Physics 338—Advanced Physics Laboratory
T R 1:15-2:30 pm
Course Description, Spring 2024

Instructor:	Andrew Dougherty
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Lab:	HSC 025 610-330-5212
E-mail:	doughera@lafayette.edu
Web Page:	`http://workbench.lafayette.edu/~doughera/`
Course Web Page:	`https://moodle.lafayette.edu/course/view.php?id=27052`

Office Hours: Please feel free to e-mail or call at any time and ask a question or set up an appointment. As we start the semester, I will be holding in-person office hours. If you prefer to meet virtually, over Zoom, we will use the class link on our Moodle page.

You are not limited to the listed times. I will also normally be available on most other days during the free times indicated on my schedule.

Classes on Snow Days and Other Emergencies: If I am unable to make it to class, I will send out an email via Moodle.

Web Pages: All course assignments and documents will be posted to our Moodle site `https://moodle.lafayette.edu/course/view.php?id=27052`.

Description: Physics is an experimentally-based science. Experiments have often paved the way for scientific revolution, and they remain the final arbiter among competing theories. However, experiments are rarely as straightforward as one might believe based on typical textbook descriptions, so it is important for an educated scientist to develop an understanding of, and an appreciation for, reliable, quality research.

In this course, you will perform experiments from a variety of areas of physics, with emphasis on understanding the underlying physics, designing experiments, statistically analyzing observations, and writing reports.

Prerequisites: Physics 215 and 218 or equivalent, or permission of the instructor.

Writing: This course counts as a writing course under the Common Course of Study.

In physics, as in many other disciplines, writing is essential for the effective communication of ideas. Although scientific writing takes many forms, this course will focus on two types: brief reports and formal journal articles.

For communicating results to peers, peer-reviewed journal articles are the primary medium used in physics. As part of this course, you will complete two journal-style articles, complete with editing and revision cycles. You will also participate in the peer-review process.

Text: *An Introduction to Error Analysis*, by John R. Taylor. Additional material will be drawn from various texts you have used in other physics courses and from relevant journal articles.

Student Learning Outcomes: After completing this course, you should be able to

- Perform and interpret basic experiments involving magnetic properties of materials,
- Interpret spectroscopic results in terms of fundamental energy levels,
- Use Fourier methods to detect small signals,

- Develop and refine appropriate experimental protocols,
- Estimate uncertainties in measurements, and use those uncertainties properly in experimental analysis, and
- Communicate results in standard journal article form.

Since Phys 338 counts as a writing course under the College's Common Course of Study, you should also be able to

W2 Identify and employ a range of strategies for discovering, developing, organizing, revising, and editing.

W3 Identify and apply the discourse conventions of a chosen academic discipline(s) or fields(s) (including conventions of genre, format, citation, structure, and vocabulary).

Lab Notebook and Reports: You are required to keep an accurate and complete log of your work in this course in a laboratory **notebook**. This can be either paper-based or electronic. More details are in the separate handout on Laboratory Notebooks and Reports.

For most experiments, you will submit a brief informal lab report by the date indicated on the schedule below. The report should be typed, though diagrams and calculations may be handwritten, as long as they are legible.

For the Iodine Spectroscopy experiment and Fourier project, you will submit formal lab reports in the style of a journal article. These reports will have multiple drafts, and you will also use a peer-review process.

More details are in the accompanying handout `http://workbench.lafayette.edu/~doughera/courses/phys338-2024/latex/notebook-report.pdf`.

Colloquia: Throughout the semester, there will be various seminars hosted by the Physics department (as well as seminars in related areas). These are a valuable opportunity to learn about diverse areas of physics, and attendance at all of them is strongly encouraged. For this course, you should plan on attending at least two talks during the semester and reporting back on those talks. These reports will count for 5% of the total grade. Typically, a seminar assignment will be to turn in a 1-page double-spaced reflection on the seminar (about 350 words). More details will be included with the first seminar assignment.

Grades: The final grade will be determined from the informal lab reports (40%), iodine formal report (25%), Fourier project formal report (15%), lab notebook (10%), peer review reports (5%), and colloquium attendance (5%).

Attendance: Regular attendance is expected. It is **your** responsibility to keep advised of all assignments. If you will be absent for several classes, you should let me know in advance if possible.

Late Penalties for Reports: For each weekday that a report or paper is late, I will normally deduct 4 points from the maximum possible grade of 100%. Because peer reports are time-sensitive, late submissions will normally not be accepted. Similarly, late or incomplete drafts will normally not be accepted. I will, of course, allow for extenuating circumstances such as illness.

Academic Honesty: The fabric of science, and indeed any intellectual endeavor, is built on the integrity of all involved. Accordingly, I take academic honesty very seriously. I

expect that you will abide by the "Principles of Intellectual Honesty" appearing in the Lafayette College Student Handbook.

Working with others is often a helpful way to learn physics. For this course–and indeed for most advanced courses in any discipline—I believe such collaboration to be an essential element for success. I encourage you to collaborate with each other, but unless specifically directed otherwise, all work you turn in *as* your own should *be* your own. My expectation is that everyone will be open to both giving and receiving aid from their peers.

Some students also find it useful to consult other texts, friends, and even a variety of on-line sources. In all cases, though the principles of academic honesty apply: All nontrivial collaborators and external sources must be acknowledged (apart from your textbook and instructor). You may seek help understanding a problem, but all work you turn in must be your own original work. Copying work from another source, such as CourseHero, Chegg, Bartleby, or a generative AI source, is a violation of the Academic Honesty Policy.

Please read the department's Academic Honesty policy for the rules regarding collaboration. Feel free to ask if you have any questions about this policy.

Inclusivity: All students should feel welcome in Physics class. We all bring our own unique perspective to class, and it is my intention that all students feel included in the intellectual community of the classroom. Unfortunately, the history of science is full of exclusion, so it's important to be explicit about inclusion.

Please contact me if you feel your identity is not being honored in class, if you have a preferred name or pronouns that I am not aware of, you observe religious holidays which conflict with coursework, or if there is something else that I should address. I am still learning, too, and your feedback is important to me.

Proper Usage of Course Materials: At Lafayette College, all course materials are proprietary and for class purposes only. This includes posted recordings of lectures, examples, tests, solutions, and other course items. Such materials should not be reposted. Online discussions should also remain private and not be shared outside of the course. You must request my permission prior to creating your own recordings of class materials, and any recordings are not to be shared or posted online even when permission is granted to record. If you have any questions about proper usage of course materials feel free to ask me.

Generative AI Statement: See the general Academic Honesty section above.

Class Recordings: From time to time, it will be useful to record our classes for those unable to attend in person. I will make any such recordings available on a Google Drive shared within the class.

These recordings are for the use of this class only, and should not be shared outside of the class. If you have any concerns with being recorded during the course please let me know.

Federal Credit Hour Statement: The student work in this course is in full compliance with the federal definition of a four credit hour course. Please see the Registrar's Office web site
`https://registrar.lafayette.edu/wp-content/uploads/sites/193/2013/04/Federal-Credit-Hour-Policy-Web-Statement.doc` for the full policy and practice statement.

Andrew Dougherty Spring 2024
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Time	Mon.	Tues.	Wed.	Thurs.	Fri.
9:30					
10:20					
10:35					
10:45					
11:00					
11:25					
11:40					
12:15					
12:30					
12:55					
1:15		**Phys 338**		**Phys 338**	
1:40		HSC 017		HSC 017	
2:30					
2:45	**Phys 327**		**Phys 327**		**Phys 327**
3:35	HSC 017		HSC 017		HSC 017
4:00					
4:10					
4:30					
5:00	**Phys 151**	Committee	*Physics Club*		
5:30	**Lab**	Meeting			
6:00	HSC 119				
6:30					

ACADEMIC HONESTY GUIDELINES
Department of Physics

It is expected that each student taking courses in the Department of Physics is familiar with the statement "Principles of Intellectual Honesty" appearing in the Lafayette College Student Handbook. The following guidelines are intended to indicate how that statement pertains to your work in physics. Your instructor may have further guidelines for your specific course. We assume that students are honest; if you are not certain as to what is expected of you, consult your instructor before proceeding.

I. EXAMINATIONS:

1. Bring only those materials specifically authorized by your instructor. Frequently in the elementary courses, you will be permitted to bring in a formula sheet or you will be provided with one.
2. If you find that the seating arrangement is such that you can see someone else's paper, don't look! Better yet, ask if you can sit in another seat.
3. If you use a calculator, clear the answer before setting the calculator aside.
4. If you fail to hand in your paper at the end of the period you will be awarded a grade of zero for that test.

II. TAKE-HOME EXAMINATIONS: Take-home examinations are often assigned in some courses. Specific rules governing such tests will be announced by your instructor. The overriding principle, however, is that any work submitted be your own or be specifically credited to its source. There should be no discussion of the test questions with *anyone* other than the instructor.

III. HOMEWORK: You must acknowledge *all* collaborators. You are encouraged to learn from one another. You should first try to do homework problems on your own; after all you will have to do similar problems on your own in tests. However, discussion of difficult problems with others can help you to develop your own analytical skills and is encouraged, provided that, *after discussion* you write up solutions *on your own.* Do *not* borrow or lend homework papers. There is an important difference between discussing a problem with someone and copying his or her work. There have been students who have loaned papers to friends for a few minutes to "check answers", and been horrified to find themselves charged with academic dishonesty because their "friends" copied their solutions.

Please Note: The same ethical standards of academic integrity and honesty apply to the on-line homework as to the written homework, except that there is no place for you to specifically acknowledge collaboration. However, the same general rules apply.

IV. LABORATORY: Usually two or more students will work together in performing experiments and will submit reports of their work. In some courses, a single joint report may be submitted. Specific instructions will be announced by your instructor. If the words used to describe some part of the experiment are taken from some other source (such as the lab manual), then the source should be cited. (Reference to the lab manual can usually substitute for laborious copying.) If you consult with *anyone* about the experiment (e.g. students in your lab class other than your lab partner), that consultation should be acknowledged in your report. Do *not* borrow or lend a completed lab book or any portion of one.

V. PAPERS: Refer to the statement "Principles of Intellectual Honesty" in the Student Handbook.

Syllabus		Phys 338	Spring 2024
Jan.	23	Introduction & Overview	
	25	Magnetic Susceptibility	
	30	Linear curve fitting	
Feb.	1	Nonlinear curve fitting	
	6	Electron Spin Resonance	
	8	*ESR, continued*	Susceptibility Report
	13	*ESR, continued*	
	15	Iodine Spectroscopy	
	20	*Iodine, continued*	ESR Report
	22	Writing a Journal Article	
	27	*Iodine Analysis*	
	29	*Iodine, continued*	Iodine first draft
Mar. *Virtual*	5	*Iodine, continued*	
Virtual	7	*Iodine, continued*	
	11–15	*Spring Break*	
	19	Peer Review	Iodine second draft
	21	Fourier Analysis	Peer review reports
	26	*continued*	
	28	*continued*	Iodine final report
Apr.	2	Fourier Project introduction	Fourier Analysis Report
	4	*Project, continued*	
	9	*Project, continued*	
	11	*Project, continued*	
	16	*Project, continued*	Project first draft
	18	Peer Review	Peer review reports
	23	Superconductivity	
	25	*Superconductivity, continued*	Fourier Project Report
	30	*Superconductivity, continued*	
May	2	*Superconductivity, continued*	
	7		Superconductivity Report Due