT
4. The list of other related books and manuals brought out by NCERT (consider multimedia also)

