SYLLABUS : PHYSICS

1) MECHANICS AND KINEMATICS:

Vector algebra, Newton's laws of motion, frames of reference, Coriolis force, rigid body dynamics- moment of inertia, elasticity.
Conservation laws.
Gravitation, planetory motion, artificial satellites.
Fluid dynamics- surface tension, viscosity, osmosis, its applications.

2) HEAT, THERMODYNAMICS AND STATISTICAL PHYSICS:

Gas laws, ideal gas, real gas, VanderWaal's equations, low temperature physics, Diffusion.
Thermal conductivity.
Laws of Thermodynamics and consequences : heat engnes, carnot's cycle, entropy. Thermodynamic potentials, Enthalpy, Maxwell relations, chemical potential, phase equilibria, phase space, micro and macro states : Microcanonical, canonical and grand canonical ensembles and partition functions: Free energy and conection with Thermodynamic quantities: First and second order phase transition, Maxwell-Boltzmann, Bose Einstein and Fermi Dirac statistics, energy distribution.
Black Body radiation And Planck's Distribution law: and consequences:
Bose Einstein condensation, random walk and Brownian motion

3) WAVES AND OSCILLATIONS:

Simple Harmonic Motion, Types of waves and characteristics, intensity of waves, interference, diffraction, Doppler effect.
Acoustics.

4) OPTICS-

Geometric Optics- Fermat's Principle, reflection, refraction, dispersion, measurement of speed of light.
Physical Optics-Theory of light, Huygen's principle,reflection, refraction, Interference, diffraction, polarisation.

5) ELECTROMAGNETIC THEORY:

Electrostatics: Gauss Law and its applications; Laplace and Poisson equations, effects of electric current, boundary value problems electromagnetic induction, electrostaticinduction ;Displacement current, Maxwell's equations in free space and linear isotropic media; boundary conditions on fields at interfaces;

Scalar and vector potentials: Guage invariance; Electromagnetic waves in free space, dielectrics and conductors,- Lorentz invariance of Maxwell's equations, Poynting vector.

Dynamics of charged particles in static and uniform electromagnetic fields, radiation from moving charges, dipoles.

6) ELECTRONICS:

Semiconductor devices, Amplifiers, oscillators.

Optoelectronics, generators and detectors,Cathode ray oscilloscope. Operational amplifiers and their applications: Digital electronics and applications ,logic gates; A/D and D/A converters .

Microprocessor and microcontroller basics, memory devices.Transducers.

Basics of signals and communication.

7) ATOMIC AND MOLECULAR PHYSICS

Quantum states of an electron in an atom; Stern-Gerlachexperiment;atomic and molecular spectra ; relativistic corrections for energy levels of hydrogen atom; hyperfine structure and isotopic shift; width of spectral lines; LS and JJ coupling; Zeeman, Paschen Back and Stark effect; electron spin resonance; Nuclearmagnetic resonance.

Raman spectra of diatomic molecules; Einstein A & B coefficients.Lasers.

8) QUANTUM MECHANICS:

Wave- particle duality, wave functions, Heisenberg uncertainty principle; matrix representation; dirac's bra &ket notation; Schroedinger equation, wave function, particle in a box, oscillator, rotator, quantum mechanical tunneling, addition of angular momentum. Hydrogen atom, Helium atom; perturbation theory, WKB approximation, Born approximation; Pauli's exclusion principle, relativistic quantum mechanics.

9) **NUCLEAR AND PARTICLE PHYSICS**

Nuclear properties, mass defect, Binding energy, semi-empirical mass formula Liquid drop model- merits & demerits, Nuclear forces,Yukawa's theory of nuclear forces.Nuclear Reactions: Nuclearfission, nuclear reactor, nuclear fusion, Nuclear Detectors.

Radioactivity, Theory of alpha decay, Fermi's theory of beta decay, Beta ray spectra. K- electron capture. Internal conversion, Gamma ray spectrum,Multipolarity of gamma rays, Selection rules, Internal conversion, Elementary Particle Physics,Charged weak interactions of quarks, CPT theorem

10) **CONDENSED MATTER PHYSICS**

Crystalline state- primitive and non- primitive lattice cell-fundamental Bravais lattices:, Miller indices. Simple crystal structures-NaCl, CsCl, HCP, diamond, ZnS and Wurtzite,Point defects ,Free electron theory of metals Fermi energy. Average energy of electrons, Electronic specific heat.Thermionic emission from metals.Electrical conductivity. Drift velocity and relaxation time. Thermal conductivity.Wiedemann-Franz law, Band theory of solids: Bloch theorem Kronig Penny model-E-K curves-number of allowed states in bands-motion of electrons in 1-d-effective mass-concept of hole-freeness factor-classification of solids.

Concept of holes, expression for carrier concentration)-electrical conductivity-mobility and their temperature dependence-Hall effect in semiconductors,Para, dia&ferro magnetism.

Superconductivity-type I& II superconductors, Meissner effect-thermodynamic properties-heat capacity-thermal conductivity. . Josephson junctions BCS theory, high temperature superconductors, Applications, X-diffraction in crystals.

Nano & Smart Materials:- Properties –examples and applications

Liquid crystals: Classification, Orientational order and its determination in the case of nematic liquid crystals and applications

11) ASTROPHYSICS:

Basic concepts , Surface or effective temperature and color of a star, Spectral classification of stars and their chemical composition: Mass - luminosity relationship and expression for life-time of a star. Hertzsprung - Russell (HR) diagram: Evolution of a star, Supernova explosion. Formation of a pulsar or neutron star and blackhole , Gravitational potential energy or self-energy of a star.

12) CLASSICAL MECHANICS :

Newton's laws; phase- space dynamics, stability analysis, central-force motion, two-body collisions, scattering in laboratory and centre of mass frames;
Variational principle, Lagrangian and Hamiltonian formalisms and equations of motion; Poisson brackets and canonical transformations.Symmetryinvarianc and conversation laws,Cyclic coordinates, periodic motions small oscillations and normal modes

Special theory of relativity, relativistic kinematics and mass-energy equivalence.

13) MATHEMATICAL AND COMPUTATIONAL PHYSICS:

Linear algebra, Elements of tensors, linear differential equations, special functions- Hermite, Bessel, Laguerre, Legendre. Generation of functions, Fourier series, Laplace transform. Elements of complex analysis, group theory.Green's function, integral equations,Dirac delta function.

Numerical techniques, C programming, solution of transcendental equations, Newton-Raphons, RungeKutta method, finite difference methods.

References

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   Introductory Nuclear Physics,Kenneth S. Krane: John Wiley and Sons, 1987.
2. Nuclear Radiation Detectors, S.S. Kapoor and V.S.Ramamurthy: Wiley-Eastern, New Delhi, 1986.
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4. Solid State Physics- A J Dekkar, MacMillan India Ltd, (2000)
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24. B.K. Mathur - *Principle of Optics.* 2000
25. Subramanyam and Brijlal – *Optics,* S Chand & Company 1983.