Syllabus for PGT (Physics) Recruitment 2023

1. Mathematical Methods of Physics

Dimensional analysis, Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton Theorem. Eigen values and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions.

2. Solid State Physics

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 amplifier(common emitter configuration) and oscillator. Logic gates and its combination. Transistor and switch.

3. **Geometrical and Physical Optics**

Reflection of light, spherical mirrors, mirror formula. Refraction of light, total internal reflection and its applications, optical fibers, refraction at spherical surfaces, lenses, thin lens formula, lens-maker's formula. Magnification, power of 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 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 polarized light; Brewster's law, uses of plane polarized light and Polaroids.

4. Properties of Bulk Matter

Elastic behavior, 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, Reynolds’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.

5. Magnetic effects of Electric Current

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, 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 a 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.

6. **Oscillation 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 timeperiod; 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.

7. **Heat and 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 equi partition of energy and application to specific heats of gases; concept of mean free path, Avogadro's number.

8. **Nuclear physics**

Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semi empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Rotational spectra. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions.

9. **Motion and Mechanics**

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.

10. **Work Power and Energy**

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

11. **Electromagnetism**

Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space.

12. 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-1characteristics (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 its applications.. Potentiometer-principle and its applications Thermal and chemical effect of current.

13. 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

14. 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.

15. Quantam Physics

Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigen value problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom.

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