



**SECOND SEMESTER 2021-2022**

Course Handout Part II

Date: 15-01-2022

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 : Aravinda Raghavan

**Scope and Objective of the Course:** Solid state physics is the most influential subject that shaped the destiny of the 20<sup>th</sup> 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: Classical mechanics is invoked to understand scattering of photons by atoms, Optics is used to understand x-ray diffraction, Quantum mechanics is necessary to understand the origin of magnetism, Statistical mechanics is used to explain the distribution of electrons among electronic states, Electromagnetic theory helps to understand magnetic levitation of superconductors.

**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, 8<sup>th</sup> ed., Wiley (2005).
2. Solid State Physics, N W Ashcroft and N D Mermin, 1<sup>st</sup> ed., Thomson (1976).

**Course Plan:**

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book
1-3	Crystal structure	Crystal lattice, symmetry and Bravais lattices	Chapter 1
4-5	Amorphous structure	Continuous random network, random closed packed structure, Pair distribution function,	Chapter 2
6-9	Bonds and Cohesion	Types of bonds and cohesive energy	Chapter 3
10-13	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
22-25	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
30-36	Electrons: Band theory of solids	Nearly free electron model, Kronig-Penny model, band structure, Conductors, insulators, semiconductors –intrinsic and extrinsic, pn junction	Chapter 13
37-40	Magnetic structure	Dia-, para- and ferromagnetism in materials, exchange interaction, correlated domains	Chapter 4
41-42	Superconductivity	The phenomenon - critical energy, isotope effect, specific heat, energy gap	Chapter 18

#### Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Mid-semester	90 minutes	35	14/03 9.00am to 10.30am	CLOSED
Project/Quiz		25		OPEN
Comprehensive exam	120 minutes	40	21/05 FN	CLOSED

#### Chamber Consultation Hour:

**Notices:** Initial notices concerning CANVAS login information and Google meet links will be posted in CMS. The course materials will be posted in CANVAS. Course evaluations will be conducted through CANVAS.

**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**

