Technical Elective: Solid State Physics
Fall 2025

Instructor

Dr. Liwei Geng
Rm N402
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Meeting Time & Location

Tuesday 13:50-16:25 at Rm S103

Office Hour

Monday & Tuesday & Wednesday: 10:00-12:00, Wednesday: 13:00-17:00, or by appointment

TA information

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Course Catalog Description

This course provides an introduction to solid state physics at the undergraduate student level. The course begins with crystal structure, proceeds to electronic band structure theory, and culminates with ferromagnetism and ferroelectrics. Physical theory and mathematical derivations in solid state materials are introduced as needed.

Course Materials

Required Textbook: "Introduction to Solid State Physics", Charles Kittel, Wiley, 8th edition, 2005.
Lecture slides
Handouts

Copyrights

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Prerequisites

Physics for Science and Engineering

Course Objectives

Upon successful completion of this course, students will learn the fundamental theories and mathematical formulations of solid state physics. Lectures will be structured to help student understand the conceptual basis of solid state physics and examples will be given to reinforce those concepts. Homework and exams will be designed to assess the mathematical skills. Projects will be carried out to promote students' creativity and self-learning ability.

ABET Learning Outcomes:

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topics Covered

1. Crystal Structure
2. Wave Diffraction & Reciprocal Lattice
3. Crystal Binding & Elastic Constants
4. Phonon I: Crystal Vibration
5. Phonon II: Thermal Properties
6. Free Electron Fermi Gas
7. Energy Bands
8. Ferromagnetism
9. Ferroelectrics
10. Semiconductor Crystals
11. Fermi Surfaces and Metals

Grading

5%: participation
35%: homework
20%: project
40%: final exam

Late Assignment Policy

10% deduction/day

Grade Policy

A: 90 – 100	A−: 85 – 89	B+: 80 – 84	B: 76 – 79	B−: 73 – 75
C+: 70 – 72	C: 66 – 69	C−: 63 – 65	D: 60 – 62	F: < 60

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Academic Integrity

All students are expected to adhere to the standards of academic honesty. Any student engaged in cheating, plagiarism, or other acts of academic dishonesty would be subject to disciplinary action. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include but is not limited to the confiscation of the examination of any individual suspected of violating the University Policy.

Tentative Lecture/Lab Schedule

Week	Date	Lecture Content
1	9/09	Crystal Structure, Fundamental Types of Lattices
2	9/16	Simple Crystal Structures
3	9/23	Non-ideal Crystal Structures, Crystal Structure Data
4	9/30	Wave Diffraction, Bragg Law, Scattered Wave Amplitude
5	10/07	Reciprocal Lattice, Brillouin Zones
6	10/14	Crystal Binding, Cohesive Energy, Van der Waals Bonding
7	10/21	Ionic Bonding, Covalent Bonding, Metallic Bonding
8	10/28	Phonon I, Crystal Vibration, Monoatomic Chain Phonon Model
9	11/04	Diatomic Chain Phonon Model, Phonon Dispersion
10	11/11	Phonon II, Thermal Properties
11	11/18	Free Electron Energy Gas, Theory of Metallic Conductivity
12	11/25	Energy Bands, Band Structure
13	12/02	Ferromagnetism, LLG Equation
14	12/09	Ferroelectrics, Semiconductor Crystals, Fermi Surfaces
15	12/16	Project Presentation
16	12/23	Project Presentation
17	12/30	Final Exam

Final Project

Requirements: Slides, group presentation, 1~4 persons per group

Select an uncovered chapter (chapter 8~22) in the textbook, prepare slides, and present in class, followed by a short Q&A section. Each person has the same score in the same group.