Birla Institute of Technology & Science, Pilani
Hyderabad Campus

**SECOND SEMESTER 2022-2023**

Course Handout Part II

Date: 16-01-2023

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 341
*Course Title* : Solid State Physics
*Instructor-in-Charge* : Aravinda Raghavan

**Scope and Objective of the Course:** Solid state physics is the most influential subject that shaped the destiny of the 20th century. It was fueled by technological concerns of the industry and the solutions for which led to theories and models that explain the physical properties of the solid state. Solid state includes the periodic crystalline matter and aperiodic amorphous matter. This course can be considered as a comprehensive application of the topics in the MSc- Physics program. Here are a few vignettes to underscore the point: Electromagnetic theory is invoked to understand scattering of photons by atoms, Optics is used to understand x-ray diffraction, Quantum mechanics is necessary to understand electrical conduction, Statistical mechanics is used to explain the distribution of electrons among electronic states, thermal conduction is modelled through normal modes of a string of atoms.

**Textbooks:**

1. Fundamentals of Condensed Matter Physics and Crystalline Physics, D. L. Sidebottom, Cambridge University Press, 2012.

**Reference books**

1. Introduction to Solid State Physics, C. Kittel, 8th ed., Wiley (2005).
2. Solid State Physics, N W Ashcroft and N D Mermin, 1st ed., Thomson (1976).

**Course Plan:**

| Lecture No. | Learning objectives | Topics to be covered | Chapter in the Text Book |
|---|---|---|---|
| 1 | | Introduction to the course | |
| 2-4 | Crystal structure | Crystal lattice, symmetry and Bravais lattices | Chapter 1 |
| 5-7 | Amorphous structure | Continuous random network, random closed packed structure, Pair distribution function, | Chapter 2 |
| 8-10 | Bonds and Cohesion | Types of bonds and cohesive energy | Chapter 3 |

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| 11-13 | Scattering theory | Scattering cross-section, Static structure factor | Chapter 5 |
| 14-17 | Scattering by Crystals | Reciprocal lattice, crystal planes-Miller indices, Bragg diffraction | Chapter 6 |
| 18-21 | Crystal Vibrations | Monoatomic and diatomic basis, dispersion relation, Brillouin zone, scattering from phonons | Chapter 10 |
| 12-25 | Thermal properties | Specific heat of solids – Einstein and Debye models, Thermal conductivity | Chapter 11 |
| 26-29 | Electrons: Free electron model | Drude model, Free electron model, electronic conduction, Hall effect | Chapter 12 |
| 29-34 | Electrons: Band theory of solids | Nearly free electron model, Kronig-Penny model, band structure, Conductors | Chapter 13 |
| 35-36 | Magnetic structure | Dia-, para- and ferromagnetism in materials, exchange interaction, correlated domains | Chapter 4 |
| 37 | | Conclusion of the course | |

**Evaluation Scheme:**

| Component | Duration | Weightage (%) | Date & Time | Nature of Component |
|---|---|---|---|---|
| Mid-semester | 90 minutes | 35 | 16/03 9.30 - 11.00AM | CLOSED |
| Project/Quiz | | 25 | | OPEN |
| Comprehensive exam | 180 minutes | 40 | 15/05 FN | CLOSED |

**Chamber Consultation Hour:**

**Notices:** All notices, and course related materials will be posted CMS.

**Make-up Policy:** It is applicable to the following two cases and it is permissible on production of evidential documents: (i) Debilitating illness; (ii) Absent after obtaining prior permission from the Instructor.

**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**