Birla Institute of Technology & Science, Pilani
Hyderabad Campus

SECOND SEMESTER 2020-2021

Course Handout Part II

Date: 16-01-2021

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 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: 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, concepts of free energy arising from Thermodynamics elucidates phase transitions such as that between conducting and superconducting phase.

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
1-3	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
30-33	Electrons: Band theory of solids	Nearly free electron model, Kronig-Penny model, band structure, Conductors, insulators, semiconductors	Chapter 13
34-37	Magnetic structure	Dia-, para- and ferromagnetism in materials, exchange interaction, correlated domains	Chapter 4
39-40	Phase transitions	Free energy, critical phenomenon, density fluctuations	Chapter 15
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	06/03 1.30 - 3.00PM	OPEN
Project/Quiz		25		OPEN
Comprehensive exam	120 minutes	40	07/05 FN	OPEN

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) Out of station with 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