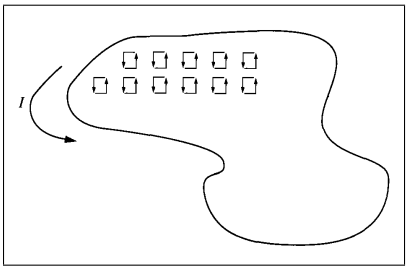
Physics 342
Electromagnetic Fields
Lafayette College
Fall 2021



Course operations

Instructor

Prof. David Nice
Hugel Science Center 030
niced@lafayette.edu
`http://sites.lafayette.edu/niced`

Locations and Times

Class meets Monday, Wednesday, and Friday, 10:00-10:50 in Hugel Science Center.

At the start of the semester, we will schedule "fourth hour" meetings for small-group problem-solving

Covid-19

We will follow College guidance regarding protocols required by the Covid-19 pandemic. For example, masks will be required in the first weeks of the course.

Should we need to pivot to remote teaching at any point during the semester, we will use Zoom at `https://lafayette.zoom.us/j/96657524873`. This same link will be used for any other Zoom meetings related to this class, whether group sessions or one-on-one meetings.

Should you need to be in isolation at any point during the semester, please contact me as soon as possible. We will work out accommodations on a case-by-case basis.

Website

Handouts, homework assignments, etc., will be distributed on paper and posted on Moodle.

Office hours

Office hours are a great time to discuss questions about course material, homework problems, or anything else related to the class.

My office hours will be set shortly after the start of the semester and will be posted on Moodle. I am often available to meet at other times, so feel free to E-mail any time you would like to talk, or just stop by and try your luck.

Text

We will use the following texts:

- *Introduction to Electrodynamics* by David Griffiths, 4th edition, ISBN 9781108420419.
- *Div, Grad, Curl, and All That* by H. M. Schey, 4th edition, ISBN 9780393925166.

The texts are required, but you may access them however you wish. You can use a printed copy (used or new), an eText, or maybe you can find a pdf of the text somewhere. Whatever works best for you is fine.

Homework

There will be weekly homework assignments. They are the heart of this course. You don't learn physics by reading about it, or by hearing lectures about it, or by watching someone else do it. You learn it by doing it yourself: doing real experiments in lab and doing real calculations in homework.

Homework assignments will be due on paper in class on Fridays. Each homework problem will be given one of two designations:

- *Checked for completion.* Normally five points per problem. These will be looked at only cursorily and will be given full credit if they appear to be complete.
- *Fully checked.* Normally ten points per problem. These will be fully checked. Neatness, readability, and organization will count for 20% of the scores on these problems.

This system may evolve over the course of the semester.

Late papers will be accepted through the following Monday. Late homework may be penalized by 50%. If you are having difficulty completing an assignment on time, please contact me. I can make accommodations in cases of illness, personal difficulties, etc.

You know this already, but I say it anyway. 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 in groups is a powerful way to learn. It is also more fun.

Please take advantage of office hours if you have questions about the homework. I am happy to help. Often there will be other students there with questions similar to yours. I expect that most of you will take advantage of office hours sooner or later during the semester.

Exams

There will be two midterm exams:

- Midterm exam #1. Friday, October 8 (the day before fall break)
- Midterm exam #2. Monday, November 22 (Thanksgiving week)

Each exam will be 1 hour and 50 minutes. Ideally, you will start one hour before the normal class start time or else you will end one hour after the normal class end time. If neither of these is possible, we will find an alternative time for you to take the exam. My goal in having exam periods longer than class periods is to reduce time stress during the exams.

Each midterm exam will be on the material covered in the preceding weeks of class (i.e., since the previous hour exam). Further details will be given before each exam.

There will be a comprehensive final exam during finals week covering all material in the course. The final exam will be three hours and will be scheduled by the Registrar.

Details of exam logistics (e.g., reference materials allowed during the exam) will be given in advance of each exam.

Grading

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

Homework	30%
Midterm Exam #1	20%
Midterm Exam #2	20%
Final Exam	30%

I will post homework and exam grades on Moodle. The exam grades may be re-scaled depending on the difficulty of the exam. I will use the following numerical score when setting letter grades:

A	92.500 and higher	B−	79.500−82.499	D+	66.500−69.499
A−	89.500−92.499	C+	76.500−79.499	D	62.500−66.499
B+	86.500−89.499	C	72.500−76.499	D−	59.500−62.499
B	82.500−86.499	C−	69.500−72.499	F	59.499 and below

Overview

From the college catalog: Electric fields due to static charges, magnetic fields due to steady currents, fields in matter, Laws of Coulomb, Gauss, Biot-Savart, Ampere, Faraday; scalar and vector potentials; solutions of Laplace's and Poisson's equations. Mathematical emphasis is on the solutions to boundary value problems.

Prerequisites

Math 264, Physics 218

Course goals

The goals of this course are to develop a deep understanding of the fundamentals of electromagnetism and to learn and apply mathematical techniques applicable to a wide range of vector and field problems. We will achieve these goals by coverage of the topics listed below.

Topic Coverage

The table below is an approximate weekly schedule of topic coverage. This will evolve over the course of the semester. A weekly list of topics will be given on each homework set.

Week	Dates	Topic	Text
1	Aug. 30–Sep. 2	Electrostatic fields 1	Griffiths §2.1–2.2
2	Sep. 6–10	Vector calculus; Electrostatic fields 2	Griffiths §1.2–1.3; §2.1–2.2; Schey
3	Sep. 13–17	Potential, work, energy	Griffiths §2.3–2.5
4	Sep. 20–24	Calculating potentials 1	Griffiths §3
5	Sep. 27–Oct. 1	Calculating potentials 2	Griffiths §3
6	Oct. 4–8	Electric fields in matter 1; *Midterm #1*	Griffiths §4
7	Oct. 11–15	*Fall break*; Electric fields in matter 2	Griffiths §4
8	Oct. 18–22	Magnetostatics 1	Griffiths §5
9	Oct. 25–29	Magnetostatics 2	Griffiths §5
10	Nov. 1–5	Magnetic fields in matter 1	Griffiths §6
11	Nov. 8–12	Magnetic fields in matter 2	Griffiths §6
12	Nov. 15–19	Electrodynamics 1	Griffiths §7
13	Nov. 22–26	*Midterm #2*; *Thanksgiving break*	
14	Nov. 29–Dec. 3	Electrodynamics 2	Griffiths §7
15	Dec. 6–10	Electromagnetics waves	Griffiths §9

Outcomes

After completing this course, you will be understand the fundamentals of electromagnetism, and you will be able to apply a wide range of problem-solving techniques. Among other things, you will be able to:

- Use vector calculus concepts such as Stokes' Theorem and Gauss's theorems
- Calculate electric fields for a variety of charge distributions
- Calculate potentials based on charge distributions
- Calculate potentials based on boundary conditions
- Understand and use multipole expansions in approximate-field calculations
- Understand and calculate properties of polarized materials
- Calculate magnetic fields for a variety of current sources
- Understand and use the vector potential
- Understand and calculate fields of magnetized materials
- Understand the interrelation of electric and magnetic fields
- Use Maxwell's equations to derive the wave equation

Course policies

Intellectual honesty

You are expected to abide by the principles of intellectual honesty outlined in the Lafayette Student Handbook available at `http://conduct.lafayette.edu`.

Learning is a collaborative process, I encourage you to discuss and collaborate with other students on homework. "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.

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.