Physics Syllabus

Part I (20 marks): This part consists of compulsory short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.

Part II (50 marks): This part is divided into three Sections A, B and C. There are six questions in Section A (each carrying 7 marks) and you are required to answer four questions from this Section. There are three questions in Section B (each carrying 6 marks) and you are required to answer two questions from this Section. There are three questions in Section C (each carrying 5 marks) and you are required to answer two questions from this Section. Therefore, you are expected to answer eight questions in Part II.

SECTION A

1. Role of Physics

(i) Scope of Physics.

(ii) Role of Physics in technology.

(iii) Impact on society.

2. Units

(i) SI units. Fundamental and derived units (correct symbols for units including conventions for symbols).

(ii) Accuracy and errors in measurement, least count of measuring instruments (and the implications for errors in experimental measurements and calculations).

(iii) Significant figures and order of accuracy with reference to measuring instruments. Powers of 10 and order of magnitude.

3. Dimensions

(i) Dimensional formula of physical quantities and physical constants like g, h, etc. (from Mechanics only).

(ii) Dimensional equation and its use to check correctness of a formula, to find the relation between physical quantities, to find the dimension of a physical quantity or constant; limitations of dimensional analysis.

4. Vectors, Scalar Quantities and Elementary Calculus

(i) General Vectors and notation, position and displacement vector.

(ii) Vectors in one dimension, two dimensions and three dimensions, equality of vectors and null vector. Vector operations (addition, subtraction and multiplication of vectors including use of unit vectors $\hat{i}$, $\hat{j}$, $\hat{k}$); parallelogram and triangle law of vector addition.

(iii) Resolution and components of like vectors in a plane (including rectangular components), scalar (dot) and vector (cross) products.

(iv) Elementary Calculus: differentiation and integration as required for physics topics in Classes XI and XII. No direct question will be asked from this subunit in the examination.

5. Dynamics

(i) Cases of uniform velocity, equations of uniformly accelerated motion and applications including motion under gravity (close to surface of the earth) and motion along a smooth inclined plane.

(ii) Relative velocity.

(iii) Projectile motion.

(iv) Newton's laws of motion and simple applications. Elementary ideas on inertial and uniformly accelerated frames of reference. Conservative and non-conservative forces. Conservation of linear momentum, impulse.

(v) Concurrent forces (reference should be made to force diagrams and to the point of application of forces), work done by constant and variable force (Spring force).

(vi) Energy, conservation of energy, power, elastic and inelastic collisions in one and two dimensions.

6. Friction

(i) Friction in solids: static; sliding; rolling.

(ii) Laws of friction. Co-efficient of friction. Methods to minimise friction.

7. Circular and Rotational Motion

(i) Uniform Circular Motion, Centripetal acceleration and force, motion on a level and a banked track (smooth as well as rough), a point mass at the end of a light inextensible string moving in a (i) horizontal circle, (ii) vertical circle and a conical pendulum.

(ii) Centre of mass, moment of inertia: rectangular rod; disc; ring; sphere.

(iii) Parallel axis theorem and perpendicular axis theorem; radius of gyration.

(iv) Torque and angular momentum, relation between torque and moment of inertia and between angular momentum and moment of inertia; conservation of angular momentum and applications. Comparisons of linear and rotational motions.

8. Gravitation

(i) Newton's law of universal gravitation; gravitational constant (G); gravitational acceleration on surface of the earth (g).

(ii) Relation between G and g; variation of gravitational acceleration above and below the surface of the earth.

(iii) Gravitational field, its range, potential, potential energy and intensity.

(iv) Escape velocity (with special reference to the earth and the moon); orbital velocity and period of a satellite in circular orbit (particularly around the earth).

(v) Geostationary satellites - uses of communication satellites.

(vi) Kepler's laws of planetary motion.

9. Fluids

(i) Pressure in a fluid, Pascal’s Law and its applications, buoyancy (Archimedes Principle).

(ii) Equation of continuity of fluid flow and its application, buoyancy, Bernoulli's principle, (venturimeter, pitot tube, atomizer, dynamic uplift).

(iii) Stream line and turbulent flow, Reynold's number (derivation not required).

(iv) Viscous drag; Newton's formula for viscosity, co-efficient of viscosity and its units.

(v) Stoke's law, terminal velocity of a sphere falling through a fluid or a hollow rigid sphere rising to the surface of a fluid.

SECTION B

10. Properties of Matter - Temperature

(i) Properties of matter: Solids: elasticity in solids, Hooke’s law, Young modulus and its determination, bulk modulus and modulus of rigidity, work done in stretching a wire, Poisson’s ratio. Liquids: surface tension (molecular theory), drops and bubbles, angle of contact, work done in stretching a surface and surface energy, capillary rise, measurement of surface tension by capillary rise method.

(ii) Gases: kinetic theory of gases: postulates, molecular speeds and derivation of $p = \frac{1}{3} \rho c^2$, equation of state of an ideal gas $pV = nRT$ (numerical problems not included from gas laws).

(iii) Temperature: kinetic interpretation of temperature (relation between c^2 and T); absolute temperature. Law of equipartition of energy (statement only).

(iv) Thermal equilibrium and zeroth law of thermodynamics.

11. Internal Energy

(i) First law of thermodynamics.

(ii) Isothermal and adiabatic changes in a perfect gas described in terms of curves for PV = constant and PV^{γ} = constant; joule and calorie relation (derivation of PV^{γ} = constant not required).

(iii) Work done in isothermal and adiabatic expansion; principal molar heat capacities; Cp and Cv; relation between Cp and Cv (Cp - Cv = R). Cp and Cv for monatomic and diatomic gasses.

(iv) Second law of thermodynamics, Carnot's cycle. Some practical applications.

(v) Thermal conductivity; co-efficient of thermal conductivity, Use of good and poor conductors, Searle’s experiment. [Lee’s Disc method is not required]. comparison of thermal and electrical conductivity. Convection with examples.

(vi) Thermal radiation: nature and properties of thermal radiation, qualitative effects of nature of surface on energy absorbed or emitted by it; black body and black body radiation, Stefan's law (using Stefan's law to determine the surface temperature of the sun or a star by treating it as a black body); Newton's law of cooling, Wien's displacement law, distribution of energy in the spectrum of black body radiation (only qualitative and graphical treatment).

SECTION C

12. Oscillations

(i) Simple harmonic motion.

(ii) Expressions for displacement, velocity and acceleration.

(iii) Characteristics of simple harmonic motion.

(iv) Relation between linear simple harmonic motion and uniform circular motion.

(v) Kinetic and potential energy at a point in simple harmonic motion.

(vi) Derivation of time period of simple harmonic motion of a simple pendulum, mass on a spring (horizontal and vertical oscillations).

(vii) Free, forced and damped oscillations (qualitative treatment only). Resonance.

13. Waves

(i) Transverse and longitudinal waves; relation between speed, wavelength and frequency; expression for displacement in wave motion; characteristics of a harmonic wave; graphical representation of a harmonic wave; amplitude and intensity.

(ii) Sound as a wave motion, Newton's formula for the speed of sound and Laplace's correction; variation in the speed of sound with changes in pressure, temperature and humidity; speed of sound in liquids and solids (descriptive treatment only).

(iii) Superposition of waves (interference, beats and standing waves), progressive and stationary waves.

(iv) Laws of vibrations of stretched strings.

(v) Modes of vibration of strings and air columns; resonance.

(vi) Doppler Effect for sound.