PGP/PSP 5434 **CONDENSED MATTER PHYSICS – II** **4 hrs/4 Cr**

This course enables learners to acquire knowledge of energy bands in crystals, understand the different classification of materials, translate the learned information to a variety of quasi particles, present reasoned explanation for various superconducting effects and apply the systematic approach to problem solving in dielectrics and Ferro electrics

At the end of the course, students will be able to

i. derive and explain the electrical properties of crystals
ii. explain the theory of quasi particles and their characteristics
iii. classify the types of superconductors and explain its properties
iv. explain the origin of dielectric and Ferro-electric phenomena
v. describe quantum theory of magnetism and classify magnetic materials

Unit I:Fermi Gas and Energy Bands:

Free electron theory in 1D and in 3D – Fermi-Dirac distribution – Density of states – Heat capacity of the electron gas – Electrical conductivity and Ohm's law – Motion of electrons in magnetic field – Hall Effect – Nearly free electron model – Bloch functions – Kronig-Penney model.

Unit II:Plasmons, Polaritons, Polarons and Excitons

Dielectric function of the electron gas – Plasma Optics – Transverse and Longitudinal modes of Plasma – Plasmons – Polaritons – LST equation – Polarons, Optical Reflectance-Kramer-Kronig relation –Excitons- Frenkel and Mott-Wannierexcitons

Unit III:Superconductivity:

Experimental survey – Destruction of superconductivity by magnetic field – Meissner effect – Isotopic effect – Type I and Type II superconductors – London equation – Coherence length – BCS theory of superconductivity – Flux quantization – Vortex state – DC and Ac Josephson effect – High temperature superconductors – Fullerenes

Unit IV:Dielectric and Ferro electrics

Macroscopic electric field – Local electric field at an atom – dielectric constant and Polarizability – Classius-Mossati equation – electronic polarizability and its frequency dependence – Structural phase transitions – Ferro electric crystals – Displacive transition – Landau theory of phase transition – antiferroelectric materials –Piezoelectricity-Ferroelasticity

Unit V:Magnetism

Quantum theory of dia and para magnetism- Rare earth ions- Hund's rule- Orbital quenching- Paramagnetic susceptibility of conduction electrons- Ferromagnetic order- antiferromagnetic order- Magnons, thermal excitons of magnons , spin waves

Text Book:

1. Charles Kittel, *Introduction to Solid State Physics*, 5th edition.

References:

1. S.O Pillai(1997), *Solid State Physics*, Wiley Eastern Lmt.
2. S.V Subramanian, E.S Rajagopal(1989), *High Temperature Super conductivity*, Wiley Eastern Lmt
3. H.V Keer(1994), *Principles of Solid State,* Wiley Eastern Lmt.
4. M.A.Wahab(1999), *Solid State Physics*, Narosa Publishing house, Delhi