# Physics

Mechanics, Thermal Physics and Waves and Oscillations

**1. Mechanics:**
Conservation Laws, Collision impact parameter, scattering cross-section, centre of Mass and Lab systems with transformations of Physical quantities. Rutherford Scattering. Motion of a rocket under constant force field Rotating frames of reference, Coriolis force, Motion of rigid bodies. Angular Momentum, Torque and Procession of top, Gyroscope, Central forces Motion under universe square law, Kepler's Laws, Motion of Satellites (including geostationary). Galilean Relativity, Special theory of relativity, Micheison-Morley Experiment, Lorentz Transformations - addition theorem of velocities. Variation of mass with velocity, Mass-energy
equivalence. Fluid dynamics, streamlines, turbulence, Bernouili's Equation
with simple application.

**2. Thermal Physics :**

Laws of Thermo dynamics, Entropy, Carnot's cycle, Isothermal and Adiabatic changes. Thermodynamic Potentials, Maxwell's relations, the clausius-Clapeyron equation, reversible celi, Joule-Kelvin effect, Stefan-Boltsmann Law. Kinetic theory of Gases, Maxwell's Distribution Law of velocities. Equipartition of energy. Specific heats of gases, mean free path, Brownian Motion, Black Body radiation specific heat of solids, Enstein & Debye's theories, Wein's Law, Planck's Law, Solar Constant, Thermalionization and Stelar Spectra. Production of low temperature using adiabatic demagnetization and dilution refrigeration, Concept of negative temperature.

**3. Waves and Oscillations :**
Oscillations, Simple harmonic motion, stationary and traveling waves, Damped harmonic motion, Forced oscillation and Resonance, Wave equation, Harmonic Solutions, Plane and spherical waves, Super position of waves. Phase and Group velocities, Beats, Huygen's Principle, Interference, Diffraction-Fresnel & Fraunhofer. Diffraction by straight edge, single and multiple slits. Resolving power of grating and Optical Instruments. Rayleigh's, Criterion, Polarization; Production and Detection of polarized light (linear, circular and elliptical) Laser sources (Helium, Neon, Ruby and semi conductor diode). Concepts of spatial and temporal coherence. Diffraction as a Fourier Transformation. Fresnel and Fraunhofer diffraction by rectangular and circular apertures. Holography; theory and applications.

Electricity & Magnetism, Modern Physics and Electronics

**4. Electricity & Magnetism** : Coulomb's Law, Electric field. Gauss's law, Electric potential. Poisson and Laplace equations for a homogeneous dietectric, uncharged conducting plane. Magnetic Shell. Magnetic induction and field strength. Biot-Savart's law and applications. Electromagnetic induction,Faraday's and Lenz's laws, Self and Mutual Induction. Alternating currents. L.C.R. circuits, series and parallel resonance circuits, quality factor, Kirchoff's laws with applications. Maxwell's equations and electromagnetic waves. Transverse nature of electromagnetic waves, Poynting vector. Magnetic fields in matter dia-para, ferro antiferro and ferri magnetism (qualitative approach only).

**5. Modern Physics :** Bohr's theory of hydrogen atom. Electron spin. Optical and X-ray Spectra. Stern-Gerlach experiment and coaxial quantization. Vector model of the atom, spectral terms, fine structure of spectral lines. J-J' and L-S coupling Zeeman effect. Pouli's exclusion principle, spectral terms of two equivalent and non-equivalent electrons. Gross and fine structure of electronic band Spectra. Raman effect, Photoelectric effect. Compton effect. De Brogile waves. Wave-Particle duality and uncertainity principle. Schrodinger wave equation with application to (i) Particle (ii) Motion across a step potential, one dimensional harmonic oscillator eigen values and eigen functions. Uncertainity principle Radioctivity. Alpha, beta and gamma radiations. Elementary theory of the alpha decay. Nuclear binding energy. Mass spectroscopy, Semi empirical mass formula. Nuclear fission and fusion. Nuclear Reactors. Elementary particles and their classification. Strong and Weak Electromagnetic interactions. Particle accelerator; cyclotron, Leniar accelerators, Elementary ideas of Superconductivity.

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6. **Electronics** : Band theory of solids - conductors, insulators and semi-conductors, Intrinsic and extrinsic semi-conductors. P-N junction. Thermistor, Zener diode, reverse and forward biased P-N junction, solar cell. Use of diodes and transistors for rectification, amplification, oscillation, modulation and detection of r.f. waves. Transistor receiver. Television. Logic Gates.

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