PANE

NEIPTS 2025 SYLLABUS

I. Motion, Force, and Work

Motion:

Concepts of distance and displacement; velocity; uniform and non-uniform motion along a straight line; acceleration; distance–time and velocity–time graphs for uniform and uniformly accelerated motion; derivation of equations of motion by graphical method; introduction to uniform circular motion.

Force and Newton's Laws:

Force and motion; Newton's laws of motion; action–reaction forces; inertia and mass; momentum; relationship between force and acceleration; basic idea of conservation of momentum.

Gravitation:

Newton's law of gravitation; gravitational force of the Earth (gravity); acceleration due to gravity; mass and weight; concept of free fall.

Floatation:

Thrust and pressure; Archimedes' principle; buoyant force; basic concept of relative density.

Work, Energy and Power:

Work done by a force; energy and power; kinetic and potential energy; law of conservation of energy.

Sound:

Nature and propagation of sound in different media; speed of sound; audible range in humans; ultrasound; reflection of sound, echo, and SONAR; structure of the human ear (auditory aspects only).

II. Effects of Current

Electric Current:

Concept of electric current and potential difference; Ohm's law; resistance and resistivity; factors affecting resistance of a conductor; combination of resistors (series and parallel) and their practical applications; heating effect of electric current and its uses; electric power and relationships among P,V,I,RP, V, I, RP,V,I,R.

Magnetic Effects of Current:

Magnetic field and field lines; magnetic field due to a current-carrying conductor, coil, and solenoid; force on a current-carrying conductor; Fleming's left-hand rule; electric motor; electromagnetic induction, induced emf and current, Fleming's right-hand rule; electric generator; direct and alternating current (DC and AC), frequency of AC, advantages of AC over DC; domestic electric circuits.

III. Light

Reflection and Refraction:

Reflection of light by curved mirrors; image formation by spherical mirrors; terms related to mirrors (centre of curvature, principal axis, focus, focal length); mirror formula and magnification (derivation not required).
Refraction and laws of refraction; refractive index; refraction by spherical lenses; image formation by lenses; lens formula and magnification (derivation not required); power of a lens.

Applications:

Structure and functioning of the human eye; defects of vision and their correction; practical uses of spherical mirrors and lenses; refraction through a prism; dispersion and scattering of light; everyday applications.

IV. Units and Measurements

Units of measurement; systems of units and SI units; fundamental and derived units; measurements of length, mass, and time; accuracy, precision, and errors; significant figures; dimensions of physical quantities; dimensional analysis and its applications.

V. Motion in a Straight Line

Frame of reference; position-time graph; speed and velocity; concepts of differentiation and integration in describing motion; uniform and non-uniform motion; average speed and instantaneous velocity; uniformly accelerated motion; velocity–time and position–time graphs; graphical derivation of relations for uniformly accelerated motion.

VI. Motion in a Plane

Scalars and vectors; position and displacement vectors; equality and operations with vectors (addition, subtraction, scalar multiplication); relative velocity; unit vector and resolution of vectors; scalar and vector products; motion in a plane with uniform velocity or acceleration; projectile motion; uniform circular motion.

VII. Laws of Motion

Concept of force; inertia and Newton’s first law; momentum and Newton’s second law; impulse; Newton’s third law; law of conservation of linear momentum and its applications; equilibrium of concurrent forces; static and kinetic friction, laws of friction, and lubrication; dynamics of uniform circular motion (centripetal force, motion of vehicles on level and banked roads).

VIII. Work, Energy and Power

Work done by constant and variable forces; kinetic energy and work–energy theorem; power; potential energy, including that of a spring; conservative and non-conservative forces; conservation of mechanical energy; motion in a vertical circle; elastic and inelastic collisions in one and two dimensions.

IX. System of Particles and Rotational Motion

Centre of mass of two-particle and rigid-body systems; conservation of momentum and centre of mass motion; moment of force, torque, and angular momentum; conservation of angular momentum and applications; equilibrium of rigid bodies; rotational motion and related equations; comparison of linear and rotational motion; moment of inertia, radius of gyration, standard moments of inertia for simple shapes (no derivation); parallel and perpendicular axes theorems and applications.

X. Gravitation

Kepler's laws of planetary motion; universal law of gravitation; acceleration due to gravity and its variation with altitude and depth; gravitational potential and potential energy; escape velocity; orbital velocity; geostationary satellites.

XI. Mechanical Properties of Solids

Elastic behaviour; stress–strain relationship; Hooke's law; Young's, bulk, and shear moduli; Poisson's ratio; elastic potential energy.

XII. Mechanical Properties of Fluids

Pressure in fluids; Pascal's law and applications (hydraulic lift and 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, surface tension, angle of contact, excess pressure in curved surfaces; applications to drops, bubbles, and capillary rise.

XIII. Thermal Properties of Matter

Heat and temperature; thermal expansion of solids, liquids, and gases; anomalous expansion of water; specific and latent heats; Cp and Cv; calorimetry; heat transfer by conduction, convection, and radiation; thermal conductivity; qualitative ideas of blackbody radiation, Wien's law, Stefan's law, and greenhouse effect.

XIV. Thermodynamics

Zeroth law and concept of thermal equilibrium; heat, work, and internal energy; state variables and equation of state; first law of thermodynamics; isothermal and adiabatic processes; second law of thermodynamics, reversible and irreversible processes; heat engines and refrigerators.

XV. Behaviour of Perfect Gases and Kinetic Theory

Equation of state for a perfect gas; work done during compression; assumptions of kinetic theory; pressure of a gas; kinetic interpretation of temperature; rms speed of gas molecules; degrees of freedom and law of equipartition of energy (statement only); applications to specific heat capacities; mean free path; Avogadro's number.

XVI. Oscillations and Waves

Oscillations:

Periodic motion, time period, frequency, displacement; simple harmonic motion (S.H.M.) and its equation; phase; oscillations of a spring; energy in S.H.M.; simple pendulum and its time period; free, forced, and damped oscillations; resonance (qualitative).

Waves:

Transverse and longitudinal waves; speed of a travelling wave; displacement relation for a progressive wave; principle of superposition; reflection of waves; standing waves in strings and pipes; fundamental mode and harmonics; beats and Doppler effect.

XVII. Electrostatics

Electric Charges and Fields:

Conservation of charge; Coulomb's law; superposition principle; continuous charge distributions; electric field and field lines; electric dipole and torque in a uniform field; electric flux; Gauss's theorem and applications (long wire, infinite plane, spherical shell).

Electrostatic Potential and Capacitance:

Electric potential and potential difference; potential due to point charges and dipoles; equipotential surfaces; potential energy of charge systems; conductors and insulators; dielectrics and polarization; capacitors and combinations (series, parallel); capacitance of a parallel-plate capacitor with/without dielectric; energy stored in a capacitor.

Current Electricity:

Electric current and drift velocity; mobility; Ohm's law; resistance, resistivity, conductivity; temperature dependence; carbon resistors and colour coding; series and parallel circuits; internal resistance and emf of a cell; combination of cells; Kirchhoff's laws; Wheatstone bridge and metre bridge; potentiometer and its applications.

XVIII. Magnetic Effects of Current and Magnetism

Moving Charges and Magnetism:

Magnetic field, Oersted's experiment, Biot–Savart law (circular loop); Ampere's law (long wire, solenoid, toroid); motion of a charged particle in magnetic and electric fields; cyclotron; force on a current-carrying conductor; force between parallel conductors (definition of ampere); torque on a current loop; moving coil galvanometer and its conversion to ammeter and voltmeter.

Magnetism and Matter:

Magnetic dipole, dipole moment of current loop and revolving electron; field due to a dipole; bar magnet as an equivalent solenoid; Earth's magnetic field and magnetic elements; para-, dia-, and ferromagnetic substances; electromagnets and permanent magnets.

Electromagnetic Induction and AC:

Faraday's and Lenz's laws; induced emf and current; eddy currents; self and mutual induction; alternating current—peak and RMS values, reactance and impedance, LC oscillations (qualitative), LCR series circuit, resonance, power factor and wattless current; AC generator and transformer.

Electromagnetic Waves:

Concept of displacement current; electromagnetic wave characteristics; transverse nature; electromagnetic spectrum (radio to gamma rays) and their uses.

XIX. Optics

Ray Optics and Instruments:

Reflection and refraction; total internal reflection and optical fibres; spherical mirrors and lenses; mirror and lens formulas, magnification, lensmaker's formula, combination of lenses; refraction through a prism; dispersion and scattering of light; blue sky and red sunrise; optical instruments (microscope, telescope) and their magnifying powers.

Wave Optics:

Wavefront and Huygens' principle; proof of laws of reflection and refraction; interference (Young's double-slit experiment); diffraction by single slit; resolving power of microscope and telescope; polarisation, Brewster's law, and uses of polarised light.

XX. Dual Nature of Radiation and Matter

Dual nature of radiation; photoelectric effect (Hertz, Lenard, Einstein's equation); particle nature of light; matter waves—de Broglie hypothesis; Davisson–Germer experiment (qualitative discussion).

XXI. Atoms and Nuclei

Atoms:

Rutherford's α-scattering experiment; Bohr's model and hydrogen spectrum.

Nuclei:

Composition and size of nucleus; radioactivity—α, β, and γ rays; decay law, half-life, mean life; mass defect and binding energy; mass–energy relation; nuclear fission and fusion.

XXII. Electronic Devices

Semiconductor Electronics:

Energy bands in conductors, semiconductors, and insulators (qualitative); p–n junction diode—forward and reverse bias, diode as rectifier; special-purpose diodes (LED, photodiode, solar cell, Zener diode); Zener diode as a voltage regulator.