

# Physics 351: Electricity and Magnetism

Fall 2019

*“I have also a paper afloat, with a electromagnetic theory of light which, till I am convinced of the contrary, I hold to be great guns.”*

– James Clerk Maxwell

Welcome to Physics 351! In this class we will study charges, currents, electric and magnetic fields, and their interactions. Much of the physics is expressed in a single, remarkable set of equations

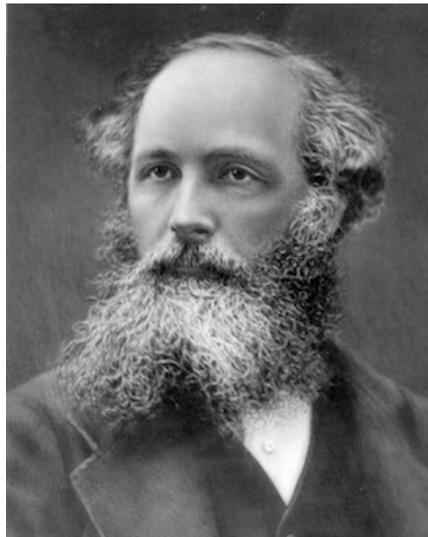
$$\vec{\nabla} \cdot \vec{E} = \frac{1}{\epsilon_0} \rho$$

$$\vec{\nabla} \times \vec{E} + \frac{\partial \vec{B}}{\partial t} = 0$$

$$\vec{\nabla} \cdot \vec{B} = 0$$

$$\vec{\nabla} \times \vec{B} - \mu_0 \epsilon_0 \frac{\partial \vec{E}}{\partial t} = \mu_0 \vec{J}$$

This formulation of electromagnetism is due primarily to the Scottish physicist James Clerk Maxwell. His equations, in one form or another, describe phenomenon ranging from the propagation of light to the deflection of a compass needle by a magnetic field.



*James Clerk Maxwell (1831-1879)*

The impact of Maxwell's equations extends well beyond electromagnetism. The Theory of Special Relativity is secreted away inside them, and they are the prototype for a unified description of the basic forces of Nature.

## ■ Basic Information

PROFESSOR: Dr. Robert McNees. I'm the professor. You can call me "Bob" or "Dr. McNees." (You should always address faculty as "Doctor" or "Professor," as appropriate, unless they explicitly tell you otherwise.)

EMAIL: [rmcnees@luc.edu](mailto:rmcnees@luc.edu). You *must* use your "@luc.edu" address when sending me an email. Emails sent from outside accounts sometimes get blocked by Loyola's mail servers!

OFFICE: Cudahy Science 308. Official office hours will be announced, but I have an open-door policy for E&M students and you can drop by anytime. If you have a busy schedule and want to make sure I'm available, you can email or call my office phone: 508-7570.

LECTURES: MWF from 11:30-12:20 in Cudahy 313.

DISCUSSION: Friday from 10:25-11:15 in Cudahy 313.

WEBSITE: <http://jacobi.luc.edu/p351.html>. We will not use Sakai in this course.

## ■ Course Information and Policies

### Objectives

The goal of Physics 351 is to build a sophisticated understanding of electric and magnetic phenomenon. You will develop a facility with these concepts that allows you to model basic physical systems in more detail than the examples you encountered in introductory courses. Mastering the material in this course will prepare you to study electrodynamics at the graduate level, if you decide to go on to grad school.

The prerequisites for this course are Phys 235 and 301. We will rely heavily on concepts and skills you learned in those courses and their prerequisites, especially material from Math Methods (Phys 301), Multivariable Calculus (Math 263), and Differential Equations (Math 264). You should already feel comfortable with the following:

- Vector calculus
- Line, surface, and volume integrals
- Fundamental theorems associated with the div, grad, and curl differential operators
- Techniques for solving ordinary and partial differential equations

If you feel rusty, please take time to review this material.

We will cover the first seven chapters of the textbook, and most of chapters eight and nine. This includes vector analysis, electrostatics, potentials, special techniques for solving the Laplace and Poisson equations, electric fields in matter and the physics of dielectric materials, magnetostatics, magnetic fields in matter and magnetization, electrodynamics, conservation of charge and energy, Poynting's theorem, momentum of electromagnetic fields, and electromagnetic waves.

## Textbook and Materials

The main text for the class is *Introduction to Electrodynamics* (4<sup>th</sup> edition) by Griffiths. Homework assignments are not taken from the book, so you should be fine using the 3<sup>rd</sup> edition if you can get a copy. The tone of the book is casual and you will probably find it to be pretty accessible. When I was an undergraduate I used the books by Wangsness and Purcell. Those texts might be useful if something in Griffiths isn't clear. The classic book by Purcell was recently released in a new edition. I have not used that one, but the original is very good. A more advanced treatment is given in Jackson's *Classical Electrodynamics*, which is the text for practically every graduate E&M course. You can find links to all these books on the [course website](#).

Griffiths' book has a very complete (for our purposes) discussion of vector calculus as it is used to describe electricity and magnetism. If you'd like to see additional discussions of this material, I recommend the book *Mathematical Methods in the Physical Sciences* by Boas, or *Mathematical Methods for Physics and Engineering* by Riley, Hobson, and Bence. For a more advanced treatment refer to *Mathematical Methods for Physicists* by Arfken and Weber. Links to those books can also be found on the course website.

From time to time I will supplement the material from the book with my own notes. I will post these as pdf files in the [Notes section](#) of the website.

## Meeting Times and Locations

Lectures take place MWF from 11:30 - 12:20, in Cudahy Science Building 313. The discussion section meets Friday from 10:25-11:15 in the same room.

## Lecture and Discussion Sections

Class will meet three times each week for lectures, and once each week for a discussion section. **Attendance at weekly lectures and the discussion section is mandatory.** During the lectures we will talk about the material, work through examples, and ask each other lots of questions. Notice that I said "ask each other". You're going to get a lot of questions from me, and I expect to get a lot of questions from you. The weekly discussion section will be devoted to discussing the current homework assignment or additional material that is somewhat outside the scope of the lectures. During exam weeks it will be used in combination with the subsequent lecture to give more time for exams than a 50 minute class period.

## Office Hours

I have an open-door policy for E&M students: You can drop by my office any time with questions about homework or course material. If I am busy I will arrange another time for us to meet. There will also be official office hours each week, with times announced in class and posted in an updated version of this syllabus. My office is in room 308 of Cudahy Science Building.

## Expectations

I expect you to arrive to class ready to discuss the material. That means you should read ahead of the lecture for any material covered in the text. Homework will be posted weekly, and you should start working on it as soon as it is posted. *Do not* wait for us to go over all the material before you start. Instead, work on the homework and identify any questions you might have, so they are fresh in your mind during lecture.

## Special Circumstances and Accommodations

Please speak to me if you have any concerns about the course material or your ability to follow course policies. You can reach me by email or you can stop by my office. Rules for schedule conflicts and make up exams are outlined elsewhere in the syllabus, but you should always let me know if something happens that interferes with your ability to participate in the course. If you need special accommodations for quizzes and exams you should speak with me as soon as possible, and no later than one week in advance. Once I have the appropriate paperwork from SSWD (<http://www.luc.edu/sswd/>) we can make the necessary arrangements.

## Intellectual Property

All lectures, notes, assignments, solutions, and other instructional materials in this course are the intellectual property of the professor. As a result, they may not be distributed or shared in any manner – on paper, electronically, or otherwise – without my explicit written permission. Lectures may not be recorded without my written consent; when consent is given, those recordings may be used for review only and may not be distributed. **Sharing copies of homework assignments, solutions, or exams with anyone who is not enrolled in the course is not allowed. Providing these materials to students who may enroll in the course at a later date will be considered a violation of Loyola's academic integrity policy and will be reported to the department and the college.** Recognizing that your work, too, is your intellectual property, I will not share or distribute your work in any form without your written permission.

## Statement of Intent

By remaining in this course you agree to abide by the rules and policies laid out in this syllabus. Any changes to the syllabus will be announced in class, and the updated syllabus will be posted on Sakai. Missing class is not a valid reason for being unaware of changes to the syllabus.

## ■ Homework, Exams, and Grades

### Homework Assignments

Homework will be assigned each week throughout the semester, except for exam weeks, with occasional gaps due to holidays. I expect that there will be a total of twelve (12) homework assignments. Each assignment must be handed in at the beginning of class on the day that it is due, or else delivered to my office mailbox by the appropriate deadline. Emails of scanned homework will not be accepted. If you work on a tablet and print out your assignments, make sure that the full page was printed with no material cut off at the borders. Late homework will not be allowed.

Homework in this class is absolutely essential. You have to do every single problem (along with examples from the lectures and book, extra problems for things you find tricky, etc) to master the skills we're trying to develop.

You should definitely discuss the homework assignments with your classmates – you might be able to clarify a tough concept for them, or they might point out a good strategy for a confusing problem. But after working together, you must go back and complete the problems on your own. If your solutions look like they were copied from someone else's work then you need to redo it from scratch. If you can't explain each step of your solution then you haven't completed the problem on your own. That is the only way to be sure that you are ready for the exams, and, more importantly, the only way to know if you understand the material.

Do not, under any circumstances, hand in homework copied from another student, a solutions manual, or some source you found on the internet. There are lots of reasons I am telling you this. First, it's cheating, and I may have to report it to the department chair. (I know, I just told you to work together. That's why taking what you learned and working out the solution on your own is so important. Don't worry; I can tell the difference between working together and copying.) Second, and more importantly, you don't learn anything that way. Obviously you don't learn anything from copying a classmate's homework. You have to be able to do this stuff on the exams, and copying won't prepare you for that. Third, you don't get much (or any) benefit when you piggyback on a solution that you find online or in a manual. Finding material that you can adapt to another problem is a useful skill, but it's not the one we're trying to develop here. Part of understanding the material in this course is figuring out how to deploy it to solve different kinds of problems or model new situations. You only develop that skill by trying different things, playing around with a problem, maybe putting it down for a while and coming back to it later.

Do the homework yourself. In every class I've ever taught, students who relied on solutions manuals, online resources, or copying from classmates ended up doing poorly on the exams.

### **A Warning**

Never, ever hand in an assignment that you copied from a solutions manual or found online. You won't learn anything that way, and it will earn you an automatic grade of "zero" for that assignment. If it happens more than once it will be reported to the Department Chair and the Dean. Consider yourself warned.

### **Exams**

There will be two exams and a final exam. I expect that the exams will be held on October 4 and November 15. It is possible that these dates will change after we've had a chance to talk about everyone's schedule. The material covered on these exams will be discussed in class. The final exam, which is comprehensive, will be held on Monday, December 9, from 1-3 PM.

### **Grades**

Grades in the course are primarily determined by homework assignments and exams. The weekly homework grades contribute 35% of your final grade in the class, and two "midterm" exams (dates TBA) count 15% each. A cumulative final on Friday, December 9 (from 1:00-3:00 PM) is worth 30%. The remaining 5% depends on your attendance and participation. To receive the full 5% you should do two things that show me you are engaging the material and thinking about what we're doing. First, you must regularly attend lectures and discussion sections. Second, you should ask questions. This can happen either in class, discussion, or office hours. There is no minimum number of questions you need to ask, and if you don't like to speak up in class you can ask them during office hours. In any case, you *must* visit me during office hours at least once during the semester, with a question related to something we've done in class. As long as you do these things, you get the 5%.

Once your grades have been added up and converted to a percentage, your final grade will be assigned according to the following table:

Percentage	Letter Grade
100 – 92	A
91 – 90	A–
89 – 88	B+
87 – 82	B
81 – 80	B–
79 – 78	C+
77 – 72	C
71 – 70	C–
69 – 68	D+
67 – 62	D
61 – 0	F

So, suppose you finish the class with a 91% average on the homeworks, grades of 85% and 82% on the two exams, and an 89% on the final. You attended the lectures, came to office hours a few times, and asked questions, so you get the full 5% for participating. Then your final grade would be

$$91\% \times 0.35 + 85\% \times 0.15 + 82\% \times 0.15 + 89\% \times 0.30 + 5\% = 88.6\%, \quad (1)$$

which earns you a B+.

### **Makeups and Absences**

If you must miss one of the exams due to illness, emergency, or a Loyola-approved activity, let me know as soon as possible and we will schedule a make up. You will need to provide written documentation (from a doctor, for instance, or the university if you are traveling for an event) before the make up exam will be administered. The documentation must be relevant to the date you missed class. For Loyola-approved activities you should let me know as far in advance as possible, and no later than one week before the exam.

### **■ Calendar**

We will cover most of the first nine chapters of the textbook, with the exception of parts of chapters 8 and 9. The table below is an estimate of how we'll spend our time.

Week	Dates	Chapter
1	August 26, 28, 30	1
2	September 2, 4, 6	1, 2
3	September 9, 11, 13	2
4	September 16, 18, 20	2
5	September 23, 25, 27	2, 3
6	September 30; October 2, 4	3, Exam 1
7	October 7, 9, 11	<i>Mid-Semester Break, 3</i>
8	October 14, 16, 18	3, 4
9	October 21, 23, 25	4
10	October 28, 30 and November 1	4, 5
11	November 4, 6, 8	5
12	November 11, 13, 15	5, 6, Exam 2
13	November 18, 20, 22	6, 7
14	November 25, 27, 29	<i>7, Thanksgiving Break</i>
15	December 2, 4, 6	9

Please keep in mind that these dates are subject to change. There are two reasons for this. First, I usually teach this course on TTh. We are switching over to MWF, so I may occasionally be ahead of or behind schedule. Second, I may decide to switch things around or spend more or less time on a given chapter. I will always notify you about any changes I make to this schedule.

Other important dates can be [found on the CAS calendar for the Fall 2019 semester](#). Besides the holidays listed on the calendar above, please contact me if you need any accommodations for activities or observances associated with the religious holidays listed below. If I've missed anything please let me know!

Dates	Religious Holidays
September 9-10	Ashura
September 29 - October 1	Rosh Hashanah
September 29 - October 8	Navratri
October 8 - 9	Yom Kippur
October 27	Diwali

## ■ Other Things You Should Know

### Academic Integrity

Any incidence of academic dishonesty on a homework assignment or exam will result in a grade of "O" and will be reported to both the Chairperson of the Physics Department and the Dean of the College of Arts and Sciences.

The full copy of the CAS Statement of Academic Integrity can be found at the end of this syllabus. Please note that sharing homework assignments or exam materials from previous semesters falls under the university's working definition of "plagiarism," and will be treated accordingly.

### **Cell Phones and Other Electronics**

No phones in class, period. Do not send or check text messages. If this becomes a distraction (to me or the other students) you will be asked to leave. Just turn your phone off before class starts.

Please tell me if you have an important reason to leave your phone on, like a sick family member or a kid in daycare. I completely understand, and I'm fine with that. Just let me know before class.

If you feel like you need to use a laptop or tablet in class, be sure you use it for taking notes and nothing else. I will occasionally spot-check laptops and tablets. If I see anything not related to what we're talking about in class, you will be asked to leave. There's a growing body of literature that suggests that taking notes by hand is much better for retention than typing on a laptop. I won't tell you how to take notes, and of course there are lots of good reasons why typing may be your best or only option. But consider trying to write things down instead of typing them if you are able, and see how it works for you.

All electronic devices must be turned off and put away, completely out of sight, during exams. If any such device is visible it will constitute a violation of the academic integrity policy and result in a grade of zero on the exam.

### **Travel and Exams**

Travel plans are not an excuse for missing a quiz or exam. This includes travel plans made by parents, without your knowledge. If you are aware of a pre-existing conflict you must let me know during the first week of class, so we can arrange a makeup. After the first week I will not accept travel conflicts as a valid excuse for missing a quiz or exam. Pay very close attention to that last sentence.

### **Student Support Resources**

- ITS HelpDesk  
[helpdesk@luc.edu](mailto:helpdesk@luc.edu)  
773-508-4487
- Library Subject Specialists  
<http://libraries.luc.edu/specialists>
- Services for Students with Disabilities  
<http://www.luc.edu/sswd/>
- Writing Center  
<http://www.luc.edu/writing/>
- Ethics Hotline  
<http://luc.edu/sglc/aboutus/>  
855-603-6988

## College of Arts & Sciences Statement on Academic Integrity

[Read the statement on the CAS website](#)

A basic mission of a university is to search for and to communicate the truth as it is honestly perceived. A genuine learning community cannot exist unless this demanding standard is a fundamental tenet of the intellectual life of the community. Students of Loyola University Chicago are expected to know, to respect, and to practice this standard of personal honesty.

Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student's work, and submitting false documents.

Academic cheating is a serious act that violates academic integrity. Cheating includes, but is not limited to, such acts as

- Obtaining, distributing, or communicating examination materials prior to the scheduled examination without the consent of the teacher
- Providing information to another student during an examination
- Obtaining information from another student or any other person during an examination
- Using any material or equipment during an examination without consent of the instructor, or in a manner which is not authorized by the instructor
- Attempting to change answers after the examination has been submitted
- Unauthorized collaboration, or the use in whole or part of another student's work, on homework, lab reports, programming assignments, and any other course work which is completed outside of the classroom
- Falsifying medical or other documents to petition for excused absences or extensions of deadlines
- Any other action that, by omission or commission, compromises the integrity of the academic evaluation process

Plagiarism is a serious form of violation of the standards of academic dishonesty. Plagiarism is the appropriation of ideas, language, work, or intellectual property of another, either by intent or by negligence, without sufficient public acknowledgement and appropriate citation that the material is not one's own. It is true that every thought probably has been influenced to some degree by the thoughts and actions of others. Such influences can be thought of as affecting the ways we see things and express all thoughts. Plagiarism, however, involves the taking and use of specific words and ideas of others without proper acknowledgement of the sources, and includes the following

- Submitting as one's own material copied from a published source, such as print, internet, CD-ROM, audio, video, etc.
- Submitting as one's own another person's unpublished work or examination material
- Allowing another or paying another to write or research a paper for one's own benefit
- Purchasing, acquiring, and using for course credit a pre-written paper

The above list is in no way intended to be exhaustive. Students should be guided by the principle that it is of utmost importance to give proper recognition to all sources. To do so is both an act of personal, professional courtesy and of intellectual honesty. Any failure to do so, whether by intent or by neglect, whether by omission or commission, is an act of plagiarism. A more detailed description of this issue can be found [here](#).

In addition, a student may not submit the same paper or other work for credit in two or more classes without the expressed prior permission of all instructors. A student who submits the same work for credit in two or more classes without the expressed prior permission of all instructors will be judged guilty of academic dishonesty, and will be subject to sanctions described below. This applies even if the student is enrolled in the classes during different semesters. If a student plans to submit work with similar or overlapping content for credit in two or more classes, the student should consult with all instructors prior to submission of the work to make certain that such submission will not violate this standard.

Plagiarism or any other act of academic dishonesty will result minimally in the instructor's assigning the grade of "F" for the assignment or examination. The instructor may impose a more severe sanction, including a grade of "F" in the course. All instances of academic dishonesty must be reported by the instructor to the chairperson of the department involved, and to the Dean of the College of Arts and Sciences.

The chairperson may constitute a hearing board to consider the imposition of sanctions in addition to those imposed by the instructor, including a recommendation of expulsion, depending on the seriousness of the misconduct. In the case of multiple instances of academic dishonesty, the academic dean of the student's college may convene a hearing board. Students have the right to appeal the decision of the hearing board to the academic dean of the college in which they are registered. The decision of the dean is final in all cases except expulsion. The sanction of expulsion for academic dishonesty may be imposed only by the Provost upon recommendation of a dean. Students have a right to appeal any finding of academic dishonesty against them. The procedure for such an appeal can be found [here](#).

The College of Arts and Sciences maintains a permanent record of all instances of academic dishonesty. The information in that record is confidential. However, students may be asked to sign a waiver which releases that student's record of dishonesty as a part of the student's application to a graduate or professional school, to a potential employer, to a bar association, or to similar organizations.