Physics 3200
Solid-State Physics
MWF 12:30 – 1:20 am
Course Syllabus, Spring 2010

Instructor:

Colin Inglefield
Office: 204 SL Office Phone: 626-6127
Lab: 122 SL Lab Phone: 626-6306
cinglefield@weber.edu

Office Hours:

Monday-Friday 10:00-11:00

If these hours don't fit your schedule feel free to drop by my office or call at another time. If I am unavailable, you can make an appointment.

Texts:

J. I. Gersten and F. W. Smith, *The Physics and Chemistry of Materials* (Wiley 2001)
R. H. Silsbee and J. Dräger, *Simulations for Solid State Physics* (Cambridge 1997)

I will provide copies of the *Simulations* book for you to use during the semester. These will need to be returned to me at the end of the semester.

The main test for the course (Gersten and Smith) has an ftp site with lots of supplementary material:
ftp://ftp.wiley.com/public/sci_tech_med/materials

Overview/Comments:

As you might guess from the title, this course is meant to serve as an introduction to the physics of solids, or, more generally speaking, an introduction to materials science. In this course you will learn the language of solid-state physics, fundamental of the physical properties of solids, some experimental techniques, and some interesting (to me anyway) applications.

Although there is no scheduled laboratory period for this class, you will complete 5 laboratory-type activities over the course of the semester. I encourage (but will not require) you to work in groups of 2 or 3 on the labs. Each of you will turn in your own report. In addition, you will complete several "virtual" experiments with the simulation package.

At the end of the course each of you will give a 10-15 minute presentation on an experimental technique (of your choosing) used by researchers to characterize materials. You will be required to work with me in advance of your presentation. You will also each provide a problem/question from your talk and its solution/answer. The combination of these questions will constitute a portion of your take-home final examination.

This course is only offered every other year and partly because of that modern physics (Phsx 2740) is a corequisite (as opposed to a prerequisite). Some of you are further along in your physics education than others, and may have taken courses (Quantum Mechanics, Thermal Physics, Electricity and Magnetism, Physical Chemistry) that will help your understanding. As the authors of the text state "To gain the most benefit from courses based on this textbook, students should have had at least on year each of introductory physics, chemistry, and calculus, along with a course in modern physics or physical chemistry. For optimal use of the textbook it would be helpful if the

students have had courses in thermodynamics, electricity and magnetism, and an introduction to quantum mechanics." I will attempt to design assignments and exams which are as fair as possible to all the students.

The main text (Gersten and Smith) might have given you sticker shock and I apologize for that. There are very few books available at an appropriate level and many of those are out of date. The book is, in my opinion, a good value despite the high price tag. You will notice that there is much more material in the book than we will cover. With the recent publication date and the ftp site, the book is relatively up-to-date. If you find sections of the book difficult to work through, I can suggest some texts at a slightly lower level including:

Introduction to Phonons and Electrons by Lou
Understanding Solids by Tilley
Introductory Solid State Physics by Myers
The Solid State: From Superconductors to Superalloys by Guinier and Jullien.
Elementary Solid State Physics by Omar
The Physics of Solids by Turton.

As David Goodstein states in *States of Matter*: "The field is not distinguished by imaginative book titles".

Grading:

Your grade will be based on homework, exams, and the final as follows:

Homework (including simulations)	20%
Exams (3) 3X10%	30%
Labs (4) 4X5%	20%
Presentation	10%
Final	20%

The homework assignments should be turned in by 5:00 on the day they are due. Solutions will be made available to you. Late assignments will be considered on a case-by-case basis.

In general, I will be less strict in grading your homework as compared to your exams. I will let you know the exam format and what material you will be accountable for at least one week in advance.

Notes:

Any student requiring accommodations due to a disability must contact Services for Students with Disabilities (SSD) in room 181 of the Student Services Center.

Attendance at lecture is strongly recommended. You will be responsible for material discussed in lecture, which may or may not be in the book.

Please turn cell phones and pagers off before coming to class.

Academic dishonesty will not be tolerated. Cheating on exams may result in your failure of the course.

Phsx 3200 Spring Semester 2010 Schedule

	Monday	Wednesday	Friday	Notes
Jan 4-8	Introduction Solids Materials Science 1.1	Crystal Lattices 1.2-1.4	Crystals: Directions Positions & Planes 1.5	
Jan 11-15	Crystal Basis 1.6-1.7	Packing Fraction Density Radial Dist. Fn. 1.8	Elastic Scattering of Waves	Lab 1 Packing Fraction
Jan 18-22	**MLK Day** **Holiday**	Reciprocal Lattice 3.1-3.2	Diffraction Conditions 3.3-3.4	Lab 2 2D Diffraction
Jan 25-29	Diffraction from Caystals Structure& Form Factor 3.5	Diffraction from Amorphous Solids 3.6	**EXAM I**	
Feb 1-5	Bonding General 2.1	Covalent and Metallic Bonding 2.2-2.3	Van der Waals and Ionic Bonding 2.4-2.5	Lab 3 XRD
Feb 8-12	Mixed Bonding Hydrogen Bonding 2.6-2.7	Order and Disorder 4.1-4.2	Amorphous Solids 4.3	
Feb 15-19	**Pres. Day** **Holiday**	Defects, Local and Extended 4.4-4.5	Stress and Strain 10.1-10.4	
Feb 22-26	Elastic Properties 10.5-10.7	**EXAM II**	Atomic Vibrations 1D Monatomic Lattice 5.1	
Mar 1-5	1D Diatomic Lattice 5.2	Phonons 5.3-5.4	Specific Heat 5.5-5.6	
Mar 8-12	Specific Heat 5.7	Thermal Expansion 5.9	Electrical Properties Drude Model 7.1-7.2	
Mar 15-19	**Spring Break**	**Spring Break**	**Spring Break**	
Mar 22-26	Hall Effect Sommerfield Model 7.3-7.4	Bloch Theorem Bloch Functions 7.6	Nearly Free Electrons 7.8	
Mar 29- Apr 2	Tight Binding Models 7.9	Metals, Insulators Semiconductors, Semimetals 7.10	Quantum Effects Effective Mass 7.12	
Apr 5-9	**EXAM III**	Semiconductors Band-Structure 11.1-11.2	Semiconductors Doping 11.5	Lab 4 AFM
Apr 12-16	Semiconductor Statistics, Confinement 11.6	Applications Technology, Moore's Law 11.12	**Student Presentations**	
Apr 19-23	**Student Presentations**			