Faculty of Engineering & Technology

Advanced PG Diploma in Nanotechnology

Semiconductors : Elemental and compound semiconductors, Energy bands, Direct and indirect semiconductors, Electrons and holes, Effective mass, Intrinsic material, Extrinsic material, Fermi level, Electron and hole concentration at equilibrium. Temperature dependence of carrier concentrations Compensation and space charge neutrality, Conductivity and mobility, Hall effect in semiconductors.

II

(a) **Special Relativity** : Frames of reference, Postulates of special relativity, Galilean and Lorentz transformations, Inverse Lorentz transformations, Velocity addition, Length contraction and time dilation, Relativity of mass, Mass-Energy relation, relativistic expression for total wenergy of moving particle, Relation between total energy and momentum of a particle, mass less particles (Photons).
(b) Maxwell's Equations and Electromagnetic Waves : Maxwell's Equations, Travelling Electromagnetic Wave, Quantitatively, Energy Transport & the Pointing Vector.

III

Particles and Waves : Mechanism of X-ray production (continuous and characteristics X-rays, Duane-Hunt limit), Diffraction of X-rays (Bragg Planes, Bragg's law, Bragg Spectrometer), Compton effect, Pair production, Phase and group veolocites, Electron microscopes, Unicertainty principle, Applications of Uncertainty principle.

IV

Quantum Mechanics : Introduction to quantum mechanics, Wave function, Conditions necessary for physically acceptable wave function, Probability density and probability, Schrodinger equation (Time dependent form and steady state or time independent form), Eigenvalues and Eigenfunctions, Expectation values, Particle in a box (Infinite potential well), Finite potential well, Tunnel effect.

V

Masers and Lasers : Basic principle, Einstein coefficients for Induced absorption, Spontaneous Emission and induced emission, Ammonia maser and its applications, Ruby and He-Ne Lasers, Semiconductor laser, Spatial and temporal coherence, Characteristics of lasers and its applications based on these characteristics (such as in Industry, Science, Medicine, Communications, Surveying, Holography, Fusion reactors, Isotope separation, etc.).

VI

(a) **Fibre Optics** : Basic principle, Fibre construction and dimensions, Light Propagation in fibres, Numerical aperture of the fibre, Step index and graded index fibres, Signal distortion in optical fibres, Transmission losses, Light wave communication in optical fibres, Fibre Optics in medicine and industry.
(b) **Superoncudctivity** : Zero resistivity, Meissner effect, Type I and Type II Superconductors, High Temperature Superconductors, BCS theory (qualitative), Josephson effect, SQUIDS.

VII

Statistical Mechanics : Statistical distribution, Maxwell-Boltzmann statistics, Molecular energies in an ideal gas, Quantum statistics. The three statistical distribution functions, Specific heats of solids Free electron in a metal and Fermi energy, Electron – energy distribution, Dying starts, White dwarfs, Neutron starts, Blackholes.

VIII

Nuclear Physics : Q value and threshold energy of nuclear reactions, Cross section of a nuclear reaction and reaction rate, Breeder reactors, Fusion reactors, Nuclear detectors (names and general working principle), Gas filled detectors, Scintillation detectors, Track detectors, Semiconductor detectors.

IX

Structure and function of biomolecules; Characteristics of bacteria, actinomycetes, fungi and viruses; cell biology; Plant vascular systems; Animal physiology; Metabolism; Molecular genetics; Immunology; Enzymes; Molecular biology; Infection and diseases, Bionanomaterials; Drug delivery; Environment toxicology; Analytical and Spectroscopic techniques.

X

Electronic structure of atoms; Periodic table and periodic properties; Chemical equilibria; Thermodynamics; Molarity; Acids and Bases; Buffers; Chromatographic separations; Organic and Inorganic Composites; Redox Reactions.