Spring 2013 **PHYSICS 440 - Introduction to Condensed Matter Physics**

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Lab: SSC 108 and 110
Office Hours: After class and by appointment

Course contents:

Electrons in solids
Quantum mechanics of the electron gas
Transport (electrical and thermal conductivity, etc.)
Crystal structures
Energy bands
Metals, semiconductors, and insulators
Semiconductor junctions, the diode and the transistor
Lattice vibrations (phonons)
Overview of superconductivity

Text and other materials:

Required text: M. Ali Omar, *Elementary Solid State Physics* (Addison-Wesley, 1993 revised printing)

Unfortunately, there doesn't seem to exist a single really good textbook for a course of this level. I like the assigned one better than others, but it's not perfect. Therefore, the reading will jump around the book a fair amount, and there will be extra handouts and/or alternative derivations given in class. You're responsible for all of the above.

Background:

Solid state physics rests on the pillars of quantum mechanics and statistical physics. To start out, a background at the level of, say, Physics 161-163 should be adequate. More advanced tools will be introduced as needed.

Grading:

Your grade will be determined by your homework (35%), two midterms (35% for both), and the final (30%). The percentages are approximate; class participation also will be taken into account. The exams will be closed-book, but one sheet of notes (both sides) will be allowed.

Homework will be due *at the beginning of class* on date due. Since solutions will be handed out right away, I won't accept late homework.

(*continued on the next page*)

Please take care to prepare complete, logically laid out, and legible homework solutions. Specifically, you should:

*Write neatly (no hurried scribbles on scratch paper, please)

*Show all intermediate steps

*Use lots of words and explanations, not only equations. Write as if you are preparing a solutions manual and want the reader to be able to follow what you are doing

*Box or underline the final results

*Watch out for correct units. This is invaluable to make sure that you have not made an error along the way. And be sure to check whether the final result makes physical sense (is the order of magnitude reasonable? does the dependence on the given variables appear logical? do the limiting cases match what you expect? etc.).

The above is not only to make it easier to grade your work, but first and foremost for self-awareness: you can be certain that you have truly mastered a problem if and only if you are able to explain it in detail.

The same applies to the tests. In general, *credit will be given only if the reader can easily follow the arguments.*

Physics Department Colloquium:

I encourage you to attend the department colloquium whenever possible. It's a great opportunity to hear about cutting-edge developments in physics and related fields. A good colloquium talk will be largely understood by juniors and seniors. (Admittedly and unfortunately, not all speakers turn out to be good, but most of them are.) The talks are held on Mondays at 4:15 p.m. in SLH102, and last about an hour. The speaker's name and the talk title and abstract are posted several days in advance in SSC, and a list is on the Physics Department web page (`http://dornsife.usc.edu/physics/colloquia/depart_colloquium.cfm`). Free (bad) coffee and cookies are served outside the room before the colloquium.

There is also a regular Condensed Matter/ Quantum Information seminar usually held on Friday afternoons, see `http://physics.usc.edu/~shaas/cmseminar.html`.

Important dates:

University holidays: January 21, February 18
Spring recess: March 18-23
Last day of classes: May 3
Final exam: Thursday, May 9, 2-4 p.m.