Syllabus for PG entrance test in Physics under NEP-2020.

Session-2025

UNIT-I

Cartesian co-ordinate system, spherical & cylindrical coordinate system with expression for velocity and acceleration. Newton's laws of motion, dynamics of a system of particles. centre of mass. Inertial and non-inertial frames of references, uniformly rotating frame, Coriolis force & its applications.

Momentum and energy: Conservation of linear momentum in system of particles.

UNIT-II

Work and energy, Conservation of energy. Rotational motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum in system of particles.

Special theory of relativity: Galilean and Lorentz transformations. Postulates of special theory of relativity. Length contraction. Time dilation. Relativistic addition of velocities.

UNIT-III

The Lagrangian Approach to Mechanics: degrees of freedom, constraints and generalized coordinates,

Euler Lagrange equation of motion, the Hamiltonian, cyclic coordinates and canonical momenta.

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and potential energy. Total energy and their time averages. Damped oscillations,

UNIT-IV

Vector Analysis: gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors. Dirac Delta function.

Fourier Series, Properties and Applications. Fourier transform, Sine, Cosine and Complex transforms with examples, Properties of Fourier Transforms, Transforms of derivatives.

UNIT-V

Laplace transform, Properties and examples of Laplace Transform.

Complex functions, Analytic functions, Cauchy - Riemann conditions. Cauchy's Integral Theorem.

Probability: Definitions and simple properties. Random Variables, mean, variance. Marginal and conditional probability distributions.

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UNIT- VI

Gauss's theorem of electrostatics. Applications of Gauss theorem: Electric field due to point charge. infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet. charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate capacitor. Energy per unit volume in electrostatic field.

UNIT – VII

Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia. para, and ferro-magnetic materials. Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field.

UNIT-VIII

System with Two Degrees of Freedom: Coupled Oscillators. Normal Coordinates and Normal Modes. Energy Relation and Energy Transfer. Normal Modes of N Coupled Oscillators. Free Oscillations. Damped Oscillations: Damping Coefficient, Log Decrement.

Forced Oscillations: Transient and Steady States, Amplitude, Phase, Resonance, Sharpness of Resonance, Power Dissipation and Quality Factor. Helmholtz Resonator.

UNIT-IX

Fraunhofer diffraction: Fraunhofer diffraction at one, two and N slits, diffraction grating, Rayleigh criterion of resolution, resolving power of grating.

Fresnel diffraction: Fresnel's half period zones, zone plate.

Polarization: plane, circular and elliptical polarizations-Production and analysis

UNIT-X

Intensive and Extensive thermodynamic variables. Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work.

Applications of First Law: General Relation between C_p & C_v, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes.

UNIT-XI

Second law & Entropy. Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications: Joule-Thompson Effect, Clausius-Clapeyron Equation: application to phase equilibrium. Expression for $(C_p - C_v)$, C_p/C_v, TdS equations.

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UNIT-XII

System and ensemble, phase space, micro and macrostates, Postulate of classical and quantum statistics, Entropy and Thermodynamic Probability. Maxwell Boltzmann Distribution Law. Ensemble Concept. Law of Equipartition of Energy – Applications to Specific Heat and its Limitations. Distribution functions: Classical, Bose-Einstein and Fermi- Dirac distributions.

UNIT-XIII

Properties of Thermal Radiation. Blackbody Radiation. Stefan Boltzmann Law and Wien's Displacement law. Stefan Boltzmann Law: Thermodynamic Proof. Radiation Pressure. Spectral Distribution of Black Body Radiation. Wien's Distribution Law. Rayleigh Jean's Law. Ultraviolet Catastrophe. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation

UNIT-XIV

Photoelectric Effect. Compton Effect, De-Broglie Hypothesis. Wave-Particle Duality. Davisson-Germer Experiment. Group and Phase Velocities and relation between them.

Properties of Wave Function: Interpretation of Wave Function. Probability Current Density and Probability, Expectation values; operators; Particle in a one dimensional box.

UNIT – XV

Electron spin; Stern-Gerlach experiment; Pauli's exclusion principle; Symmetric and anti-symmetric wave functions;

Atomic structures, Spin- orbit coupling; Total angular momentum J, Normal and anomalous, Zeeman Effect; Lande g-factor. Quantization of rotational energies; Rotational energy levels; Pure rotational spectra;

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