



**Subject/Number: PHGN440/MLGN502A**

**Course Title: Solid State Physics**

**Semester/year: Fall 2016**

**Instructor or Coordinator:** Eric Toberer

**Contact information (Office/Phone/Email):** etoberer@mines.edu

**Office hours:** TBD

**Class meeting days/times:** 10-11 MWF

**Class meeting location:** Alderson 162

**Web Page/Blackboard link (if applicable):** <http://solidstate.mines.edu>

**Teaching Assistant (if applicable):** Xiaoning Zang (xzang@mymail.mines.edu)

**Contact information (Office/Phone/Email):** wpainter@mymail.mines.edu

**Instructional activity:**  3 hours lecture  hours lab 3 semester hours

**Course designation:**  Common Core  Distribute Core  Major requirement  Elective

Other (please describe \_\_\_\_\_)

**Course description from Bulletin:** An elementary study of the properties of solids including crystalline structure and its determination, lattice vibrations, electrons in metals, and semiconductors.

**Textbook and/or other requirement materials:**

**Resources**

- Kittel, *Solid State Physics* 8<sup>th</sup> edition
- Vesta (freeware) <http://jp-minerals.org/vesta/en/download.html>
- Evgeny Tsybal at U. Nebraska - Lincoln: Has a great write-up for his Physics 927 class. Essentially the cliffnotes: <http://physics.unl.edu/tsybal/teaching/SSP-927/index.shtml>
- The Oxford *Solid State Basics* by Steven H. Simon is a nice additional text

**Core learning objectives:**

By the end of the semester, students will have met the following learning objectives:

1. Design elastic and inelastic diffraction measurements and interpret results to infer the both static structure and nuclear dynamics of crystalline solids.
2. Model and explain properties (electronic, thermal and optical) by combining quantum mechanical descriptions with classical transport theory and knowledge of chemical structure.
3. Model and explain the impact of non-equilibrium environments (illumination, thermal gradients, and electrical potential) on material properties.
4. Design materials and devices with tailored properties (electronic, thermal and optical) by altering chemical structure.

**Cross-cutting learning objectives:**

For every topic above, students will be able to:

*Limits:* Articulate key assumptions & define boundaries of applicability. Note the classical vs quantum mechanical basis of approaches.

*Clarity:* Construct and communicate a complete solution that someone else with a similar physics background can follow.

*Blank page:* In the face of ambiguous solution pathways, analyze and compare different approaches and select appropriate methodologies.

*Maps:* Interpret physical phenomena portrayed by different representations (pictures, graphs, equations, etc.) and be able to translate between different representations as needed.

*Validation:* Design experiments to test and refine models, including a treatment of experimental uncertainty.

*Computation:* Construct advanced models using computational tools; visualize and interpret results as a function of independent variables.

*Reciprocal space:* Articulate how reciprocal space serves as a map to guide understanding and the mechanism by which properties are mapped into reciprocal space.

**Assessment techniques:**

*Summative:* Homework, case study analyses with report and presentation (peer evaluated); oral final one-on-one discussion

*Formative:* Self-evaluation (eg. pre-class evaluations), quizzes, and in-class worksheets

**Grading:**

- Homework: 20% (4 x 5%)
- Lab reports: 15%
- Participation: Pre-class evaluations 5%
- Participation: In-class activities: 5%
- Oral mid-term exam: 10%
- Oral final exam: 15%
- Final project (written): 20%
- Final project (oral): 10%

**Policy on academic integrity/misconduct:**

The Colorado School of Mines affirms the principle that all individuals associated with the Mines academic community have a responsibility for establishing, maintaining and fostering an understanding and appreciation for academic integrity. In broad terms, this implies protecting the environment of mutual trust within which scholarly exchange occurs, supporting the ability of the faculty to fairly and effectively evaluate every student's academic achievements, and giving credence to the university's educational mission, its scholarly objectives and the substance of the degrees it awards. The protection of academic integrity requires there to be clear and consistent standards, as well as confrontation and sanctions when individuals violate those standards. The Colorado School of Mines desires an environment free of any and all forms of academic misconduct and expects students to act with integrity at all times.

Academic misconduct is the intentional act of fraud, in which an individual seeks to claim credit for the work and efforts of another without authorization, or uses unauthorized materials or fabricated information in any academic exercise. Student Academic Misconduct arises when a student violates the principle of academic integrity. Such behavior erodes mutual trust, distorts the fair evaluation of academic achievements, violates the ethical code of behavior upon which education and scholarship rest, and undermines the credibility of the university. Because of the serious institutional and individual ramifications, student misconduct arising from violations of academic integrity is not tolerated at Mines. If a student is found to have engaged in such misconduct sanctions such as change of a grade, loss of institutional privileges, or academic suspension or dismissal may be imposed.

The complete policy is [online](#).

**Coursework Return Policy:** Homework will be returned with solutions within two weeks of receipt.

**Absence Policy:** Please inform me in advance if you're going to be absent for an activity/sports. That way I don't assume you're just skipping class to play video games.

**Homework/Exams:**

- Late homework will not be accepted. Homework is due in class. Welcome to the real world.
- Exams: If you will be absent during a scheduled exam, you should schedule a make-up time well in advance. Concerning the final exam, leaving for home early does not constitute a reason to have the exam early.

**Detailed Course Schedule:** Please see the webpage for a weekly schedule.