Course Type	Course Code	Name of Course	L	T	P	Credit
DC	PHC302	SOLID STATE PHYSICS	3	0	0	9

Course Objective

The objective of the course is to discuss the basic crystallography and physical properties of solids. Different theories related to free electrons in solids and to learn the electrical and magnetic properties of solids.

Learning Outcomes

Upon successful completion of this course, students will have/be able:

- a broad understanding of the crystallography and to identify different crystal structures.
- a high-level understanding of the bonding between the crystal and to know about band theory of solids.
- to know about the free electron theory, lattice vibrations of solids.
- to familiar with different electrical and magnetic properties of materials and their applications.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Crystallography: Crystal structure, fundamental translational vectors, unit cell, Wigner-Seitz cell, Symmetry elements, lattice types, lattice planes, Miller indices, Common crystal structure, Reciprocal lattice, Bragg's law and application.	6	This topic covers the basic crystal structure of solids. Students will be familiar with different types of crystal structures. They can learn to analyze the crystal system using Bragg's law and X-ray diffraction pattern.
2	Bonding in crystals: Potential between a pair of atoms; Lennard-Jones potential, concept of cohesive energy, covalent, Vander Waals, Crystal Defects.	6	This unit will help student to get knowledge about the different types of interatomic forces and bonding between the atoms. They will also learn about various types of defects that are usually present in a crystal.
3	Thermal properties: Lattice vibration, vibration of one dimensional monoatomic and diatomic linear chain of atoms, concept of phonons, Debye model.	6	In this topic, students will learn about the coupled vibration in lattices. Then they get familiar with phonon. Debye model is explained to describe the variation of lattice specific heat with temperature.
4	Free electron theory of metals: Drude-Lorentz theory, Sommerfield's Model, Fermi-Dirac Distribution, free electron concentration, electrical conductivity, Thermal Conductivity, Sommerfield theory of electrical conductivity.	6	This topic tells that the valance electrons move freely in any metal and it helps in conduction of electricity. Drude-Lorentz Theory and Sommerfield's Theory are discussed.
5	Band Structure: Electron in periodic potential: Bloch theorem, Kronig-Penney Model, energy bands.	5	This part will help to understand the potential experienced by an electron in a crystal. Bloch theorem, Kronig Penney model are used to describe periodic potential of an electron.
6	Dielectric properties: Static, electronic, ionic and orientational polarization, Lorentz internal field, dielectric loss and relaxation time.	5	In this topic, students will learn about the dielectric properties: dielectric loss, relaxation time, polarization etc. .
7	Piezo, Pyro, Ferro electric properties and application.	3	In this topic, students will learn about Pyroelectricity, Piezoelectricity and Ferroelectricity and their applications in various fields.
8	Magnetic Properties: Diamagnetic, Paramagnetic and Ferromagnetic Materials, Curie-Weiss law of susceptibility, Weiss Molecular field theory	5	In this part, different magnetic properties are such as diamagnetism, paramagnetism, ferromagnetism are discussed. Then Curie Weiss Law of magnetic susceptibility and Weiss molecular field theory are introduced.
Total		**42**	

Textbooks:

1. Introduction to Solid State Physics; C. Kittle; Wiley; 2012
2. Solid State Physics; Ashcroft and Mermin; Cengage Learning India Pvt Ltd; 2010
3. Elements of X-ray Diffraction, B.D. Cullity, Addison-Wesley Publishing Compony, INC., MA, USA 1956

Reference Books:

1. Solid State Physics: Structure and Properties of Materials; M.A. Wahab; Narosa; 2009
2. Solid State Physics; S. O. Pillai; New Age International; 2010
3. Elements of Solid State Physics; J. P. Srivastava; Prentice Hall of India; 2013
4. Solid State Physics; A. J. Dekker; Macmillan; 2010
5. Crystallography Applied to Solid State Physics; Verma & Srivastava; New Age; 1991