Syllabus for PHYS 340- Physics of Materials, Spring '10

Basic information:

•Prerequisites: a passing grade in PHYS 212. If you don't meet this requirement, please talk to me right away! It would be beneficial, but not required, to have taken PHYS 310. A note: due to my upcoming sabbatical, this course will also be offered in Spring '11, if that works better with your schedule.

•Instructor: Yumi Ijiri
Wright 216
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with course information available on Blackboard.

•Class hours and location: MWF 10-10:50 am in Wright 209.

•Problem session: An optional problem session will be held at a time and place to be determined, probably on Monday.

•Office hours: to be determined based on schedules. Also feel free to just stop by- Tuesday and Thursday mornings are the best.

•Textbook: The required textbook for this course is *Physics and Chemistry of Materials* by Joel Gersten and Frederick Smith. It is the first time we'll be using this book, which hopefully will be an improvement from the past two choices. The standard undergraduate text is *Intro to Solid State Physics* by Kittel, which almost no one likes!! Last time's book of Hook and Hall, Solid State Physics was viewed as better, but still… so hopefully the third times the charm! I've placed a number of other books, with their own pros and cons, (by Ashcroft and Mermin, Blakemore, Christman, and Dalven, etc.) on reserve in the Science Library for you to refer to as well. As you gather from this, class will be particularly important to flesh out things, expand beyond or in different ways from the text.

Description:

In this course, we will investigate the structural and physical properties of materials by developing a better understanding of crystal structure, band theory, and scattering. Particular attention will be paid to studying the electrical and magnetic behavior of solids.

Objectives: The objectives of the course are three-fold: 1) to increase your understanding/knowledge about the physics of materials 2) to improve your problem solving ability and 3) to develop skills in working from primary and secondary literature. As you will see, this course will draw on your knowledge from many of your previous classes!

Format: The components for the course (lectures, problem sets, exams, and presentations) are described in more detail below.

Lectures: In lecture, we will go over the material, using demonstrations and examples taken from the current research literature. Please ask lots of questions! This class will draw on lots of different parts of physics: some things from mechanics, E&M, a little thermo, some things related to quantum mechanics, etc, etc… It's a chance to see physics and chemistry and materials science all put together.

Problem sets: Homework assignments will be due on Wednesday at class. The problem session is designed to help you with any hurdles you may have encountered along the way. I encourage you to work with other members of the class, but the solutions you had in should represent your own understanding of the material. Make sure to write and sign the Honor Code pledge: "I affirm that I have adhered to the Honor Code in this assignment," and cite any sources you used or collaborators in your work. Failure to do this may constitute an Honor Code violation, particularly if you have verbatim copied from a source without attribution, i.e. an act of plagiarism. I will drop your lowest homework score.

Exams: There will be two take-home exams for the class, the first due Monday, March 22nd at class and the second due at 9 pm Wednesday, May 19th. The exams (~ 2 hours) will be limited open book/notes and cover the first and second half of the course respectively.

Presentations and reports: Twice during the semester, you will be asked to choose an article from the recent literature concerning materials physics. I will give you a variety of suggestions if you can't think of anything! You will give an in-class presentation (~10 min in length) describing what was discovered, at a level that your classmates can understand. You will also write a short paper (~ 3-5 pages in length) summarizing and explaining the main features of the work. If you prefer to do a different type of presentation (say make a computer model of crystal structures, or explain data you've taken from a summer REU), you may but please consult me in advance. At any rate, the requirements of an oral presentation and paper will remain. The presentation dates are the week of Mar. 22nd and May 10th, and the reports are due Mar. 26 and May 14. Remember to write and sign the Honor Code and cite sources appropriately.

Grading: Grading for the course will be based as follows: 35% on the problem sets, 35% on the two exams, 20% on the papers, and 10% on in-class presentations and class participation.

Other issues: If you have any special needs, I encourage you to speak with me as soon as possible. In particular, if you have a learning disability, it may take some time to work with Jane Boomer in Student Academic Services to assure that the necessary paper work is in place in order for accommodations to be made.

Schedule: A tentative schedule for the course is listed below. We will first discuss structure of materials and then go into thermal, electrical, and magnetic properties.

Week	**Topic**	**Assignments**
Feb. 8,10,12	**Structure of Materials:** Ch. 1 and 2: Crystal structure and bonding	
Feb. 15,**17**,19	Ch. 3: Diffraction	W: Prob. set #1 on crystal structure and bonding
Feb. 22,**24**,26	**Thermal properties:** Ch. 5: Phonons	W: Prob. set #2 on diffraction
Mar. 1,**3**,5	Ch. 5/7: Thermal properties and connection to electrons	W: Prob. set #3 on phonons
Mar. 8,**10**,12	**Electrical properties:** Ch. 7: Electrical properties	W: Prob. set #4 on rest of 5 with paper topics
Mar. 15,**17**,19	Ch. 7/11: Semiconductors	W: Prob. set #5 on electrons
Mar. **22,**24**,26**	In class presentations on research papers	**M: EXAM 1** **F: Paper due**
	SPRING BREAK	
Apr. 5,**7**,9	Ch. 11/12: Semiconductors, Metals	W: Prob. set #6 on semiconductors
Apr. 12,**14**,16	**Magnetic Properties:** Ch. 9: Magnetic properties	W: Prob. set #7 on 11/12
Apr. 19,**21**,23	Ch. 9/17: Magnetic materials	W: Prob. set #8 on magnetic properties
Apr. 26,**28**,30	Ch. 16: Superconductors	W: Prob. set #9 on magnetic materials with paper topics
May 3,**5**,7	**Other properties:** effects of dimensionality Ch: 20 thin films	W: Prob. set #10 on superconductivity
May 10,12,**14**	In class presentations on research papers	**F: Paper due**
May **19**	EXAM 2 due by 9 pm in my office	**W: EXAM 2**

Other references: I have placed on reserve in the Science Library a number of other textbooks for you to look over. Some to note in particular:

As mentioned above, Kittel's Intro to Solid State Physics and Hook and Hall's Solid State Physics were previously the course textbook.

Another book with more of a chemistry bent is Elliot's Physics and chemistry of solids.

Probably the most well-liked, but graduate level, book is Ashcroft and Mermin's Solid state physics.