In Physics 377, we will explore the realm of condensed matter. Condensed matter is a vast area of physics, ranging from crystals, superconductors and semiconductors to liquids, glasses, and polymers. We will only be able to scratch the surface of this field, but my goal is to give you an outline of the field and prepare you for more advanced study.

The major goals for the course are for students to:

- Learn what happens when atoms come together to form condensed matter, and to connect the atomic level interactions with the macroscopic properties we observe,
- Explore the fundamental reasons why different materials have the properties they do,
- Continue developing the capacity to break a complex problem into solvable pieces, and
- Continue developing the ability to explain complicated concepts as clearly as possibly both orally and in written work.

We will use a combination of lectures, group work, demonstrations, simulations, lab projects, & homework to achieve these goals.

We will also have a student group project, in which each group will give a presentation to the rest of the class on some condensed matter topic of their choosing. Details will follow.

Lecture: Mondays, Wednesdays, Fridays 10:00 – 10:50 am Taylor 104
Text: *The Physics of Solids* by Richard Turton
Class Website: physics.wooster.edu/ lehman/p377_2014.html
Exams: There will be two midterm exams, scheduled for Monday February 10 and Wednesday March 5. The cumulative final exam is on Tuesday, May 6 at 9 a.m.
Grading: Your grade is determined from the exams, lab reports, and homework by the following proportions:

- Projects 20%
- Midterm exam I 25%
- Midterm exam II 25%
- Final exam 30%

The following scale will be used to determine your final letter grade:

- Outstanding (A, A-): > 88%
- Good (B+, B, B-): > 77%
- Adequate (C+, C, C-): > 66%
- Minimally passing (D): > 60%

All exams must be taken when scheduled. Only truly unavoidable conflicts will be considered for rescheduling the exams. The College sets the final exam date, and only the Dean can grant exceptions. Unannounced quizzes may be given and may not be made up in any case.
**Guiding Principles of the Course**

1. People understand concepts better by seeing them in action and thinking about them than by hearing them explained.

2. Physics is learned by working problems, not by reading about working problems. Understanding physics is a learned skill, like cooking or playing basketball. It takes time, effort, and practice.

3. People learn best by thinking about topics and discussing them with others.

4. Students learn most when they take the responsibility for what is learned. It is not my responsibility to teach you; it is my responsibility to give you the tools and environment so that you can teach yourself. Remember that you are here because you want to be – it’s your future that you are studying for.

Being able to explain what you have learned is an essential step in the learning process. Thus, in all problems, your work and thought process must be clear. Neatness counts. Steps should be explained using short phrases or sentences. Any sketches or graphs should be clearly labeled.

**Homework**

Homework will be assigned, but I will not be collecting or grading it. Each assignment will have a completion date by which I expect you to have done the homework. We will then discuss the homework problems in class, and I will call on students to work some of the problems on the board during class. Solutions will be available. Each exam will include at least one problem taken directly from the assigned homework.

**It is your responsibility to ensure that you understand the material.** I encourage you to collaborate on homework, but in the end, you will not succeed in this class if you rely too much on your peers or the posted solutions. A good practice is to re-write your solution without looking at your previous notes or consulting a peer to be sure that you understand each step yourself. Rewriting also helps the material sink deeper into your long-term memory.

**Academic Integrity**

_The Wooster Ethic:_ I hereby join this community with a commitment to the Wooster Ethic upholding academic and personal integrity and a culture of honesty and trust in all my academic endeavors, social interactions, and official business of the College. I will submit only my own original work, and respect others and their property. I will not support by my actions or inactions the dishonest acts of others.

**Cheating on a test, quiz, or other assignment is a serious breach of academic integrity and is grounds for an F for the entire course.** Violations of the Wooster Ethic include copying from any source without proper citation, going beyond what is allowed in a group project, fabricating excuses and lying in connection with your academic work. You will be held responsible for your actions. If you are unsure as to what is permissible, always ask!
Curricular and Extra-curricular Conflicts

The College of Wooster is an academic institution and its fundamental purpose is to stimulate its students to reach the highest standard of intellectual achievement. As an academic institution with this purpose, the College expects students to give the highest priority to their academic responsibilities. When conflicts arise between academic commitments and complementary programs (including athletic, cultural, educational, and volunteer activities), students, faculty, staff, and administrators all share the responsibility of minimizing and resolving them.

As a student you have the responsibility to inform me of potential conflicts as soon as you are aware of them, and to discuss and work with me to identify alternative ways to fulfill your academic commitments.

If you know of any conflicts that will require you to miss class, notify me immediately.

Academic Support from the Learning Center

The Learning Center (ext. 2595) offers services designed to help students improve their overall academic performance. Sessions are structured to promote principles of effective learning and academic management. Any student on campus may schedule sessions at the Learning Center.

The Learning Center also offers a variety of services and accommodations to students with disabilities based on appropriate documentation, nature of disability, and academic need. Any student with a documented learning disability needing academic accommodations is requested to speak with me and with Pam Rose, Director of the Learning Center (ext. 2595), as early in the semester as possible. All discussions will remain confidential.

Approximate Schedule

Week 1: Atoms and Bonding
Week 2: Lattices and Crystal Structure
Week 3: X-ray Diffraction
Week 4: The Reciprocal Lattice
Week 5: Mechanical Properties
Week 6: Thermal Properties
Week 7: Electronic Properties: Classical Approach of the Drude Model
Week 8: Electronic Properties: Quantum Approach
Week 9: Electronic Properties: The Free Electron Gas
Week 10: Electronic Properties: A Periodic Potential and Bloch’s Theorem
Week 11: Electronic Properties: Semiconductors and Devices
Week 12: Student Presentations
Week 13: Student Presentations
Week 14: Magnetic Properties / Non-crystalline Solids

Keep in mind that we may deviate from this schedule depending on student interest in different areas. We could spend an entire semester discussing nearly any single chapter in the text.