

Physics 1374, Fall 2017
Introduction of Solid State Physics

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Course Description:

Solid State Physics introduced for upper-level undergraduate students without extensive knowledge of quantum mechanics. See course schedule below for a list of covered topics.

The course will be held in the **flipped format**. Students will be expected to spend approximately two hours each week reading textbook and watching lecture videos. To compensate for this workload, classroom contact will be 1.5 hours (one class per week instead of two). Students will arrive to class with their reading done, and the class period will be dedicated to an engaged two-way discussion of the material.

Textbook: **Oxford Solid State Basics** by Steven H. Simon will be the primary textbook upon which material up to the Midterm exam will be based.

Introduction to Solid State Physics (Eighth Edition) by Charles Kittel is an additional recommended textbook. Material beyond the midterm is partially covered in this text.

It is important to do the reading assigned in the syllabus **before** the associated lecture.

Lectures: 1:00pm- 2:15pm on Thursdays (occasionally on Tuesdays) in room 219 Allen Hall (note that the room is different from that listed in the Student Center). *The first class will take place at 1:00pm on Tuesday August 29.*

Quizzes: Pre-lecture quizzes based on the textbook and video material will be due prior to each class to test preparedness. The quizzes will be graded.

Homework: Homework assignments consisting of problems to solve will be assigned every 1-2 weeks before the Midterm. Homeworks will typically be due to the grader 2 weeks after the assignment date. There will be a penalty of 10% per day for homeworks submitted late. There will be no homeworks past the midterm. After the midterm, students will focus on the preparation of their final projects.

Courseweb: There is a Courseweb site associated with this course. It can be accessed through your <http://my.pitt.edu> account. This site will be used to make important announcements and to make materials available such as homework assignments, lecture slides and videos, announcements, final project topics etc.

Examinations: There will be one midterm examination, given during a regular lecture period. The scheduled date is October 26, subject to change. Makeup exams will not be allowed. **Final examination** will consist of an advance preparation of a written report on a topic in modern solid state physics and the presentation of the report during the last class of the term on December 7. Example topics will be provided via Courseweb. Students should choose their topics and discuss them with the instructor no later than November 9.

Grading: Homework will account for 30% of the final grade, pre-lecture quizzes will be worth 15%, Midterm exam 30% and the final project 25%.

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Course Outline
(approximate, subject to change)
Instructor: S.M. Frolov

No	Topic	Chapters	Date
1	Syllabus, Overview of Solid State Physics	Oxford 1	August 29
2	Background in quantum mechanics and statistical mechanics	Oxford 5-7	August 31
3	Heat capacity of solids, Einstein and Debye Models of Solids	Oxford 2	Week 2
4	Drude and Sommerfeld theory of metals	Oxford 3,4	Sept 7
5	One-dimensional models for vibrations in solids	Oxford 8-10	Week 3
6	Electrons in solids : a tight-binding one dimensional model	Oxford 11	Sept 14
7	Crystal structure of solids, real space	Oxford 12	Week 4
8	Reciprocal Space, Brillouin zone	Oxford 13	Sept 21
9	Scattering Experiments (Neutron and X-ray diffraction)	Oxford 14	Week 5
10	Bloch's theorem, Nearly free electron model	Oxford 15	Sept 28
11	Band structure of electrons in solids	Oxford 16	Week 6
12	Physics of Metals, Insulators, Semiconductors	Oxford 16-17	Oct 5
13	Semiconductor devices (diode, transistor, solar cell)	Oxford 18	Week 7
14	Paramagnetism and Diamagnetism	Oxford 19	Oct 12
15	Magnetic Order, Magnetic resonance	Oxford 20-21, Kittel 13	Week 8
16	Models of Magnetism with Interactions (Mean Field)	Oxford 22-23	Oct17or19
17	MIDTERM EXAM		Oct 26
18	Superconductivity : main experiments	Kittel 10	Week 10
19	Superconductivity : main theories	Kittel 10	Nov 2
20	Superconductivity : devices	Kittel 10	Week 11
21	Low-dimensional systems : graphene and carbon nanotubes	Handout	Nov 9
22	Quantum confinement, 2DEGs, quantum Hall effects	Kittel 17	Week 12
23	Quantum devices (quantum point contact, quantum dot)	Kittel 18	Nov 16
	THANKSGIVING (NO CLASS)		
24	Quantum computing principles	Slides	Week 13
25	Solid state quantum computing implementations	Slides	Nov 30
26	FINAL PROJECT PRESENTATIONS		Dec 7

Note : Chapters given in the Oxford textbook can often be found in Kittel as well

Academic Integrity:

Students in this course will be expected to comply with the University of Pittsburgh's Policy on Academic Integrity. 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 University Policy. Furthermore, no student may bring any unauthorized materials to an exam, including dictionaries and programmable calculators.

Disabilities:

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services (DRS), 140 William Pitt Union, (412) 648-7890, as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.