ADVANCE PHYSICS 8 (SOLID STATE PHYSICS)

PRE-REQUISITE: Undergraduate level Physics

CREDITE HOURS: 3+1

INTRODUCTION:

Bonding in solids, thermal and electrical properties of solids, energy bands, imperfections in solids, properties of semiconductors and insulators.

COURSE OBJECTIVE:

This course deals with crystalline solids and is intended to provide students with the basic physical concept and mathematical tools used to described solids. The course deals with groups of materials, as in the periodic table, in terms of their structure, electronic, optical, and thermal properties.

TOPICS COVERED:

Crystal Structure:
Reciprocal Lattice:
Crystal Binding and Elastic Constants:
Crystal Vibrations: Phonons I:
Thermal Properties: Phonons II:
Noncrystalline Solids:
Point Defects:
Dislocations:

COURSE OUTLINE:

Crystal Structure:
Periodic arrays of atoms, fundamental types of lattices, index system for crystal planes, simple crystal structures, direct imaging of atomic structure, non-ideal crystal structures.

Reciprocal Lattice:
Diffraction of waves by crystals, scattered wave amplitude, Brillouin zones, Fourier analysis of the basis, quasi crystals.

Crystal Binding and Elastic Constants:
Crystals of inert gases, ionic crystals, covalent crystals, metals, hydrogen bonds, analysis of elastic strains, elastic compliance and stiffness constants, elastic waves in cubic crystals.

Crystal Vibrations: Phonons I:
Vibrations of crystals with monatomic basis, two atoms per primitive basis, quantization of elastic waves, phonon momentum, inelastic scattering by phonons.

Thermal Properties: Phonons II:
Phonon, heat capacity, anharmonic crystal interactions, thermal conductivity, electronic heat capacity.

Noncrystalline Solids:
Diffraction pattern, glasses, amorphous ferromagnets and semiconductors, low energy excitations in

amorphous solids, fiber optics.

Point Defects:

Lattice vacancies, diffusion, color centers.

Dislocations:

Shear strength of single crystals, dislocations, strength of alloys, dislocations and crystal growth, hardness of materials.

Practical Work:

1. To study Zeeman Effect
2. To study Hall effect in an n-type/p-type semiconductor or a metal.
3. To measure work function of a metal and verification of Richardson's equation.
4. Determination of dielectric constant of liquid and solid.

Evaluation Criteria

Examination	Type	Marks
Internal Examination	Sessional Work	15%
	Mid-Semester	25%
External Examination	Final Semester	60%

REFERENCE BOOKS:

1. Introduction to Solid State Physics by C. Kittle, 7th Edition, John Wiley & Sons, Inc. (1996)
2. Solid State Physics by Neil W. Ashcroft, N. David Mermin, CBS Publishing Asia Ltd. (1987).
3. Solid State Physics by J. S. Blakemore, Cambridge University Press, (1991).