Birla Institute of Technology & Science, Pilani
Hyderabad Campus

Second Semester 2023- 2024

Course Handout (Part II)

Date: 09-01-24

In addition to Part I (General Handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

Course No. **: PHY F341**

Course Title **: Solid State Physics**

Instructor-in-charge **: Souri Banerjee**

Scope and Objective:

This is an introductory course on Solid State Physics. It aims at providing physical as well as mathematical understanding of a wide range of phenomena associated with crystalline matter. Its objective is to lay the foundation for a working understanding of solids through fundamental theoretical concepts.

Learning outcomes: At the end of the course students must gain knowledge on the following points -

- Differentiating between different types of solid materials; their structure and the structure determination
- Applying the vibrations and waves (learnt fromMechanics, Oscillations and Waves course) in understanding the lattice waves and Brillouin zones
- Different models of thermal and electrical transport.
- Explaining the electrical properties such as conductivity and Hall Effect using the classical and quantum models
- How the energy bands are formed and understanding density of states
- Theory and applications of some important materials (semiconductors, magnetic materials and superconductors) in use today

Text Book:

Introduction to Solid State Physics, C. Kittel, 7th ed., Wiley (1997)

Reference Book:

Solid State Physics, N W Ashcroft and N D Mermin, 1st ed., Thomson (1976)

Course Plan:

Lectures	Learning Objectives	Topics to be covered	Reference to text book
1-5	Crystal Structure	Bravais Lattices, Miller Indices	Chapter 1
6-9	Diffraction of waves by crystals	Bragg Law, Reciprocal Lattice, Laue Equations, Brillouin Zones	Chapter 2
10-11	Crystal binding	Van der waals bond, ionic bond, metallic, and covalent bond	Chapter 3
12-14	Crystal Vibrations	Monatomic and Diatomic Crystals	Chapter4
15-18	Thermal Properties	Einstein and Debye Models of Heat Capacity	Chapter 5
19-23	Free Electron Fermi Gas	Density of States, Heat Capacity, Electrical Conductivity, Hall Effect	Chapter 6
24-28	Nearly free electron Model	Energy Bands, Bloch Functions, Kronig-Penney Model, Boltzmann Transport Equation	Chapter 7 and Appendix F
29-32	Semiconductors and their applications	Intrinsic Carrier Concentration, Mobility, Donor and Acceptor States, p-n junctions and conductivity	Chapter 8 and Chapter 19
33-37	Superconductivity	Meissner Effect, London Equation, Type I and Type II superconductors, Theory of Superconductivity	Chapter 12
38-42	Magnetism	Diamagnetism, Paramagnetism, Ferromagnetism and Anti-ferromagnetism	Chapter 15

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature
Mid-Sem	90 min	30	16/03 - 2.00 - 3.30PM	Open Book
Quiz *	30 min	30		closed Book
Comprehensive Examination	180 min	40	18/05 FN	Closed Book

***Note: Three quizzes will be conducted and the best two will be considered while assigning the final grade. There will be no make up for the quizzes.**

Make-up Policy: Make-up will be given only in genuine cases with **prior permission** from the IC.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge
PHY F341