Physics 112—General Physics II: Electricity, Magnetism, and Optics
Section 1, MFW 11:00 a.m. – 11:50 a.m.
Section 2, MFW 1:10 p.m. – 2:00 p.m.
Course Description, Spring 2022

Instructor:	Andrew Dougherty
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E-mail:	doughera@lafayette.edu
Web Page:	`http://workbench.lafayette.edu/~doughera/`
Course Web Page:	`https://moodle.lafayette.edu/course/view.php?id=22633`

Office Hours: Please feel free to e-mail or call at any time and ask a question or set up an appointment. To start the semester, all meetings outside of class will take place 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=22633`.

Description: Phys 112 is the second semester of an introduction to the foundations of physics, designed primarily for science students who do not require a calculus-based physics course. Topics include electric and magnetic forces and fields, DC circuits, induction, mechanical and electromagnetic waves, optics, and introductory atomic and nuclear physics.

Recognizing and applying physical ideas is stressed; there will also be emphasis on problem solving.

Prerequisites: Phys 111, 131, or 151; Math 125, 141, or 161. Calculus is used occasionally. High school algebra and trigonometry are used extensively.

Texts: You will need two items for the lecture portion of this course: the textbook and the online "Modified Mastering Physics" component. The textbook is *College Physics: A Strategic Approach, 4th edition*, by Randall D. Knight, Brian Jones, and Stuart Field. The online component is "Modified Mastering Physics." More details—including a fully digital option— are available both on our Moodle site, and at `http://workbench.lafayette.edu/~doughera/phys112/text.html`.

The online platform contains both homework problems and a very rich set of study aids, including pre-lecture videos, MCAT prep quizzes, and numerous fully-worked video tutor solutions.

Any additional resources needed will be linked from our Moodle site.

Lab Materials:

There are no specific additional items needed for lab. The lab manual will be distributed digitally, and all lab reports will be submitted online.

Laboratory: The laboratory is an essential part of this class, and successful completion of the laboratory is required in order to pass the course. You are responsible for completing all of the assigned experiments at the scheduled times. If you can not make it to your scheduled lab, please contact your lab instructor as soon as possible.

Supplemental Instruction: Phys 112 participates in the Supplemental Instruction program (SI) run through Lafayette's Academic Resource Hub `https://hub.lafayette.edu`. More information about SI will be posted on the course web site. Lafayette College also offers a number of other resources to support students. See `https://citls.lafayette.edu/student-academic-support/` for more information.

Student Learning Outcomes: The main goal of this course is to help you understand, identify, and apply the fundamental principles of physics in a variety of situations. You should be able to use both qualitative reasoning and quantitative problem-solving skills in applying those principles. A second goal is to help introduce you to the *process* of doing physics, including skills such as developing and testing models, interpreting experimental data, solving problems, and communicating results.

Specifically, upon successful completion of this course, you should be able to

- Calculate the electric potential and field due to simple charge configurations,
- Calculate the magnetic field due to simple current configurations,
- Predict the motion of charges in electric and magnetic fields,
- Build and analyze simple DC electrical circuits,
- Describe phenomena related to electromagnetic induction,
- Describe the characteristics of mechanical, sound, and electromagnetic waves,
- Apply the conditions for constructive or destructive interference of waves,
- Apply simple geometric optics,
- Perform simple quantum energy level calculations, and
- Predict basic properties of some common nuclear decays.

In addition to the outcomes listed above, this course (particularly the lab component) will promote the outcomes from the Natural Sciences section of the Common Course of Study:

- NS 1 Employ the fundamental elements of the scientific method in the physical and natural world by identifying and evaluating a testable scientific hypothesis.
- NS 2 Create and evaluate descriptions and representations of scientific data via equations, graphs, tables, and/or models.

Your Responsibilities:

Read the text. Your text is a critical resource for this class—it is a source of definitions, facts, ideas, explanations, derivations, and worked examples. I do not intend to spend class time simply repeating the text. Instead, class time will be used to *discuss* those ideas, answer your questions, observe demonstrations, do examples, and practice applying those ideas to various physical situations.

Accordingly, you should read the text ahead of time. I have included a detailed daily syllabus so you know what the assigned readings for each day will be.

The text also includes a large number of video resources, including pre-lecture videos and numerous fully-worked out problems. Some of these will be explicitly assigned throughout the course, but you are encouraged to review the offerings with each chapter and make good use of these resources. See the `Study Area` link at our Mastering Physics course site.

Ask questions. If you are confused, it is important that you stop me and try to sort it out rather than falling behind. *Please* interrupt and stop the class whenever anything isn't clear. Remember that if you are confused, there are almost certainly many others who are confused as well, and they would welcome your question.

Do all assigned work. A good rule of thumb is that you should anticipate spending approximately two hours outside of class for each hour in class for a college course. This means you should anticipate spending an average of six hours per week outside of class for physics (not including the lab). Plan ahead. I am here to help. If you start on your homework ahead of time, I will be available to help you if you get stuck. Don't wait until the night before an assignment is due before starting it.

Participate in class. Class time will be used to go beyond merely reading the text. Your active engagement during class can play an important part in helping you to master the material. Class time will also be used to announce changes to the syllabus. I will also post everything to our Moodle site. It is *your* responsibility to keep up.

Tests: There will be three hour-long in-class tests on the dates indicated on the syllabus. There may also be additional quizzes, either announced or unannounced.

Equation Sheet: You will receive an equation sheet with each test. The idea is that you will use your study time to focus on the fundamental ideas and practice doing physics rather than to memorize formulae. A copy of this equation sheet is available on our Moodle site.

Homework Problems: Homework assignments will be due at the beginning of class on the dates indicated on the syllabus. Some assignments will be given and graded using *Modified Mastering Physics*, an on-line system with quick feedback, hints, and guided tutorials. Other assignments will be pencil-and-paper problems; these problems will typically focus as much on the *methods* of solving problems as on getting the right numerical answer. These will be submitted via a third-party website known as Gradescope. There will be more specific instructions as part of the first assignment.

- Problems will be due at the *beginning* of class. **Late homework will normally not be accepted**.
- For written homework, I expect your work to be clearly organized and easy to follow. Your solution should include not just numbers and calculations, but also some text to explain *what* you are doing and *why*. This can usually be quite brief, but it is *your* responsibility to make your reasoning clear; it is not the reader's responsibility to try to figure out what you meant.

    1. Be sure to include your name on each page.
    2. Each problem should be clearly labeled. A common convention is to number problems with chapter and problem number, so that something like "5.32" refers to Chapter 5, problem 32.
    3. For most problems, you should include a figure with clear labels.
    4. Show your work clearly, and include all non-trivial steps. Use words to explain what you are doing and why. This can often be very brief, something like "Use Newton's second law," or "Use conservation of energy since all the forces involved are conservative."

5. Allow plenty of space.
6. Put a box around your final solution, including correct units.
7. Scan your work using a scanner app and upload it following the upload instructions in the assignment. Don't just take a photo. Scans work much better. The first homework assignment includes pointers on making good scans.

These guidelines are intended to help you present your work effectively. The problem-solving approach discussed in the text (see pg. 51) goes into more detail, but remember that the goal is to convey your solution in a convincing way to the reader.

- **Illegible papers will not be accepted**. If I have difficulty reading or understanding your work, I may return it to you ungraded for re-submission. You may resubmit a legible version (along with the original) by the next class meeting, but that version must not have any new content—it must simply be a legible version of the original.
- Please look at the homework problems ahead of time and ask questions about them either in or out of class. I am happy to give whatever help you need, but it is important that you eventually learn to do these problems on your own—after all, that's what you will have to do on the tests.

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. I encourage you to collaborate with each other on homework, but unless specifically directed otherwise, all work you turn in *as* your own should *be* your own.

Academic dishonesty can hurt you in many different ways. First, of course, it is wrong to turn in someone else's work as your own. If you get caught, the penalties can be severe. Second, it hurts your grade. Learning to do problems by yourself is the best preparation for the tests. Students who take the "easy" way out and get excessive or inappropriate help from others tend to get significantly lower grades on the tests.

There are a variety of resources available to help you in your study of physics. These include office hours, SI, tutoring through the Hub, and working with classmates. 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 collaborators must be acknowledged (apart from your instructor), and all work you turn in must be your own. Copying an answer without acknowledgement from another source, such as CourseHero, Chegg, or Bartleby, 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.

Final Exam: There will be a comprehensive final exam at a time to be arranged by the registrar. *Please do not make travel plans that conflict with the scheduled exam time.*

Grades: Your grade will be based on homework (20%), laboratory (20%), tests (40% total) and final exam (20%). The lowest test or final exam score will only count as half of the usual total. If the lowest score is one of the three tests, than that test will only count for 8% of the total, and the two remaining tests will each count for 16% of the total (for a total of 40% for the tests.) If the final exam is the lowest score, it will only count for

10%, and the test average will count for 50%. The lowest homework assignment will also be dropped. Feel free to ask questions about how your grade is determined.

COVID-19 Considerations: There is much that is uncertain about this semester, but we will do best when we recognize that we are all in this together. Everyone is expected to follow College guidance regarding masking, attendance, and other campus protocols. If you feel ill, please do not come to class. Contact me and we will work out appropriate arrangements. If we need to switch to online classes for a time, we will use the Zoom link on our Moodle page. In short, we may all need to be flexible.

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.

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 2022
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Time	Mon.	Tues.	Wed.	Thurs.	Fri.
9:00 9:30					
10:00 10:30	*prep*		*prep*		*prep*
11:00 11:30	**Phys 112** HSC 100		**Phys 112** HSC 100		**Phys 112** HSC 100
12:00 12:30	*prep*		*prep*		*Physics Club*
1:00 1:30	**Phys 112** HSC 100		**Phys 112** HSC 100	**Phys 218 Lab** HSC 042	**Phys 112** HSC 100
2:00 2:30	*Office Hour*				
3:00 3:30					
4:00 4:30	**Phys 151 Lab** HSC 119	Committee Meeting	*Physics Club*	*Office Hour*	
5:00 5:30					
6:00 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		Physics 112	Spring 2022
Jan.	24	Introduction; Oscillation Review	Ch. 14
	26	Traveling Waves	Ch. 15:1–3
	28	Sound & Light Waves; Energy; HW #1	Ch. 15:4–5
	31	Doppler Effect; Superposition	Ch. 15:7, 16:1–2
Feb.	2	Standing Waves	Ch. 16:3–4
	4	Interference; Beats; HW #2	Ch. 16:6–7
	7	Electromagnetic Waves; Interference	Ch. 17:1–3
	9	Single Slit Diffraction	Ch. 17:5
	11	Thin Films; HW #3	Ch. 17:4
	14	Reflection and Refraction	Ch. 18:1–4
	16	Lenses	Ch. 18:5,7
	18	Optical Instruments; HW #4	Ch. 19:1–7
	21	**Hour Exam I**	Chs. 15–19
	23	Electric Charge	Ch. 20:1–2
	25	Coulomb's Law	Ch. 20:3–4
	28	Electric Field	Ch. 20:5–6
Mar.	2	Forces and Torques	Ch. 20:7
	4	Electric Potential Energy; HW #5	Ch. 21:1–2
	7	Electrical Potential and Field	Ch. 21:3–5
	9	Capacitors and Dielectrics	Ch. 21:6–8
	11	Electric Current; Batteries; HW #6	Ch. 22:1–3
	14–18	*Spring Break*	
	21	Resistance; Power	Ch. 22:4–6
	23	Circuits; Series and Parallel	Ch. 23:1–3
	25	DC Circuits	Ch. 23:4–5
	28	Capacitors; RC Circuits; HW #7	Ch. 23:6–8
	30	**Hour Exam II**	Chs. 20–23
Apr.	1	Magnetic Force and Field	Ch. 24:1–3
	4	Sources of Magnetic Field	Ch. 24:4
	6	Forces on Charged Particles and Currents	Ch. 24:5–6
	8	Torques; Magnetic Materials; HW #8	Ch. 24:7–8
	11	Magnetic Flux	Ch. 25:1–3
	13	Faraday's Law	Ch. 25:4–5
	15	Electromagnetic Waves; HW #9	Ch. 25:6–7
	18	Photons; Particles	Ch. 28:1–4
	20	Quantization; Uncertainty	Ch. 28:5–8
	22	The Hydrogen Spectrum; HW #10	Ch. 29:1–3
	25	**Hour Exam III**	Chs. 24, 25, and 28
	27	The Bohr Model; Quantum Mechanics	Ch. 29:4–7
	29	Nuclear Physics; HW #11	Ch. 30:1–3
May	2	Radioactivity and Half Life	Ch. 30:4–5
	4	Applications	Ch. 30:6–7
	6	*Final Review*; HW #12	

Final Exam (cumulative)