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# 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**