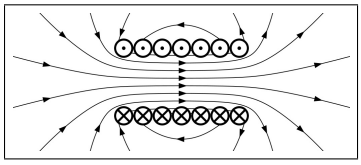

# Physics 152:
# Accelerated Physics II:
# Electricity, Magnetism, and Optics
# Lafayette College
# Spring 2014

### *What This Course Is About*

The catalog says: "An accelerated calculus-based introduction to the study of physics for science and engineering majors; a foundation on which an understanding of physics, physical chemistry, or engineering can be built. Topics include electrostatics, electric currents, magnetostatics, induction, electromagnetic waves, ray optics, interference and diffraction." These topics are all actually manifestations of a single subject, electromagnetism. Why do we spend an entire semester on this one subject?

- Electromagnetism is one of the *four fundamental forces of nature* (along with gravitation, the weak force, and the strong force). Thus it is of intrinsic interest. Further, electromagnetism and gravity are the only two of these forces which have effects which you can see with your own eyes. This makes them the natural subjects of any introductory physics sequence.
- Electromagnetism is all about *fields*. The mathematical and physical techniques used to study electromagnetism can be extended to analyze all other physical forces. It is no exaggeration to say that fields underly nearly all modern work in fundamental physics.

At first glance, this course appears to encompass a wide range of unrelated phenomena. We will see how these things all arise from a small number of fundamental ideas, and how these ideas are incorporated into a small number of equations. This simplicity—the beauty of being able to understand many things with a few simple ideas—is what I love about physics.

I am glad that you are here. I look forward to exploring this subject together with you this semester.

### *Instructor*

Prof. David Nice
Office: Hugel Science Center 020
E-mail: niced@lafayette.edu
Phone: x5204
Homepage: http://sites.lafayette.edu/niced

The instructor for Physics 152 labs is Scott Shelley, Hugel 015, shelleys@lafayette.edu.

### *Course Website*

We will use Moodle, `http://moodle.lafayette.edu`.

### *Course Locations and Times*

Class. Hugel Science Center 142. Monday, Wednesday, Friday; 10:00-10:50.
Lab. Hugel Science Center 142. Tuesday, 1:10-4:00.

### *Office hours*

I will have weekly office hours:

- Monday 3:00-4:30
- Tuesday 11:30-12:30 & 3:00-4:00
- Wednesday 3:00-4:30

Office hours are a great time to stop by for questions about course material, homework problems, or anything else related to the class. If you wish to meet, but have conflicts with my scheduled office hours, E-mail me to schedule an appointment, or just stop by and try your luck.

### *Texts and other references*

The following text is required and is available at the college bookstore:

- H. D. Young and R. A. Freedman. *University Physics with Modern Physics.* 13th edition. Pearson. ISBN 978-0-321-69686-1. This is the same text used in Physics 151 and in the Physics 131-132-133 sequence. We will not use MasteringPhysics (which is used in 131-132-133 but not 151-152).

The following books may be useful references if you want different perspectives on the course material. The books by Schey, Purcell, and Moore are available at the reserve desk of Skillman library. The book by Stewart is ubiquitous at Lafayette. (If you don't have a copy yourself, your roommate probably does.)

- H. M. Schey, *Div, Grad, Curl, and All That.*
- E. M. Purcell & D. J. Morin, *Electricity and Magnetism,* 3$^{\text{rd}}$ edition.
- T. A. Moore, *Six Ideas that Shaped Physics, Unit E.*
- J. Stewart, *Calculus*, chapter on vector calculus (6$^{\text{th}}$ ed.: chap. 17; 7$^{\text{th}}$ ed.: chap. 16).

### *Prerequisites*

The prerequisite for this course is Physics 151 or permission of the instructor. The corequisite is Math 162, i.e., you should be taking Math 162 now if you have not already taken that class or seen the material elsewhere.

### *Homework*

There will be weekly homework assignments. Homework papers will be due on Wednesday at 5 p.m. in a bin in the hallway near my office door. Late homework papers will be accepted for 50% credit through Friday at 5 p.m.

If you cannot complete a homework due to illness, family emergency, or similarly compelling reason, please contact me. (Also see the section on "Dean's excuse policy" in the Student Handbook.)

I *strongly* encourage you to work with other students on the homework. Try the problems yourself. When you get stuck, talk to someone else about them. Physics is hard. You won't get all the problems on your own. Working with others is absolutely essential in advanced physics classes.

I will have extensive office hours. They are purposely scheduled on days before homework is due. Please come and visit if you are having difficulty on homework. I am happy to help.

### *Labs*

Labs will meet weekly.

You will need a lab notebook, which you and your lab partner will share. You may continue to use your notebook from Physics 151.

Lab writeups will be distributed in class.

### *Exams*

There will be two midterm exams. They are scheduled for Friday, March 7, and Friday, April 25. You will have one hour and fifty minutes for each of these exams, including 60 minutes before or after the regular class time on that day. (If you have schedule conflicts before and after class time, we will find an alternate time later that day.)

There will be a three hour final exam at a time set by the registrar.

Exams will be closed book with equation sheets provided. I will make copies of the equation sheets available in advance of each exam. I will post exams from last year on Moodle.

Exam questions will resemble homework problems. Each midterm exam will be on the material covered in the preceding weeks of class (i.e., since the previous midterm exam). The final exam will cover all course material, with a slight bias towards material covered after midterm #2.

### *Grading*

There must be grades. Your grade will be based on:

| | |
|---|---|
| Lab | 10% |
| Homework | 20% |
| Midterm Exam #1 | 20% |
| Midterm Exam #2 | 20% |
| Final Exam | 30% |

Lab work, class participation, effort level, etc., will be factored into your final grade after your score is calculated as above. This will be most important if you are on the border between two grades.

### *This is not Physics 151*

Physics 151 and Physics 152 are designed to provide a comprehensive introduction to physics. However, the two courses are taught by two different instructors whose course policies may differ. Please do not assume a policy applies in Physics 152 because "that is how we did it in Physics 151." When in doubt, ask.

### *What to call me*

Please, let's all use first names. Call me David.

### *Course goals and topic coverage*

The goal of Physics 152 is to give you an understanding of the fundamental ideas which arise from the theory of classical electromagnetism, particularly those topics listed below.

The schedule will evolve as the semester progresses. Specific topic and text coverage will be given

on the weekly homework assignments.

We will introduce certain mathematics techniques that extend beyond those used in the textbook. The use of these techniques simplifies calculations and increases understanding of physics concepts. Specifically, we will introduce three-dimensional vector operations—divergence, gradient, and curl—to aid in analyzing and picturing electric and magnetic fields. We will introduce complex number representations of oscillating functions to simplify the analysis of alternating current circuits.

| Topic | Text Chapters* | Approximate number of classes |
|---|---|---|
| Electric force and field | YF21 | 3 |
| Flux; Gauss's law; Divergence | YF22 | 4 |
| Electric potential; Gradient; Laplacian | YF23 | 4 |
| Capacitance; Dielectrics | YF24 | 2 |
| Current; Resistance | YF25 | 2 |
| DC circuits | YF26 | 2 |
| Magnetic force | YF27 | 2 |
| Magnetic fields | YF28 | 3 |
| Curl; Induction | YF29 | 3 |
| Induced fields and currents | YF30 | 2 |
| AC circuits | YF31 | 3 |
| Properties of Waves | YF33† | 1 |
| Geometric optics | YF34† | 2 |
| Maxwell's Equations; Electromagnetic Waves | YF32† | 3 |
| Interference; Diffraction | YF35 | 3 |
| Limits of Classical Physics | | 1 |

*YF=Young & Freedman, *University Physics*
†Chapters covered out of sequence

### *Outcomes*

After completing this course, you will be able to....

- Analyze the behavior of particles in response to electric and magnetic fields.
- Understand the connection between potentials, fields, and sources.
- Use divergence, gradient, and curl operations.
- Understand the interrelation of electric and magnetic fields through Maxwell's equations.
- Construct and analyze AC and DC circuits.
- Analyze optical systems with one or more lenses.
- Analyze the behavior of systems exhibiting interference.

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

- NS1. Understand that the goal of science is to comprehend phenomena in the physical and natural world.
- NS2. Employ the fundamental elements of the scientific method:

  - NS2a. Demonstrate the ability to recognize and/or formulate a testable hypothesis based upon observations or existing scientific data;
  - NS2b. Generate, collect, and analyze evidence relevant to testing a hypothesis;
  - NS2c. Evaluate whether the evidence supports or refutes the hypothesis or leads to the development of a new line of inquiry and/or a revision of the original hypothesis.
- NS3. Create, interpret, and critically evaluate descriptions and representations of scientific data including graphs, tables, and models.
- NS4. Understand scientific uncertainty and how it is reduced with additional data acquisition and hypothesis testing.
- NS5. Distinguish the difference between scientifically testable ideas and opinion.

### *Intellectual honesty*

You are expected to abide by the principles of intellectual honesty outlined in the Lafayette Student Handbook (available from http://studentlife.lafayette.edu).

Learning is a collaborative process. Discussion and collaboration on homework in this course is very strongly encouraged. "Collaboration" does not mean "copying." You must understand and individually write out your answer to each problem.

Exams must be done on your own, using only materials specifically allowed. Exam procedures will be discussed in detail before each exam.

### *Accommodation*

*My policy.* It is important to me that you do well in this class. If you have any disabilities which you feel may interfere with your ability to succeed and prosper in this class, please contact me to discuss ways of accommodating them.

*Mandatory statement for any Lafayette course with a disability policy.* In compliance with Lafayette College policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. Requests for academic accommodations need to be made during the first two weeks of the semester, except for unusual circumstances, so arrangements can be made. Students must register with the Office of the Dean of the College for disability verification and for determination of reasonable academic accommodations.

### *Mandatory Moodle privacy statement*

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.

### *Mandatory credit hour statement*

The student work in this course is in full compliance with the federal definition of a four credit hour course.