PGP/PSP 4435 **CONDENSED MATTER PHYSICS – I** **4 hrs / 4 Cr**

This course exposes students to have a detailed discussion on different crystal structures, various diffraction techniques and different imperfection in crystals; it also deals with the different bonding natures in crystals. It also attempts to have a systematic approach to problem solving in crystal vibrations.

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

i. determine the structure factors and atomic scattering factor of crystal lattices.
ii. describe the X-ray diffraction and anomalous dispersion to predict the crystal structure and temperature effects
iii. classify and differentiate the defects in crystals.
iv. explain and relate different crystal binding forces.
v. describe and examine the effect of lattice vibrations.

Unit I: Crystallography

Basic concepts of crystallography-Index system for crystal planes –Simple crystal structure – Reciprocal lattice vectors – Fourier analysis of the basis: Structure factor for SC, BCC, FCC structures – Atomic scattering factor- Quasi crystals.

Unit II: Crystal diffraction

Braggs law – different scattering methods-derivation of scattered wave amplitude -anomalous dispersion of scattering by crystals- Theory of X-ray diffraction-temperature effect- crystal structure determination

Unit III: Crystal imperfections

Imperfections in crystals –Point defects: Lattice vacancies- Diffusion- Colorcenters- Surface and interface physics: Concentration of Frenkel and Schottky defects – Line imperfections – Screw imperfection – Burger vector – Surface imperfections – volume defects-Dislocations.

Unit IV: Crystal binding

Crystals of inert gas – van der Walls interactions – Repulsive interaction – Equilibrium lattice constants – Cohesive energy – Ionic crystals – Madelung energy – Evaluation of Madelung constant – Covalent, Metallic and Hydrogen bonding – elastic strain components

Unit V: Crystal vibrations

Vibrations of crystal with monoatomic basis – group velocity – Two atoms per basis – Quantization of elastic waves – Phonon momentum – Phonon heat capacity – Debye theory of specific heat – Debye T^3 law – Anharmonic crystal interactions

Text Book:

1. Charles Kittel, *Introduction to Solid State Physics*, 5th edition, (1993).

References:

1. S.O. Pillai, *Solid State physics*, New age international (P) limited (1997).
2. Ali Omar, *Elementary Solid State Physics*, Pearson Education India, (2000).
3. H.V Keer, *Principles of Solid State*, Wiley Eastern Lmt. (1994)
4. M.A.Wahab, *Solid State Physics*, Narosa Publishing house, Delhi, (1999)