Syllabus for written examination for PGT (Physics)

Unit I: Physical World and Measurement

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. dimensional analysis and its applications.

Unit II: Kinematics

Frame of reference. Motion in a one ,two and three dimension: Position-time graph, speed and velocity.

Uniform and non-uniform motion, average speed and instantaneous velocity.

Uniformly accelerated motion, velocity-time, position-time graphs, relations for uniformly accelerated motion .Vectors :Position and displacement vectors .addition and subtraction of vectors. Relative velocity.scalar product of vectors,Vector product of vectors.

Unit vector; Resolution of a vector in a plane - rectangular components. Motion in a plane. Cases of uniform velocity and uniform acceleration-projectile motion.

Unit III: 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. Types of friction, laws of friction, .Dynamics of uniform circular motion .

Unit IV: 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: elastic and inelastic collisions in one and two dimensions.

Unit V: Motion of System of Particles and Rigid Body

Centre of mass of a two-particle system, momentum conversation and centre of mass motion. Centre of mass of a rigid body; centre of mass of uniform rod.

; moment of a force, torque, angular momentum, conservation of angular momentum with some examples.

Dynamics of rigid bodies, comparison of linear and rotational motions; moment of inertia, radius of gyration.

Values of moments of inertia for geometrical objects. Parallel and perpendicular axis theorems and their applications.

Unit VI: Gravitation

Keplar's laws of planetary motion. The universal law of gravitation.

Variation of Acceleration due to gravity and with altitude,latitude and depth.

Gravitational potential energy; gravitational potential. Escape velocity. Orbital velocity of a satellite. Geo-stationary satellites.

Unit VII: Properties of Bulk Matter

Elastic behaviour, Stress-strain relationship, Hooke's law, modulus of elasticity.
Pressure due to a fluid column; Pascal's law and its applications
Viscosity, Stokes' law, terminal velocity, Reynold's number, streamline and turbulent flow. Bernoulli's theorem and its applications.
Surface energy and surface tension, application of surface tension ideas to drops, bubbles and capillary rise.
Heat, temperature, thermal expansion; specific heat - calorimetry; change of state - latent heat.
Heat transfer-conduction, convection and radiation, thermal conductivity, Newton's law of cooling.

Unit VIII: Thermodynamics

Thermal equilibrium and definition of temperature (zeroth law of thermodynamics). Heat, work and internal energy. First law of thermodynamics.
Second law of thermodynamics: reversible and irreversible processes. Heat engines and refrigerators.carnot cycle and carnot's theorem.
Equation of state of a perfect gas, work done on compressing a gas.
Kinetic theory of gases ,degrees of freedom, law of equipartition of energy and application to specific heats of gases; concept of mean free path, Avogadro's number.

Unit IX: Oscillations and Waves

Periodic motion - period, 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, resonance.
Wave motion. Longitudinal and transverse 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.

Unit X: Electrostatics

Electric Charges; Conservation of charge, Coulomb's law and its application,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.
Gauss's theorem and its applications
Electric potential, potential difference, electric potential due to 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, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor. Van de Graaff generator.

Unit XI: 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, 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 its applications..

Potentiometer - principle and its applications

Thermal and chemical effect of current.

Unit XII: Magnetic Effects of Current and Magnetism

Biot - Savart law and its application

Ampere's law and its applications to infinitely long straight wire, straight and toroidal solenoids.

Lorentz's force. Cyclotron, synchrotron.

Interaction of a current-carrying conductor with magnetic field. Force between two parallel current-carrying conductors. Torque experienced by a current loop in uniform magnetic field and its application;

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.

Unit XIII: Electromagnetic Induction and Alternating Currents

Electromagnetic induction; Faraday's law, induced emf and current; Lenz's Law, Eddy currents. Self and mutual inductance.

Need for displacement current.

Alternating currents and its measurement reactance and impedance; LC oscillations, LCR series circuit, resonance; power in AC circuits,.

generator , motors and transformer.

UnitXIV: 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, lens-maker's formula. Magnification, power of a lens, combination of thin lenses in contact. Refraction and dispersion of light through a prism.

Scattering of light and its application.

Optical instruments: Human eye-eye defects and its correction. Microscopes and astronomical telescopes and their magnifying powers.

Wave optics: wave front and Huygens' principle, reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygens' 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. Polarisation, plane polarised light; Brewster's law, uses of plane polarised light and Polaroids.

Unit XV: Modern Physics

Dual nature of radiation. Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation-particle nature of light. Compton effect, deffraction of X- rays ,Bragg's

law ,Hall effect.

Matter waves-wave nature of particles, de Broglie relation. Davisson-Germer experiment. Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum.

Composition and size of nucleus, packing fraction and magnetic moment, 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; liquid drop model of nucleus, nuclear fission and fusion.,critical mass ,chain reaction and fission reaction, ionization chamber,Geiger counter and scinitillation counter,linear accelerator.

Unit XVI: Electronic Devices

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 and its combination. Transistor as a switch.