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# Second Semester 2019 - 2020

**Course Handout (Part II)**

Date: 06/01/2020

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**

***Instructors*  : Hariharavenkataraman and Kannan Ramaswamy**

***Instructor-in-charge* : KANNAN RAMASWAMY**

**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 from Mechanics, Oscillations and Waves course in understanding the lattice waves and Brillouin zones
* Different models on thermal and electrical transport studies
* 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 (magnetic materials) in today’s use

**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)

Elementary Solid State Physics - Principles and Applications, M. Ali Omar, Pearson

Quantum States of Atoms, Molecules and Solids, Morrison, Estle and Lane, Prentice – Hall Physics

**Course Plan:**

|  |  |  |  |
| --- | --- | --- | --- |
| **No of**  **Lectures** | **Learning Objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 3 | Crystal Structure | Bravais Lattices, Miller Indices | Chapter 1 (Kittel) |
| 6 | Diffraction of waves by crystals | Bragg Law, Reciprocal Lattice, Laue Equations, Brillouin Zones | Chapter 2 (Kittel) |
| 6 | Crystal Vibrations | Monatomic and Diatomic Crystals | Chapter4 (Kittel) |
| 6 | Thermal Properties | Einstein and Debye Models of Heat Capacity; Umklapp processes | Chapter 5 (Kittel) |
| 6 | Free Electron Fermi Gas | Drude theory, Sommerfeld theory and failures of free electron model; Electrical conductivity and Ohm’s law, Hall effect, Widemann – Franz law | Chapter 6 (Kittel) Chapters 1, 2 and 3 (Ashcroft and Mermin) |
| 8 | Energy Bands | Bloch theorem, Electrons in a periodic potential, Kronig-Penney Model, Fermi surface and Tight binding method | Chapter 7, 9 (Kittel) Chapters 8, 9 and 10 (Ashcroft and Mermin) |
| 5 | Magnetism | Types of Magnetic structure and Mean field theory | Chapters 31, 32 and 33 (selected topics) (Ashcroft and Mermin) |

**Evaluation Scheme:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage**  **(%)** | **Date & Time** | **Nature of Component** |
| Mid-Sem | 90 min | 30 | 3/3 11.00 -12.30 PM | Closed Book |
| Assignment |  | 30 |  | Open Book |
| Comprehensive Examination | 180 min | 40 | 04/05 AN | Closed Book |

**Chamber Consultation Hour:** To be announced in the class

**Notices:** Notices and solutions of Tests & Final Comprehensive Examination will be displayed only on the **Physics Notice Board**.

**Make-up Policy:** Make-up will be given only in genuine cases with **prior permission** from the Chief Warden & IC. *No Make – up’s for Quizzes*.

**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**