Faculty of Eng. & Natural Sci.

PHYS302-202102

Solid State Physics

Instructor(s)

Name	Email	Office	Phone	Web	Office Hours
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Course Content

Free electron theory of metals. Crystal lattices and structures. Band theory of solids. Physics of semiconductors. Transport and optical processes. Introduction to devices based on p-n junctions.

Objectives

To provide an introduction to how the structure and the behavior of electrons and ions determines the physical properties (mechanical, electronic, optical and magnetic) of solids.
To provide a solid foundation for an advanced condensed matter course.
(Minor Honors Program in Physics)

Recommend or Required Reading

Textbook

The Oxford Solid State Basics
by Steven H. Simon

Readings

Introduction to Solid State Physics 7th Ed by Charles Kittel

Solid State Physics by Ashcroft/Mermin
Solid State Physics by J. R. Hook and H. E. Hall
Physics of Solids by Richard Turton

Assessment Methods and Criteria

	Percentage(%)	Number of assessment methods
Final	40	
Midterm	40	1
Exam		0
Participation	20	

Course Outline

01. Introduction to Condensed Matter; Einstein Model of Vibrations in Solids
02. Debye Model of Vibrations in Solids; Drude Theory of Electrons in Metals
03. Drude Theory of Electrons in Metals / Sommerfeld (Free Electron) Theory of Electrons in Metals
04. Sommerfeld (Free Electron) Theory of Electrons in Metals
05. Microscopic View of Vibrations in Solids in One Dimension
06. Geometry of Solids
07. Reciprocal Space and Scattering
08. Waves in Reciprocal Space
09. Nearly Free Electron Model
10. Band Structure and Optical Properties of Solids
11. Dynamics of Electrons in Bands
12. Semiconductor Devices and Introduction to Magnetism

Learning Outcomes

Describe crystal structures in terms of a lattice and unit cell and calculate the cohesive energy of the corresponding structures.

Study the diffraction from crystal and thus determine the crystal structure of a material.
Understand the collective nature of vibrational modes of a lattice (phonons) and relate the thermal properties (specific heat, thermal conductivity) to the behavior of these oscillations.
Comprehend the free electron model and have a clear understanding of strengths and weaknesses of the model in explaining the electronic properties of solids.
Explain the electronic properties of solids both from the point of view of the nearly free electron model and tight binding model.
Understand the basic features of semiconductor and relate these to simple semiconducting devices.

Course Policies

Academic Dishonesty

Cheating is subject to a disiplinary action and a null grade