

Physics Syllabus:

Physical World and Measurement:

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

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.

Kinematics:

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)

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 products of vectors

Motion in a plane. Cases of uniform velocity and uniform acceleration – projectile motion. Uniform circular motion.

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 banked road)

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.

Motion of System of Particles and Rigid Body:

Centre of mass of a two-particle system; momentum conservation and centre of mass motion.

Centre of a rigid body; centre of mass of a uniform rod

Moment of a force; torque angular momentum; laws 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 moment of inertia; for simple geometrical objects (no derivation). Statement of parallel and perpendicular axes theorems and their applications.

Gravitation:

Keplar's laws of planetary motion. The 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.

Properties of Bulk Matter:

Elastic behavior; Stress – strain relationship; Hooke's law; Young modulus; bulk modulus; shear modulus of rigidity; Poisson's ration; elastic energy.

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

Viscosity; Stoke's 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.

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; Green house effect.

## 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.

## Behavior of Perfect Gases and Kinetic Theory of Gases:

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

Kinetic theory of gases – assumptions; concept of pressure. Kinetic interpretation of temperature; rms speed of gas molecules; degrees of freedom; law of equipartition of energy (statement only) and multiplication to specific heat capabilities of gases; concept of mean free path; Avogadro's number.

## Oscillations and Waves:

Periodic motion – time periodic; frequency; displacement as a function of time. Periodic functions.

Simple harmonic motion (S.H.M) and its equation; phase; oscillations of a 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.

Wave motion: Transverse and longitudinal waves; speed of wave motion. 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.

## Electrostatics:

Electric charges; Conservation of charge; Coulomb's law-force between two point charges; forces between multiple charges; superposition principle and continuous charge distribution.

Electric field; electric field due to a point charge; electric field lines; electric dipole; electric field due to dipole; torque on a dipole in uniform electric field.

Electric flux; statement of Gauss's theorem and its applications to find field due to infinitely long straight wire; uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside)

Electric potential; potential difference; electric potential due to a point charge; a dipole and system of charges; Equipotential surfaces; electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field.

Conductors and insulators; free charges and bound charges inside a conductor; dielectrics and electric polarization; capacitors and capacitance; combination of capacitors in series and in parallel; capacitance

of a parallel plate capacitor with and without dielectric medium between the plates; energy stored in a capacitor; Van de Graff generator.

#### Current Electricity:

Electric current ; flow of electric charges in a metallic conductor; drift velocity; mobility and their relation with electric current; Ohm's law; electrical resistance; V-I characteristics (linear and non linear) electrical energy and power; electrical resistivity and conductivity. Carbon resistors; color code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance.

Internal resistance of a cell; potential difference and emf of a cell; combination of cells in series and in parallel.

Kirchhoff's laws and simple applications. Wheatstone bridge, meter bridge.

Potentiometer – principle and its applications to measure potential difference and for comparing emf of two cells; measurement of internal resistance of a cell.

#### Magnetic Effects of Current and Magnetism:

Concept of magnetic field; Oersted's experiment

Biot – Savart law and its application to current carrying circular loop.

Ampere's law and its applications to infinitely long straight wire. Straight and toroidal solenoids; Force on a moving charge in uniform magnetic and electrical fields. Cyclotron.

Force on a current carrying conductor in a uniform magnetic field. Force between two parallel current carrying conductors – definition of ampere. Torque experienced by a current loop in uniform magnetic field; moving coil galvanometer its current sensitivity and conversion to ammeter and voltmeter.

Current loop as a magnetic dipole and its magnetic dipole moment. Magnetic dipole moment of a revolving electron. Magnetic field intensity due to magnetic dipole (bar magnet) along its axis and perpendicular to its axis. Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid; magnetic field lines; earth's magnetic field and magnetic elements. Para – dia – and ferro – magnetic substances with examples. Electromagnets and factors affecting their strengths. Permanent magnets.

#### Electromagnetic Induction and Alternating Currents:

Electromagnetic Induction; Faraday's laws, induced emf and current; Lenz's laws; Eddy currents. Self and mutual induction.

Alternating currents; peak and rms value of alternating current / voltage; reactance and impedance; LC oscillations (qualitative treatment only) LCR series circuit; resonance; power in AC circuits; watt less current.

AC generator and transformer.

Electromagnetic Waves:

Basic Idea of displacement current; Electromagnetic waves and their characteristics (qualitative ideas only). Transverse nature of electromagnetic waves.

Electromagnetic spectrum (radio waves; microwaves; infrared; visible; ultraviolet; X-Rays; gamma rays) including elementary facts about their uses.

Optics:

Reflection of light; spherical mirrors; mirror formula. Refraction of light; total internal reflection and its applications; optical fibres; refraction at spherical surfaces; lenses; thin lens formula; lensmaker's formula. Magnification; power of a lens; combination of thin lenses in a contact combination of a lens and a mirror. Refraction and dispersion of light through a prism.

Scattering of light – blue colour of sky and reddish appearance of the sun at sunrise and sunset

Optical instruments: Human eye; image formation and accommodation correction of eye defects (myopia, hypermetropia) using lenses. Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.

Wave Optics: Wave front and Huygen's principle; reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygen's principle.

Interference Young's double slit experiment and expression for fringe width; coherent sources and sustained interference of light. Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and astronomical telescopes. Polarization; plane polarized light Brewster's law; uses of plane polarized light and Polaroids.

Dual Nature of Matter and Radiation:

Dual Nature of radiation; Photoelectric effect; Hertz and Lenard's observations; Einstein's photoelectric equation – particle nature of light.

Matter waves – wave nature of particles; de Broglie relation. Davisson – Germer experiment (experimental details should be omitted; only conclusion should be explained)

Atoms & Nuclei:

Alpha particle scattering experiment; Rutherford's model of atom; Bohr's model; energy levels; hydrogen spectrum

Composition and size of nucleus; atomic masses; isotopes; isobars; isotones. Radioactivity alpha, beta and gamma particles / rays and their properties; radioactive decay law. Mass energy relation; mass defect; binding energy per nucleon and its variation with mass number; nuclear fission; nuclear fusion.

## Electronic Devices:

Energy bands in solids (Qualitative ideas only) conductors; insulators and semiconductors; semiconductor diode – I-V characteristics in forward and reverse bias; diode as a rectifier; I-V characteristics of LED; photodiode; solar cell; and Zener diode; Zener diode as a voltage regulator. Junction transistor; transistor action; characteristics of a transistor; transistor as an amplifier (common emitter configuration) and oscillator. Logic gates (OR, AND, NOT, NAND and NOR). Transistor as a switch.

## Communication Systems:

Elements of a communication system (block diagram only); bandwidth of signals (speech, TV and digital data) bandwidth of transmission medium. Propagation of electromagnetic waves in the atmosphere; sky and space wave propagation. Need for modulation. Production and detection of an amplitude – modulated wave.