



## **Syllabus for Physics**

## Secondary School Physics (IX - X)

### Waves and Oscillation

**Characteristics of Mechanical Waves** - Production Of Sound, Propagation Of Sound, Longitudinal Waves, Frequency, Amplitude, Speed, Speed Of Sound In Different Media, Sonic Boom, Reflection Of Sound, Echo, Applications Of Ultrasound, Sonar

**Properties of Light** - Reflection Of Light, Refraction Of Light, Apparent Displacement, Refraction Through A Rectangular Glass Slab, Refractive Index, Optical Density, Rainbow Formation, Atmospheric Refraction, Scattering Of Light, Tyndall Effect

**Optical Devices** - Spherical Mirrors, Schematic Representation, Centre Of Curvature, Radius Of Curvature, Focal Length, Image Formation By Spherical Mirrors, Ray Diagrams, Image Formation By, Concave Mirror, Uses Of Concave Mirrors, Image Formation By A Convex Mirror, Uses Of Convex Mirrors, Sign Convention For Reflection By Spherical Mirrors, Mirror Formula And Magnification, Magnification, Refraction By Spherical Lenses, Converging Action Of A Convex Lens, Diverging Action Of A Concave Lens, Image Formation By Lenses, Nature, Position And Relative Size Of The Image Formed By A Convex Lens Nature, Position And Relative Size Of The Image Formed By A Concave Lens, Image Formation In Lenses Using Ray Diagrams, Sign Convention For Spherical Lenses, Lens Formula And Magnification, Power Of A Lens

### Thermal Physics

**Properties of Heat** - Concepts of heat and temperature, Units of measurement, Expansions of solids, liquids and gases, its uses and consequence, Anomalous Expansion of water, Thermometers, Transfer of Heat (conduction, convection & radiation, thermal insulation, vacuum flask and ventilation, Energy flow and its importance, Coefficients of expansion, Calorimetry, Specific Heat Capacity, principle of method of mixtures, Latent heat, Expressions for heat loss and heat gain involving latent heat, Common physical phenomena involving latent heat of fusion

### Atomic and Nuclear Physics

Particle nature, basic units: atoms and molecules, Law of constant proportions, Nucleus, Nuclear structure, Atomic number (Z), Mass number (A), Radioactivity and changes in the nucleus, Nuclear fission and fusion, Radioactivity as spontaneous disintegration, Uses of radioactivity - radioisotopes, Background Radiation and safety precautions, Thermionic emission, Work function, Hot cathode ray tube principle, Electron gun, Chain reaction in Nuclear Reactors, Structure and Working of Nuclear Fission Reactors

## Biophysics

Ear - Range Of Hearing, Hearing Aid, Structure Of Human Ear, Tympanic Membrane, Eye - Power Of Accommodation, Defects Of Vision And Their Correction, Myopia, Hypermetropia, Presbyopia, Astigmatism

## Mechanics and Kinematics

**Gravity and its effects** - Centripetal Force, Inverse-Square Rule, Free Fall, Value Of 'G', Motion Of Objects Under Gravity, Mass, Weight

**Types and effects of Pressure** - Thrust And Pressure, Pressure In Fluids, Buoyancy, Archimedes' Principle, Relative Density

**Types and Characteristics of Motion** - Describing Motion, Reference Point, Motion Along A Straight Line Displacement, Uniform And Nonuniform Motion, Measuring The Rate Of Motion, Speed With Direction, Rate Of Change Of Velocity, Acceleration, Graphical Representation Of Motion (Distance-Time, Velocity-Time) Equations Of Motion By Graphical Method, Velocity Time Relation, Position Time Relation, Position Velocity Relation, Uniform Circular Motion

**Laws of Motion** - Balanced And Unbalanced Forces, Newton's Laws of Motion, Law Of Inertia, Inertia And Mass, Conservation Of Momentum, Conservation Laws, Friction

**Energy: Classification and Effects** - Work, Scientific Conception Of Work, Work Done By A Constant Force, Energy, Forms Of Energy - Kinetic, Potential, Gravitational Potential, Interconvertibility Of Energy Forms, Law Of Conservation Of Energy, Rate Of Doing Work, Commercial Unit Of Energy, Good Source Of Energy, Conventional Sources Of Energy, Fossil Fuels, Thermal Power Plant, Hydro Power Plants, Improvements In The Technology For Using Conventional Sources Of Energy, Biomass, Alternative Or Non-Conventional Sources Of Energy - Solar, Wind, Tidal, Geothermal, Nuclear

## Electricity and Magnetism

**Electricity and Effects of Electric Current** - Coulomb, Ampere, Electric Potential And Potential Difference, Potential Difference Between Two Points, Volt, Circuit Diagram, Ohm's Law, Factors Affecting Resistance Of Conductors, Resistance Of A System Of Resistors (Series & Parallel), Heating Effect Of Electric Current, Joule'S Law Of Heating, Electric Power

**Magnetic Effects of Electric Current** - Magnetic Field And Magnetic Lines Of Force, Magnetic Field Due To A Current Carrying Conductor, Magnetic Field Due To A Current Through A Straight Conductor, Right-Hand Thumb Rule, Magnetic Field Due To A Current Through A Circular Loop, Magnetic Field Due To A Current In A Solenoid, Force On A Current Carrying Conductor In A Magnetic Field, Fleming's Left-Hand Rule, Electric Components - Electric

Motor, Electromagnetic Induction, Galvanometer, Fleming's Right-Hand Rule, Electric Generator, Domestic Electric Circuits

## **Astrophysics**

The sun - formation, composition and lifespan; Composition and structure of different types of galaxies (broad classifications), life cycle of stars (formation, maturity, death), Constellations, the Solar System, comets, asteroids, Oort Cloud

## Senior School Secondary Physics (XI - XII)

### Waves and Oscillation

**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

**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

**Ray Optics and Optical Instruments** - 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 contact, refraction of light through a prism. Scattering of light - blue colour of sky and reddish appearance of the sun at sunrise and sunset. Optical instruments - Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers

**Wave optics** - Wave front and Huygens principle, reflection and refraction of plane waves at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygens principle. Interference, Young's double slit experiment, expression for fringe width, coherent sources and sustained interference of light, diffraction due to a single slit, width of central maximum, resolving power of microscope and astronomical telescope, polarisation, plane polarised light, Brewster's law, uses of plane polarised light and Polaroids

**Dual Nature of Radiation and Matter**- Dual Nature of Radiation, Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation-particle nature of light. Experimental study of photoelectric effect, Matter waves-wave nature of particles, de-Broglie relation, Davisson-Germer experiment

**Communication Systems** - Elements of a communication system, 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

## Atomic and Nuclear Physics

**Atoms and Nuclei** - Alpha - particle scattering experiment; Rutherford's model of atom; Bohr 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 and fusion, chain reactions, structure and working of a nuclear fission reactor

## Thermal Physics

**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

**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

**Behaviour of Perfect Gases and Kinetic Theory of Gases** - 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

## Mechanics and Kinematics

**Physical World and Measurement** - 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

**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

**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

**Laws of Motion** - Intuitive concept of force, Inertia, Newton's laws of motion; momentum and Newton's second law of motion; impulse. 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

**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

**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, Parallel and perpendicular axes theorems

**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, Geostationary satellites

**Properties of Bulk Matter** - 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

**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

## Electricity and Magnetism

**Electric Charges and Fields** - 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 a dipole, torque on a dipole in uniform electric field. Electric flux, statement of Gauss's theorem and its applications, uniformly charged

infinite plane sheet and uniformly charged thin spherical shell

**Electrostatic Potential and Capacitance** - 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 polarisation, capacitors and capacitance, combination of capacitors (series and parallel), capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor

**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 nonlinear), electrical energy and power, electrical resistivity and conductivity, Carbon resistors, colour 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, metre 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** - Moving Charges 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 (only qualitative treatment), force on a moving charge in uniform magnetic and electric 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 a 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

**Magnetism and Matter** - Current loop as a magnetic dipole and its magnetic dipole moment, magnetic dipole moment of a revolving electron, magnetic field intensity due to a 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 Law, Eddy currents. Self and mutual induction. Alternating Current - 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, power factor, wattless current, AC generator and transformer

**Electromagnetic Waves** - Basic idea of displacement current, Electromagnetic waves, their characteristics, their Transverse nature , Electromagnetic spectrum including elementary facts about their uses

## Semiconductor Physics

**Electronic Devices** - Semiconductor Electronics: Materials, Devices and Simple Circuits, Energy bands in conductors, semiconductors and insulators (qualitative ideas only), Semiconductor diode - I-V characteristics in forward and reverse bias, diode as a rectifier; Special purpose p-n junction diodes: LED, photodiode, solar cell and Zener diode and their characteristics, 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

## Astrophysics

The sun - formation, composition and lifespan; Composition and structure of different types of galaxies (broad classifications), life cycle of stars (formation, maturity, death), Constellations, the Solar System, comets, asteroids, Oort Cloud, Explanation of Big Bang theory based on spectral evidence, Motion of distant galaxies, Cosmic Background Radiation (elementary understanding)