MP-08 (B)
ADVANCED SOLID STATE PHYSICS

(Questions will be set from each unit/section with internal choice)

Units	Topics
I	**Free Electron Gas:** Free electron model of metals, dielectric response of electrons, transverse optical modes in a plasma, transparency of alkali metals in the ultraviolet, longitudinal optical modes in a plasma plasmona, electrostatic screening, electron collisions. **Band Theory:** Nearly free electron model, wave equation of electron in a periodic potential, Bloch functions, crystal momentum of an electron reduced zone scheme, periodic zone scheme, approximate solution and near zone boundary, number of orbitals in band metals, insulators and semiconductors.
II	**Fermi Surfaces:** Construction of Fermi surfaces, electrons, holes and open orbits, physical properties of holes, effective mass electrons in crystals, wave functions for zero wave vector, lattice effect on cohesive energy of metals, pseudo potentials. Experimental methods in Fermi surface studies, cyclotron resonance in metals external orbits, De Hass- Van alphen effect. Fermi surfaces of free metals. **Transport Properties:** The Boltzmann equation, electrical conductivity, calculation of relaxation time, Impurity scattering, Ideal resistance, carrier mobility General transport coefficients, thermal conductivity, thermoelectric effects, lattice conduction, phononn drag, the Hall effect, the two band model, Magneto resistances.
III	**Semiconductors:** Intrinsic conductivity, band gap, law of mass action intrinsic carrier concentration, impurity conductivity impurity states, thermal ionization of impurities, energy bands in Si and Ge, n-n junctions, rectification, polarons, semi metals mobility of protons, point Defects, Alloys and Dislocations. Lattice vacancies, Schottky and Frenkel defects, diffusion, colour centres, alloys, magnetic alloys and the Konde effect, Order-disorder transformations, dislocations, dislocations and crystal growth Whiskers.
IV	**Superconductivity:** Experimental survey, occurrence of superconductivity, destruction of superconductivity by magnetic fields Meissner effect, heat capacity, energy gap, microwave gap. Microwave and infra-red properties, isotope effect. Theoretical survey, thermodynamics of superconducting transition, London equation, coherence length. BSC theory of superconductivity, BCS ground state, persistent current, single particle tunnelling, Josephson effect and flux quantization, type II superconductors vertex state. **Optical Phanomena in Insulators:** Colour centres, excitons, weakly and tightly bound excitons, exciton waves, excitons, in molecular crystals, solid state quantum electronics principles of maser action, three level maser, ruby laser, semiconductor junction laser, photoconductivity traps, space charge effect, crystal counters, luminescence. Study of breakdown in solid dielectrics at low, high and intermediate temperatures, influence of annealing, temperature, effect of thickness of electrode edge effects and time lag.
V	**Magnetism:** Diamagnetism and paramagnetism, quantum theory of paramagnetism ferromagnetic order, spin waves and magnons, ferromagnetic order, antiferromagnetic order, ferromagnetic domains. **Magnetic Resonance:** Nuclear magnetic resonance, line width hyperfine splitting, nuclear quadrupole resonance, ferromagnetic resonance, antiferromagnetic.