Module 1 :

Classical Mechanics : 4L

Constraints. Generalised coordinates. Lagrange's equation of motion. Hamiltonian formulation, Hamilton's equation of motion. Course should be discussed along with simple physical problems.

Quantum Mechanics: 6L

Physical interpretation of wave function Ψ(normalization and probability interpretation). Concept of probability and probability density. Operator. Commutator. Formulation of quantum mechanics and basic postulates . Operator correspondence . Time dependent Schrödinger's equation . Formulation of time independent Schrödinger's equation by method of separation of variables. Expectation values. Application of Schrödinger equation-Particle in an infinite square well potential (1-D and 3-D potential well), discussion on degenerate energy levels.

Module 2 :

Statistical Mechanics: 6L

Concept of energy levels and energy states. Macrostates. Microstates and thermodynamic probability. Equilibrium macrostate. MB, FD and BE statistics (no deduction necessary). Fermions, Bosons (definitions in terms of spin, examples). Physical significance and application. Classical limit of quantum statistics. Fermi distribution at zero and non –zero temperature. Fermi Level.

Applications of Statistical Mechanics : 4L

Planck's Black body radiation. Fermi level in intrinsic and extrinsic semiconductors. Intrinsic semiconductors and carrier concentration. Extrinsic semiconductors and carrier concentration.Equation of continuity. Direct & indirect band gap semiconductors.

Module 3 :

Dielectric Properties: 5L

Electric dipole moment. Dielectric constant. Polarizability. Electric susceptibility. Displacement vector. Electronic, ionic and orientation polarizations. Calculation of polarizabilities - Internal fields in solids. Piezoelectricity, pyroelectricity and ferroelectricity.

Magnetic Properties: 5L

Permeability, field intensity, magnetic field induction, magnetization, magnetic susceptibility. Origin of magnetic moment, Bohr magneton. Classification of dia, para and ferromagnetic materials on the basis of magnetic moment. Domain theory of ferromagnetism. Explanation of hysteresis curve. Soft and hard magnetic materials. Properties of anti-ferro and ferri magnetic materials. Ferrites and their applications. Concept of perfect diamagnetism.

Module 4 :

Band Theory of Solids: 6L

Electron in a periodic potential. Bloch theorem. Kronig-Penny model (qualitative treatment). Origin of energy band formation in solids. Classification of materials into conductors, semiconductors & insulators. Concept of effective mass of an electron and hole.

Super Conductivity: 4L

Introduction (experimental survey). General properties of superconductivity. Effect of magnetic field. Meissner effect . Explanation in view of wave mechanical property. Hard and soft superconductors. Thermal properties of superconductor. London equations and penetration depth.