MSE 102 – Bonding, Crystallography and Defects
Fall Semester, 2015

Daryl C. Chrzan
Professor, Materials Science and Engineering
318 Hearst Memorial Mining Building (HMMB)
dcchrzan@berkeley.edu

Office Hours: Tuesdays: 2:00 – 5:00 PM or by appointment

Grad. Stud. Insts.: Ian Winter
ian.winter@berkeley.edu
office hours: 8:30 -11:30 AM Tuesdays and Wednesdays in 350 HMMB

Discussion Sections: The discussion sections will be both formal and informal. Sometimes, they will expand on the material covered in class to make concepts more clear. Others will be devoted strictly to your questions. You should view these as mandatory in that material covered in the discussion sections and not necessarily covered in the main lecture is "fair game" for examinations.

Web Site: bcourses…
The web site will be your primary source of information regarding the course. Lecture notes are posted, as will problem sets, and additional information as needed.

Required Text:

None. Mostly, we will rely on course notes that will be posted to the web. This does not mean that you are absolved of any responsibility to do outside reading. You should consult the sources below often for clarification of concepts, and alternate views of presented material.

Recommended Texts:

A single textbook covering the course material is not available. Consequently, I have drawn upon a number of sources (including my own experience) in constructing the course. I find the following references to be extremely helpful. Whenever possible, I will note which of these is particularly strong for which topics to assist you in planning your additional reading.

1) Kelly, Groves and Kidd. "Crystallography and Crystal Defects" (Wiley, 2000).
2) Sands. "Introduction to Crystallography" (Dover, 1990).
3) Borchardt-Ott. "Crystallography" (Springer, 1995).
4) Nye. "Physical Properties of Crystals" (Oxford, 1985).

5) Liboff. “Introductory Quantum Mechanics” (Holden-Day, 1980).
6) Harrison. “Electronic Structure and the Properties of Solids” (Dover, 1989).

Problem Sets:

There will be 11 problem sets assigned. Problem sets will be due, in general, on Thursdays *at the start of class*. Solutions will be posted to the web after the due date. Late problem sets will not be accepted unless you have made prior arrangements with the Professor. (Exceptions can be made for family emergency/health/religious accommodation reasons.) I will count your best 9 problem sets towards your grade.

Grading:

Your grade will reflect four contributions. The problem sets will count as 20% of your grade. There will be two in-class exams that each count as 20% of your grade. The final exam will count as 40% of your grade.

The final grade will be computed by assigning a point value to each component. (For example, your nine best problem sets can contribute a maximum of 20 points.) Your final grade will be determined by a sum of all five components. I will try my best to construct problem sets and exams that are fair, and reflect what you need to know. (I would like to use a straight scale in setting the grades, but this is not usually possible.)

Syllabus:

The syllabus is posted to the web site. It describes the intellectual flow of the course, and lists important dates (in-class examinations, due dates for problem sets, etc.)
I will endeavor to stick the syllabus as much as is possible. However, I do find that the pace and depth at which topics can be addressed is very much class dependent, and we may find it necessary to adjust the syllabus as we progress.

Goals:

The course description posted on the departmental web site lists three course objectives:

- To identify and describe the types of bonding found in materials.
- To develop the language to describe crystal structures and their symmetries.
- To identify and describe different types of defects that are found in real crystal structures.

In addition, the web site lists desired course outcomes:

- The student should be able to define a lattice and a crystal.
- The student should be able to identify crystalline translational and point symmetries.

- The student should be able to read and interpret the International Tables for Crystallography.
- The student should understand the structure of a stereographic projection, and the stereograms for the 32 crystallographic point groups.
- The student should understand the relationship between symmetry and physical properties.
- The student should be able to construct a reciprocal lattice for a crystal, and relate the structure of the lattice to diffraction from that crystal.
- The student should understand the quantum mechanical origins of bonding, and structure of Schrödinger's equation, and its application to simple problems including the particle in a box, the hydrogen atom and a rudimentary band theory of solids.
- The student should be able to identify the characteristics of metallic, covalent, ionic and van der Waal's bonding.
- The student should be able to identify the different types of defects found typically in crystals.
- The student should begin to understand the importance of defects to materials properties.

Why am telling you this? Well, these objectives and outcomes serve as a type of contract. For my part, I promise to do my best to put you in a position to meet all of the objectives and successfully demonstrate all of the outcomes. Your part is to follow my lead, and attain all of the stated goals. In this respect, the objectives and outcomes serve as a study guide for the course. While we will not always focus explicitly on this list, each of our topics, problem sets and exams will somehow reflect the goals of the course and if you are aware of this, it can help you to focus your study efforts appropriately. By the end of the course you should be able to read through this list and state confidently that you can meet all of the objectives.