APHY 448/548, ENAS 850, PHYS 448/548: Solid State Physics I (Fall 2018)

Instructor: Sohrab Ismail-Beigi, Becton 307, sohrab.ismail-beigi@yale.edu
Time and location: Tue & Thu 1:00-2:15pm, Becton 408, meets during reading period
Makeup lectures: Wednesdays Oct. 24th & Dec. 5th 8:00pm-9:10pm; please reserve these dates
Exams: midterm exam October 16 during class time, final exam December 18 at 2pm
Other required work: weekly problem sets
Instructor office hours: Wed 4-5, Fri 10-11 in Becton 307 or by email appointment
TF and office hours: Yizhi Luo yizhi.luo@yale.edu Thu 8pm-10pm Mason 104 or by email appt.
Required textbook:

- "Introduction to Solid State Physics", Kittel, 8th edition (Wiley, 2005)
- "Solid State Physics", Ashcroft and Mermin (Saunders College, 1976)

Prerequisites: one semester each of quantum mechanics, statistical mechanics, and electricity and magnetism at the undergraduate level

This is the first of a two-course sequence that provides a general introduction to solid state physics. The first term (this course) presents the fundamental principles underlying the electrical, thermal and optical properties of solid materials. Specific topics to be covered include: the geometric structure of crystalline materials and its effect on materials properties; thermal vibrations of periodic lattices; electronic energy bands of metals, semiconductors and insulators; fundamental properties of simple semiconductor devices; Fermi surfaces; and, time permitting, the optical properties of dielectrics.

Problem sets: These are due each week by Friday 3pm the week after they are assigned. They are due Fridays by 3pm to the administrative assistant, Ms. Maria Rao, in Becton 301 (she will have a drop off box). Homework handed in after that are out of 50% until solutions are posted online at which time they will no longer be accepted. Solutions will be posted on Canvas within a few days of the problem set being due. Problem sets are a crucial part of the course and learning process. To receive full credit, you must show the logic and steps and not simply produce the final answer out of thin air. Problem set statements will be posted on Canvas 5 to 6 days before they are due.

Grading: Course grade will be determined by student performance on the problem sets and the exams. Problem sets will count for 40% and each exam for 30% of the total course score.

Maintaining academic integrity: Maintaining academic integrity is crucial. For problem sets, students are encouraged to collaborate in groups, but must submit their own independent work. Exams are meant to gauge individual understanding. Cheating and/or plagiarism are not tolerated. You can read more about these issues and also good practices for citation of prior work at http://ctl.yale.edu/writing/using-sources

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Provisional plan:

		Reading (chapters)	
Date	Topic	Kittel	A & M
8/29	Course logistics; crystal structure	1	4, 7
9/4	Crystal structure; reciprocal lattices	2	5, 6
9/6	Reciprocal lattices		
9/11	X-ray scattering; crystal bonding	3 (skip p. 73-85)	19, 20
9/13	Crystal bonding		
9/18	Lattice vibrations (classical)	4, 5	21, 22 (omit p. 443-447)
9/20	Lattice vibrations (classical)		
9/25	Lattice vibrations (quantum)	4, 5	23, 24 (up to p. 480)
9/27	Lattice vibrations (quantum)		
10/2	**No class**		
10/4	**No class**		
10/9	Lattice vibrations (quantum)		25 (up to p. 505)
10/11	Free electron theory	6	1, 2
10/16	**Midterm exam in class**		
10/18	**October recess**		
10/23	Free electron theory		3
10/24	**Makeup lecture 8pm location TBA**: Free electron theory		
10/25	Electron energy bands	7	8, 9 (up to p. 162)
10/30	Electron energy bands		12 (up to p. 218)
11/1	Electron energy bands		
11/6	Fermi surfaces	9 (up to p. 232)	9 (pp. 162-166)
11/8	Semiconductors	8	28
11/13	Semiconductors		
11/18	Semiconductors		
11/20	**Thanksgiving recess**		
11/22	**Thanksgiving recess**		
11/27	Semiconductor devices		29 (up to p. 600)
11/29	**No class**		
12/4	Semiconductor devices		
12/5	**Makeup lecture 8pm location TBA**: Dielectrics	16 (up to p. 466)	27 (up to p. 552)
12/6	Dielectrics	p. 410-413	
12/18	**Final exam at 2pm**		