

SYLLABUS

Meeting Times

Lectures: MWF, 8:00-8:50 am
Room: Hugel Science Center 100
Office Hours: M 1:30 pm - 3 pm
T 10:30 am - 12 pm
F 2:30 pm - 4 pm

Contact Information

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Course Overview This course is a calculus-based introduction to the foundations of electricity and magnetism, intended for students majoring in science or engineering. Our emphasis will be on identifying, understanding, and applying the fundamental principles of electric fields and potentials, basic circuits, magnetic fields, and electromagnetic waves.

Learning Outcomes By the end of this course, you will be able to

- understand that the goal of physics is to comprehend phenomena in the physical world
- demonstrate the ability to formulate a testable hypothesis based upon acquired physical data
- collect and analyze experimental data relevant to testing a hypothesis
- evaluate whether the evidence supports, refutes, or leads to the revision of the hypothesis
- create, interpret, and critically evaluate graphs, tables, and models of physical data
- understand scientific uncertainty and how it is reduced with additional data acquisition and hypothesis testing
- distinguish between scientifically testable ideas and opinion
- understand, identify, and apply the fundamental principles of physics in various physical situations
- use qualitative reasoning and quantitative problem-solving skills in applying those principles
- apply Maxwell's equations and the principles of waves to appropriate physical situations
- engage in the process of *doing* physics, including such tasks as developing and testing models, interpreting experimental data, solving problems, and communicating results

Prerequisites PHYS 131 or 151, MATH 162 or permission of instructor

Course Texts

University Physics with Modern Physics, 14th ed. by Young and Freedman
with *Mastering Physics*

*If you did not purchase with *Mastering Physics* with the text, you can buy it online at
<http://www.MasteringPhysics.com/>)

Physics 133 Laboratory Manual

Course Policies Attendance is mandatory and I encourage you to read the relevant sections of the text *before* class so that the material is not completely unfamiliar to you when we start discussing it together. I know an 8 am class is early, but if I can drag myself out of bed to be here, so can you. (Plus, as students, you have the added perk of being able to show up in pajamas if you want to. Lucky you.)

Grading Grades are determined on the following basis:

Problem Sets:	30%	Mid-term Exam I:	10%
Labs:	20%	Mid-term Exam II:	10%
Final Exam:	20%	Mid-term Exam III:	10%

Laboratory The laboratory is an essential part of this course. There you will see and experiment with many of the concepts we cover in class and learn how to approach, analyze, and communicate details of an experiment. You **must** complete all of the assigned experiments. Details will be provided by your laboratory instructor.

Assignments

Problem Sets: Homework will be assigned on a weekly basis and will generally be due on **Wednesdays**, turned in **to me** at the start of class (**8 am**). Late assignments are generally not accepted, unless you have received an exemption from me ahead of time. Please plan to manage your time accordingly. I will drop one problem set (typically the lowest) when computing your final grade.

Weekly problem sets will generally consist of a combination of online and written problems. Online problems will be through *Mastering Physics*. For at least one of the written problems each week, you will be required to work as a group. I will assign groups of ~ 4 students and the groups will rotate every 3 weeks or so. For your group problem, **each member must write up the solution *individually* and must include the names of the other group members on the write up**. I encourage you to work with your group on the rest of the problems in the assignment as well! The purpose of these group problems are to introduce you to more challenging and interesting concepts and to give you additional practice developing problem-solving skills and insight into the physics we are studying. Working with a variety of others will help inform your problem-solving by bringing potentially disparate approaches/opinions to the table, forcing you to discuss and debate with one another as you work towards a common solution.

A few notes about assigned problem sets:

- It is to your advantage to do the assigned homework. I have chosen the problems to help *you* learn the material. Physics can be a complicated thing, but repeatedly working with it (and at it) is essential in order to gain physical intuition and get comfortable with the mathematical theory.
- Feel free to use computational aids for some of the mathematics if you prefer, but note that there is some advantage to working things out by hand. Not being able to solve problems "by inspection" could end up hurting you on an exam where you may not be permitted to use computational tools and, frequently, there are mathematical tricks you can use to easily simplify a problem that you will not appreciate if you ask a program to do the work.
- I encourage you to work on these problem sets collaboratively, though I do expect you to take 10-15 minutes to give a problem "the old college try" on your own so you enter into discussion with others having some ideas to contribute. You will make your life easier as well as improve your understanding if you work with others (either by explaining it or having it explained to you). I expect solutions to be written up individually (or, if your handwriting is illegible, typed), and all collaboration should be properly acknowledged.
- I expect your problem sets to be clearly and logically organized. This means that:
 - Each problem should start on a **new** page.
 - Write out the problem (or an abbreviated version containing all relevant information). Draw a picture/diagram if useful.
 - Clearly work out the problem, commenting your work as you go. Problem sets should never contain just the math; use words to describe what you are doing and to reference where in the text an equation came from and why it is relevant.
 - Remember to keep track of units (by writing them out with all your calculations)! Do the units work out as you expect they ought to at the end of a problem? Dimensional analysis is the easiest check to ensure you have tackled the problem correctly.
 - Box your final solutions or major milestones as you do the problem. This makes it easier to grade and also for you to follow your own work when you look it over.
 - Comment on the significance of your answer. (Does it make sense? Is it what you expected? Why or why not?)
 - Attach a cover page to your problem set. This can be the problem sheet or something else, but it should have your name and a clear acknowledgement of all those you have collaborated with on the assignment. This includes fellow students, faculty, SIs, etc. (anyone who you consulted or worked with).
 - Please see me if you have any questions about this! I know it seems a bit ridiculous listed out like this, but I promise that it will serve you well in the long run. Writing in science is different from the traditional humanities paper, but the point is the same: to clearly and effectively communicate something. This will help you to accomplish that.

Exams There will be three in-class exams and a comprehensive final for this class. For each exam, I will provide you with an equation sheet which will be made available ahead of time so you may familiarize yourself with it. On the exams, I want you to demonstrate that you know and understand how to apply the concepts/formulas from class; I want you to focus on the physics, not on memorizing a bunch of formulas.

The point of this class is to understand and be able to use the basic physics principles of electricity, magnetism, and waves, not to memorize the solutions to specific types of problems. Accordingly, exam problems will **not** be identical to any particular homework problems, but they will be based on the same principles and can be solved using similar strategies. Practice (via SI session attendance and homework assignments) will be essential in developing the skills and intuition of the physics needed to do well on exams.

Supplemental Instruction SIs will be holding problem help sessions multiple times during the week. These sessions are useful ways to practice applying the physics we discuss in class.

Accommodations In accordance with Lafayette College policy, reasonable academic accommodation and support services are available to students who have a documented disability. It is your responsibility to provide me with the appropriate paperwork from the Accessibility Services Office. More information is available at <http://attic.lafayette.edu/disability-services>.

Gender Inclusion This is a gender-inclusive classroom. I have been provided with a class roster and your legal names. I will gladly honor any requests to be addressed by a different name or pronoun than appears on the class. Please make me aware of any preferences.

Moodle Privacy Statement Please note that Moodle contains student information that is protected by the Family Educational Right to Privacy Act (FERPA). Disclosure to unauthorized parties violates federal privacy laws. Courses using Moodle will make student information visible to other students in this class. Please remember that this information is protected by these federal privacy laws and must not be shared with anyone outside the class. Questions can be referred to the Registrar's Office.

Federal Credit Hour Compliance 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.

Tentative Lecture Schedule and Associated Readings

Aug. 27	Coulomb's Law	Ch. 21:1-3	
Aug. 29	Electric Fields	Ch. 21:4-5	
Aug. 31	Continuous Charge Distributions	Ch. 21:6-7	
Sept. 3	Electric Flux	Ch. 22:1-2	
Sept. 5	Gauss' Law	Ch. 22:3	PS 1 due
Sept. 7	Applications of Gauss' Law	Ch. 22:4-5	
Sept. 10	Electrostatic Potential Energy	Ch. 23:1-2	
Sept. 12	Electric Potential	Ch. 23:3	PS 2 due
Sept. 14	Equipotential Surfaces	Ch. 23:4-5	
Sept. 17	Capacitance	Ch. 24:1-2	
Sept. 19	Electric Field Energy	Ch. 24:3-5	PS 3 due
Sept. 21	Exam I	Chs. 21-24	
Sept. 24	Electric Current	Ch. 25:1-2	
Sept. 26	Ohm's Law	Ch. 25:3-4	PS 4 due
Sept. 28	Energy and Power in Circuits	Ch. 25:5-6	
Oct. 1	Kirchoff's Rules	Ch. 26:1-2	
Oct. 3	RC Circuits	Ch. 26:4	PS 5 due
Oct. 5	Magnetic Fields	Ch. 27:1-3	
Oct. 8	no class (Fall Break)	-	
Oct. 10	Magnetic Forces on Charges	Ch. 27:4-5	PS 6 due
Oct. 12	Magnetic Forces on Currents	Ch. 27:6-8	
Oct. 15	Bio-Savart Law	Ch. 28:1-4	
Oct. 17	Ampère's Law	Ch. 28:5-6	PS 7 due
Oct. 19	Applications of Ampère's Law	Ch. 28:7	
Oct. 22	Faraday's Law	Ch. 29:1-4	
Oct. 24	Induction	Ch. 29:5-7	PS 8 due
Oct. 26	Exam II	Chs. 25-29	
Oct. 29	Inductance and Magnetic Field Energy	Ch. 30:1-3	
Oct. 31	RL and RLC Circuits	Ch. 30:4-5	PS 9 due
Nov. 2	Mechanical Waves	Ch. 15:1-5	
Nov. 5	Superposition	Ch. 15:6-8	
Nov. 7	Sound Waves	Ch. 16:1-4	PS 10 due
Nov. 9	Resonance	Ch. 16:5-7	

Nov. 12	Electromagnetic Waves	Ch. 32:1-3	
Nov. 14	Energy and Momentum in EM Waves	Ch. 32:4-5	PS 11 due
Nov. 16	Reflection and Refraction	Ch. 33:1-3	
Nov. 19	Polarization and Scattering	Ch. 33:4-7	
Nov. 21	no class (Thanksgiving Break)	-	
Nov. 23	no class (Thanksgiving Break)	-	
Nov. 26	Interference	Ch. 35:1-2	
Nov. 28	Thin Film Interference	Ch. 35:4	
Nov. 30	Exam III	Chs. 15, 16, 30, 32, 33, 35	
Dec. 3	Diffraction	Ch. 36:1-4	
Dec. 5	Diffraction Gratings and Circular Apertures	Ch. 36:5-7	PS 12 due
Dec. 7	Catch-Up/Review	-	

FINAL EXAM (comprehensive): date and time TBD by the Registrar