SYLLABUS
PHZ 6426, Condensed Matter Physics I
Fall 2006
Michael D. Johnson

Lecture: MAP 306 MWF 3:30 – 4:20 PM
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Office hours: Mon 1–3 PM Tu 8:30 – 10 AM Wed 8:30 – 10 AM
Final exam: Friday, December 8, 1:00 – 3:50 PM in MAP 306

Textbook: Michael P. Marder, *Condensed Matter Physics*, Wiley-Interscience, 2000, ISBN 0471177792. Make sure your copy is the corrected 5th printing or newer. For older printings, consult the errata at Marder's website.

This course is the first of a two-semester sequence that introduces topics in Condensed Matter Physics at the graduate level. Condensed Matter is by far the broadest area in physics, both in content and in the number of physicists pursuing research in this field. Even a year-long course cannot cover the entire field nor cover any topic in complete depth. The topics covered this semester will be a balance between information broadly considered essential and topics that I find particularly interesting or important.

The goal of this class is for you to learn this information at a level that prepares you to begin research in this field and to understand related ideas in research papers and seminars. If your research is in this area you will quickly see that this course only gives the basic background needed to get started; you will then need to dig much deeper into the literature to develop real expertise.

We will cover a great deal of information in a relatively short period. Some information you will learn only from reading. Other topics I will also explain in class. I will give reading assignments which you must complete before the scheduled lecture if you are to keep up.

An important part of the course will be weekly homework assignments. You may work in groups, but must hand in individual reports that demonstrate your own understanding.

I will make every effort to be available during my scheduled office hours, but my administrative duties may occasionally interfere. Please phone ahead to make sure that I am in my office. You are also very welcome to contact me by email at any time. This in fact is usually the quickest way to get an answer. Please talk with one another as well.

Condensed Matter physicists know that nature continues to surprise us. Nearly every novel idea in this field developed from an unexpected experimental result – matter is too complicated for us to make many original predictions before the experimental discovery. But complete understanding of what is discovered requires theoretical insight. A pleasure of this field, one which I hope you will come to share, is this repeated (and continuing) discovery and explanation of remarkable facets of nature.

Grades: The final grade will be determined by:

Homework	30%
Mid-Term Exam	30%
Final Exam	40%

I will use plus and minus grades (A, A-,B+,B, . . .).

Planned Topics

- Ch. 1: Crystal structure: 2D lattices, symmetries and groups
- Ch. 2: 3D lattices
- Ch. 3: Experimental determination of crystal structures
- Ch. 5: Complex structures: alloys, liquids, glasses, etc.
- Ch. 6: Electronic structure: single-electron model
- Ch. 7: Schroödinger's equation in crystals: metals, semiconductors, insulators
- Ch. 8: Nearly free and tightly bound electrons
- Ch. 9: Electron-electron interactions
- Ch. 10: Calculation of band structures
- Ch. 13: Phonons
- Ch. 16: Electron transport: dynamics of Bloch electrons
- Ch. 17: Transport phenomena and Fermi liquid theory
- Ch. 19: Electronics

Useful Books: No single textbook suits everyone. A benefit of Marder is that it is modern in coverage and point of view. Inevitably some of you will prefer other books. Please get in the habit of working with multiple sources. Some of the books that I have found useful are:

N.W. Ashcroft and N.D. Mermin, *Solid State Physics*

C. Kittel, *Quantum Theory of Solids*

P.L. Taylor and O. Heinonen, *A Quantum Approach to Condensed Matter Physics*

J.M. Ziman, *Principles of the Theory of Solids*