

COURSE SYLLABUS

Instructor: Prof. Mark Yuly Rm. P106 mark.yuly@houghton.edu 567-9282
Office Hours: Rm. P106 MTWRF 1:30-2:30 PM

Preferred means of contact: Please come talk to me whenever you feel like it. If I am in my office, I'm available to talk!
 If that is not possible, please contact me at mark.yuly@houghton.edu to set up a zoom appointment.

Schedule: Laboratory Rm. P117, P207 TR 9:00-9:50 AM

“it is especially in sciences... that we see the wonders of God,
 his power, wisdom and goodness;
 ... that is why, since my youth, I have given myself to the science that I loved.”

-- Gottfried Wilhelm Leibniz

Catalog Description: Selected experiments in mechanics, electricity and magnetism, and modern physics. Liberal Arts. This course has a fee. Prerequisite: PHYS 152

Objectives: This semester this course will focus on the classic experiments of modern physics, that is, those experiments that were crucial in the development of quantum physics since the beginning of the 20th century. Topics will include blackbody radiation, the photoelectric effect, electron diffraction, and Compton scattering. Our approach will be to examine the both classical and modern theoretical descriptions, then compare the predictions of these models with measurements. Students will be expected to maintain a logbook of their progress and results and to present their work on one of the experiments orally.

Learning Outcomes: These objectives will be evidenced by the following outcomes:

1. Familiarity with the experimental and theoretical underpinnings of the physics of the 20th century. (P1)
2. The ability to use a variety of laboratory tools and techniques. (P2, E6)
3. Understanding of the relationship between experiment and theory in modern physics research. (P1, P2, E6)
4. The ability to give a professional oral presentation about a technical subject. (P3, E3)

Numbers in parentheses indicate the corresponding departmental learning objectives, available at

Engineering: TBD

Physics: <https://www.houghton.edu/academics/majors-programs/physics/physics-department-mission/>

- Textbook:** None required, but you will need to buy an AMPAD #22-156 computation book to use as your experiment logbook.
- Homework:** A total of five experiments, plus an initial laboratory exercise, are planned for this class. You will be expected to
1. carry out the experiments and activities.
 2. keep a logbook describing your experiments, to be turned in at the dates listed in the course schedule.
- make a 15 minute (per student) oral group presentation on one of the laboratory experiments. **“Audience” attendance at oral report sessions is expected. Extra credit points will be given for asking hard questions.**
- Grading:** Grades are assigned according to the Physics Department grading rubric at <http://www.houghton.edu/physics/physics-grading-rubric/>. Grades will be based on your logbook (70%) and your oral report (30%).
- Class Attendance:** Because the point of a laboratory course is for students to engage with the physical world, a “virtual laboratory” course is an oxymoron. Moreover, both the expense and difficulty of the experiments in this class preclude doing them at home. For these reasons, students will be expected to carry out the experiments in person in the Houghton laboratory.
- Prior to each experiment will be a synchronous in-person class session devoted to discussing the relevant theory. If at all possible, you are encouraged to participate in-person for these sessions. However, if you cannot be present in-person, you are still expected to be present and engaged remotely for each scheduled class session. If you are unable to attend a class session for any reason, including quarantine, please make arrangements with me. If you miss a class session and do not contact me for instructions your grade for the course may be negatively affected.
- Students participating in-person will need to sit in the same spot every day to facilitate taking attendance and keeping a seating chart.
- Attendance at student presentations is very strongly encouraged, and will be rewarded with extra credit points for questions.
- You will be expected to complete each lab at your convenience (but before the due date!), and will be issued a key to Rm. 117 for this purpose. When you need help, please come to me -- I will be happy to answer questions any time.
- Course website:** All materials for this course are available on the course website, which can be found at <http://www.houghton.edu/physics/course-websites/phys-275-experimental-physics-laboratory/>.
- In the event campus classes are canceled:** In the event on campus classes are canceled due to pandemic, it will be very difficult to complete the objectives of this course, so we will have to do the best we can. Any remaining classroom sessions will carry on remotely, synchronously, at the same meeting time as before. Attendance at online class sessions will be required.
- This difficulty will be the laboratory work, which will become impossible. If necessary, we will have synchronous sessions in which I will perform the experiment and send you the collected data. We will be able to talk about what I am doing, but you unfortunately will

not have the experiment of setting up, troubleshooting, and performing the experiment for yourself.

**COVID-19
rules for in-
person class
sessions:**

The following safety precautions must be scrupulously observed:

1. Everyone, teachers and learners, will wear a mask while moving to and from classes.
2. Students should not enter the classroom until five minutes before the scheduled start.
3. Students should leave the classroom within five minutes of the scheduled end.
4. Teachers should ensure that the class session ends promptly at the scheduled time.
5. Students will wear masks while in the classroom.
6. Students should clean their desks at the beginning of the class using materials provided. Teachers should clean podiums and other surfaces they routinely touch, including doorknobs. Please clean keyboards, computer hardware, and switches with disinfecting wipes.
7. Once everyone is seated, teachers may switch from a mask to a clear face shield. They should return to wearing a mask by the end of the class session.
8. Adequate social distancing will inform seating arrangements.
 - a. Chairs, desks, and table spaces that should not be used will be labeled.
 - b. Please do not rearrange any furniture.
 - c. Student seating will be assigned, and careful attendance records will be kept, including where each student was located during class.

Faculty will stay in the teaching area at the front of the room, at least six feet away from others people. If circumstances require the teacher to move outside the teaching area, a mask will be used.

**COVID-19
rules for
laboratory:**

The following safety precautions must be scrupulously observed:

1. **Hygiene.** Careful and thorough hygiene will be necessary: Everyone in the room should wash or disinfect their hands before entering the space, and immediately upon leaving. Anyone with signs or symptoms of illness should not attend labs, studios, or classes.

Work spaces, such as lab tables, doorknobs, and other surfaces that are commonly touched should be disinfected before beginning to use the space, and again at the end of the session.

Shared apparatus that requires a lot of touching, like computer keyboards or touchpads on instruments, should be disinfected between sessions. For some items, such as delicate or small parts, clay, specimens, and paint, routine disinfection may not be practicable. When such items are shared or passed from one student to another, please emphasize the importance of good hygiene practices, like washing hands and not touching one's face.

2. **Personal Protective Equipment.** Masks should be worn at all times in laboratories and studios. Careful use of masks is essential when people may be closer than six feet, even for a moment. Clear face shields have not been shown to be as effective as masks, so professors should also wear a mask if they might come closer than six feet to another person. Additional protective equipment, such as gloves, goggles, and face masks may be used if the professor considers them necessary.

3. **Social distance.** Spread out in the lab or studio so that you are at least six feet apart. Since laboratories last longer than most classes, if more than six feet of separation is possible, please make it so. Each student group, e. g. lab partners, should consist of the same members throughout the semester.

With thorough hygiene and careful use of personal protective equipment, it will be permissible for students to work in small groups at distances closer than 6 feet for short periods of time. The length of time in proximity should be as short as possible, ideally no more than 10 minutes at a time.

Working together on labs:

In this class you will need to work together in groups of two. In some cases, you may be best to talk with your partner remotely. In that case, I would recommend using the video chat capability of MS Teams.

To simulate writing on the chalkboard, I would recommend using either Invision freehand <https://projects.invisionapp.com/d/main#/projects> for short things that you do not want to print out, or ConceptBoard <https://app.conceptboard.com/>.

Turning lab notebooks:

Every student is required to keep a lab notebook of his work. Normally we would use AMPAD computation books. However, since part of our class time must be online, and since we might have to leave at any time, this semester we are using Rocketbook.

Rocketbook allows you to write your notes on paper just like you always do, then quickly scan and upload it using a phone. It rotates everything, makes it the correct size, stitches the pages together and uploads a pdf.

1. To use this, you can download free paper templates at: <https://getrocketbook.com/pages/rocketbook-for-free>
2. I would recommend printing out a bunch of these pages, then putting them into a three ring binder and using it just like an AMPAD notebook.
3. Download and install Rocketbook for android or iOS. See <https://rocketbookhelp.zendesk.com/hc/en-us/categories/360000286633-Getting-Started>
4. Set up Rocketbook to email the pdf files to yourself.
5. Finally, upload the pdf file to the proper assignment in MS Teams (or, alternatively, to the Homework section in MS OneNote).
6. Alternatively, if you have a tablet you could just use OneNote to write your homework directly into the OneNote section for homework.

Technology Policy:

During class sessions, please silence cell phones and do not use computers for taking notes without talking to me first.

College Support Services:

I want you to be aware of some of the services that the college provides that may be helpful for you (more information can be found online or by talking to me).

[Academic Support and Accessibility Services](#)
[Writing Center](#)
[Counseling Services](#)
[Office of Vocation and Calling](#)

Self-Reporting of Disabilities:

If you have an academic disability that requires special accommodations or modifications, it is up to you to self-report any such disability to the Academic Support and Accessibility Services office (585-567-9622). With appropriate documentation, you will be afforded

the necessary accommodations and/or modifications. For more information , go to: <http://www.houghton.edu/academics/academic-resources/center-for-academic-success-and-advising/> .

Academic Integrity:

From the course catalog: “Honesty is the foundation on which all intellectual endeavors rest. To use the ideas of others without acknowledging the authors of those ideas belies the nature and purpose of academic life. At Houghton, where we strive to live out Christian calling and commitment, personal integrity, including academic honesty, should be the hallmark of all our work and relationships.

Students are expected to exhibit extreme care relative to personal honesty in all academic work, including in-class and out-of-class learning experiences, such as exams, quizzes, journals, papers, research projects, etc. Dishonest work includes but is not limited to the following:

1. Obtaining aid or information without giving due recognition to the sources of such aid or information. Such dishonesty encompasses 1) asking to copy or copying other students’ work to claim as one’s own on an exam or assignment of any kind and 2) all forms of plagiarism. Plagiarism includes using ideas, words or phrases from any source without citing that source and downloading or purchasing papers or parts of papers from others or the Internet and claiming such work as one’s own.
2. Giving aid or information when it is clearly inappropriate to do so, such as providing answers for an exam or writing a portion of a paper or an entire paper for someone, including selling one’s work.

See the college catalog at <https://www.houghton.edu/academics/course-catalog/catalog-table-of-contents/> page 39 for the college statement on academic honesty.

Expected Minimum Time Required:

For each credit hour, the minimum amount of time expected for independent course-related work is 45 hours (3 hours per week per credit) giving 5400 minutes for this 2 credit hour class. An estimate for the time required to complete each task in this class is shown below.

Learning activity	Additional comments	Typical <i>minimum</i> time on task	Total time in minutes
Class time	Lectures, presentations	30 class sessions, 50 minutes each session	1500
Laboratory exercises and Warmup	Perform experiment outside of class period	6 experiments, 8 hours per experiment	3120
Logbook	Keep detailed records of experimental work, answer questions	2 hours per experiment	720
Presentations	Prepare PowerPoint slides and practice talk	5 hours preparation time	300
TOTAL			5640

Schedule of class sessions:

Online Sessions

1. Tuesday, Sept. 1 **Introduction**
Syllabus, Safety Contracts, Logbook instructions, Sign up for labs, Oral reports
2. Thursday, Sept. 3 **Uncertainty in Measurement**

In-person Sessions

3. Tuesday, Sept. 8 **Uncertainty in Measurement**
Warm Up Exercise
4. Thursday, Sept. 10 **Experiment 1 – Photoelectric Effect**
5. Tuesday, Sept. 15 **Reading Half Day – No Class Session** Work on Warm up exercise
6. Thursday, Sept. 17 **Experiment 1 – Photoelectric Effect**
7. Tuesday, Sept. 22 **Experiment 1 – Photoelectric Effect**
8. Thursday, Sept. 24 **Warm Up Exercise Reports**
Due: Logbook on Warm Up exercise Work on Experiment 1: Photoelectric Effect
9. Tuesday, Sept. 29 **Experiment 2 – Black Body Radiation**
10. Thursday, Oct. 1 **Experiment 2 – Black Body Radiation**
Due: Logbook on Exp. 1 Photoelectric Effect
11. Tuesday, Oct. 6 **Experiment 3 – Compton Scattering**
12. Thursday, Oct. 8 **Experiment 3 – Compton Scattering** Work on Experiment 2: Blackbody radiation
13. Tuesday, Oct. 13 **Experiment 3 – Compton Scattering**
14. Thursday, Oct. 15 **Experiment 3 – Compton Scattering**
Due: Logbook on Exp. 2 Blackbody Radiation
15. Tuesday, Oct. 20 **Experiment 4 – Electron Diffraction**
16. Thursday, Oct. 22 **Reading Half Day – No Class Session** Work on Experiment 3: Compton Scattering
17. Tuesday, Oct. 27 **Experiment 4 – Electron Diffraction**
18. Thursday, Oct. 29 **Experiment 4 – Electron Diffraction**
Due: Logbook on Exp. 3 Compton Scattering

19. Tuesday, Nov. 3	Reading Half Day – No Class Session	
20. Thursday, Nov. 5	Experiment 5 – Franck-Hertz Experiment	Work on Experiment 4: Electron Diffraction
21. Tuesday, Nov. 10	Experiment 5 – Franck-Hertz Experiment Due: Logbook on Exp. 4 Electron Diffraction	
22. Thursday, Nov. 12	Experiment 5 – Franck-Hertz Experiment	
23. Tuesday, Nov. 17	Presentation on Photoelectric Effect	Work on Experiment 5: Franck-Hertz
24. Thursday, Nov. 19	Experiment 5 – Franck-Hertz Experiment	
25. Tuesday, Nov. 24	Experiment 5 – Franck-Hertz Experiment <i>Due: Logbook on Exp. 5 Franck-Hertz Experiment</i>	
26. Online Sessions		
27. Thursday, Nov. 26	THANKSGIVING BREAK	
28. Tuesday, Dec. 1	Presentation on Blackbody Radiation <i>Due: Logbook on Atomic Spectra</i>	
29. Thursday, Dec. 3	Presentation on Compton Scattering	
30. Tuesday, Dec. 8	Presentation on Electron Diffraction	
31. Thursday, Dec. 10	Presentation on Franck-Hertz Experiment	