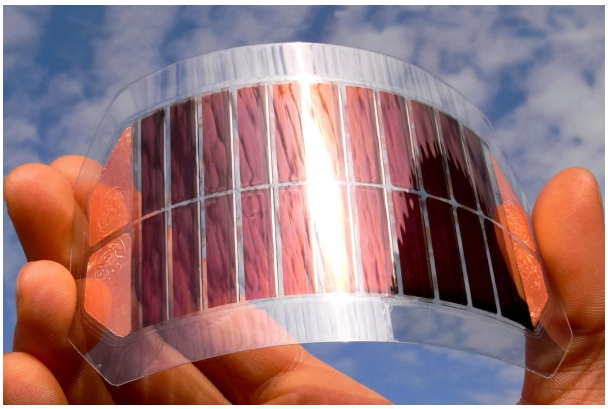

Syllabus

PHY 340
Condensed Matter

Instructor: Liz Boatman
Email: boatman@gustavus.edu
Lecture: MWF 11:30 a - 12:20 p, Olin 216
Lab: Tu 1:30 - 4:20 p, TBA
Office hours: Zoom link, TBD
Lab TA: Matthew Keeley

Course Overview

Condensed matter is the study of matter in its **solid state**. As a consequence of being solid, such matter can have various mechanical **properties** of interest, as well as a range of other practical properties: electrical conductivity, thermal conductivity, piezoelectricity, superconductivity, etc. Using methods that range from quantum mechanics to crystallography to electromagnetism -- and even metallurgical and other processing techniques! -- we can not only *explore* the properties and behaviors of solid state matter but also *manipulate* them.

The latter forms the basis of the discipline of **materials engineering** (which is my doctoral discipline). In fact, this entire course, along with the techniques of chemistry, forms the physical basis that unlies the discipline of materials engineering. For this reason, we will follow the "classic" approach to "condensed matter" -- except that we will also emphasize the materials engineering perspectives and, most importantly, the *frontiers* of condensed matter science and engineering.

This course is listed as a **project-based course**. Thus, each of you will undertake an **independent project** to complete the course requirements. As an independent **investigator**, each of you will carry out the scientific process, from beginning to end, to complete your project. We will contribute three (3) lab periods, or ~¼ of our lab time, to these endeavors.

Course Resources

- Moodle course page
- Textbook

Please Bring to Class Daily

- Laptop
- Note taking materials

COVID-19/Lab Safety

To be mindful of COVID-19 safety practices. I will keep lab groups separated as much as possible while working in-person, and I will make sure that hand sanitizer is available when using shared equipment. If you have any concerns for how we are approaching our in-class experiences, please talk to me. Please be mindful of the lab safety considerations that are relevant to respective labs. These will be explicitly stated in lab guides. If you are ever unsure, please ask before proceeding!

Disability Accommodation

The college and I are committed to ensuring an equitable and inclusive learning environment for all students in this course. If you have a disability and anticipate or experience barriers to equal access, please speak with the accessibility resources staff about your needs so that I can be best informed how to help you succeed in this course. Accessibility resources staff are located in the Academic Support Center (https://gustavus.edu/asc/accessibility/) (x7227). Accessibility Resources Coordinator, Katy Clay (clayk@gustavus.edu), can provide further information.

Submitting Your Work

All assignments reviewed for credit will be submitted to electronic dropboxes via Moodle, except for lab notebooks, which will be submitted as physical documents.

Late Assignments and Deadline Extensions

Life happens, I get it. But keeping to deadlines is also good practice for the harsh reality of adulting (which is one of my least favorite things in life). To honor both of these facts, I'm instituting a policy in the middle: assignments will be due as specified when assigned, but you may have two (2) no-penalty 24 h late submissions and one (1) no-penalty 48 h late submission. Separate accommodations will be made for Checkpoints. Please remember to notify me if you are planning to use a late submission pass.

Attendance

I won't explicitly grade attendance. However, periodic assessments will be conducted as Checkpoints (see Course Schedule), and you must be present in class to take these. Moreover, you must actually complete Labs to be able to write them up. Please try to contact me ahead of time if you need to complete a scheduled Lab at an alternate time. I will make appropriate accommodations as-needed for any COVID-19 related situations that should arise.

Academic Integrity

While I absolutely encourage you to work together and to consult additional educational resources, please remember ultimately to do your own work. The goal is for *you* to learn how to use the equipment and software, and to improve *your* technical communication skills. I will not award credit for any work that appears to be copied, whether from another student or a solution manual published to the internet. The initial infraction will incur a penalty of "0/3" on the assignment. A repeat infraction will incur a subsequent penalty of "0/3" and an Honor Code violation report to the Provost's Office.

Final Grade

Most work will be reviewed on a 0-3 scale, where 0 = did not complete; 1 = lacking depth/quality; 2 = sufficient; 3 = very thoughtful and well completed work. Your final score on the 0-3 scale will be determined according to the weighted percentages in the left-most column below. The conversion scale for letter grades will be: >2.75=A; 2.50-2.74=A-; 2.25-2.49=B+; 2.00-2.24=B; 1.75-1.99=B-; 1.50-1.74=C; 1.00-1.49=D; <1.00 = F.

Extra Credit

Of the items reviewed on a ✔/✘ scale, if you earn mostly ✔'s, then I will bump up your final grade by one-third of a letter (0.25 points on the 0-3 scale).

Toward the end of the semester, you will be able to submit an itemized (i.e., organized by topic/assignment) binder of all work that you completed for our course. If your binder is complete (including documentation of all lab and project work) and well-organized, and all work is nicely laid out and legible, I will bump up your final grade by one-third of a letter grade (0.25 points on the 0-3 scale). You *are* expected to revise incorrect answers/solutions (solution keys will be made available on Moodle). Practically, this binder will serve as both a physical portfolio of your work and a resource for future coursework that builds on these topics.

Type of Work	Description	Review Structure
Assignments (0%)	Homework "Assignments" will generally include a list of questions on the related topic that require either thoughtful qualitative or thorough quantitative responses.	✔ = completed ✘ = not completed
Lab Completion (30%)	"Lab Completion" will be scored on two aspects: (1) completing the lab and (2) thoroughly documenting your work (including answers to questions in the lab guide). Twice this semester, I will collect your individual lab notebooks to review your documentation practices and provide feedback.	0-3 scale (holistic)
Communication Assignments (30%)	The last step of the scientific process is to "share" or "report" your findings. In practice, this requires the ability to understand your audience and the format of your communication piece, so that you can communicate your findings to both technical and non-technical audiences. In this modern age of science-skepticism, your ability to communicate with the latter audiences is more critical than ever. For this reason, you will practice a range of communication formats in this course (e.g., blog, Ted Talk, etc.).	0-3 scale (holistic)
Checkpoints (30%)	Assessments will be conducted as periodic 15-20 minute "Checkpoint" quizzes, which will include a combination of qualitative and quantitative questions. See our Course Schedule for further details.	0-3 scale
Project (10%)	PHY 340 is designated as a project course, thus you must undertake and execute a "Project" of your own design to satisfy this portion of the course. More details will be forthcoming, but as an independent investigator, you will execute, independently, your own project from start to finish.	0-3 scale (weighted by project component)

Course Schedule*

Week	Monday	Wednesday	Friday	Lab
1 / Feb 1	Course intro., Origin of matter, Properties of solids	Bonding	Bonding (ctd.)	No lab
2 / Feb 8	Solid structures	Solid structures (ctd.)	**Checkpoint 1**, Solid structures (ctd.)	Solid structures
3 / Feb 15	Scattering	Scattering (ctd.)	Scattering (ctd.)	Scattering phenomena I / II
4 / Feb 22	Scattering (ctd.)	Phase transitions	**Checkpoint 2**, Phase transitions (ctd.)	Scattering phenomena I / II
5 / Mar 1	Mechanical properties	Mechanical properties (ctd.)	Mechanical properties (ctd.)	Mechanical properties I / II
6 / Mar 8	1st quarter break	Thermal properties	**Checkpoint 3**, Thermal properties (ctd.)	1st quarter break - No lab
7 / Mar 15	Thermal properties (ctd.)	Electronic properties of metals	Electronic properties of metals (ctd.)	Mechanical properties I / II
8 / Mar 22	Electronic properties of metals (ctd.)	Electronic properties of semiconductors	**Checkpoint 4**, Electronic properties of semiconductors (ctd.)	Thermal and electronic properties I / II / III
9 / Mar 29	Electronic properties of semiconductors (ctd.)	Magnetic properties	Easter recess	Thermal and electronic properties I / II / III
10 / Apr 5	Magnetic properties (ctd.)	Dielectric and optical properties	Dielectric and optical properties (ctd.)	Thermal and electronic properties I / II / III
11 / Apr 12	Dielectric and optical properties (ctd.)	Superconductivity	**Checkpoint 5**, Superconductivity (ctd.)	Project
12 / Apr 19	Finite solids	Finite solids (ctd.)	Amorphous solids	Project
13 / Apr 26	Biological molecules	Frontiers in materials engineering	**Checkpoint 6** Presentations	Project
14 / May 3	Presentations (ctd.)	Presentations (ctd.) Course wrap-up	No class	No lab

***I reserve the right to revise at my discretion.**