Physics 30: Electromagnetism

Fall 2018

Instructor: Prof. Matthew Headrick
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Office: Abelson 313
Office hours: Wednesday 4–5pm and by appointment. You are also welcome to knock on my door at any time, and I will meet with you if I can.

Time and place: Monday, Wednesday, Thursday from 10:00 to 10:50am in Abelson 126

Credits: Four-Credit Course (with three hours of class-time per week). Success in this 4 credit-hour course is based on the expectation that students will spend a minimum of 9 hours of study time per week in preparation for class (readings, problem sets, recitations, preparation for exams, etc.).

Content: Maxwell’s theory of electromagnetism is a pillar of physics, with applications that pervade nearly every aspect of science and technology. It is also an intellectual triumph and a model for a large class of physical theories. This course will cover the fundamentals and some applications of this theory, along with associated mathematical methods. More specifically, the topics to be covered include: vector calculus; important partial differential equations such as Laplace’s equation and the wave equation, their properties, and methods for solving them, such as separation of variables; fundamentals of electrostatics, such as the behavior of conductors; the potential formulations of the electric and magnetic fields; work and energy in electromagnetism; electric and magnetic polarization of matter; Maxwell’s equations; and electromagnetic radiation. We will follow Griffiths’ textbook *Introduction to Electrodynamics* (fourth edition), covering most of chapters 1–11.

Readings: A reading from the textbook will be assigned each week, to be done before Monday morning. Associated with the reading, some problems will be assigned, which are not to be handed in but which we may discuss in class. For each reading, you will also have to submit a TQ (thought or question) on Latte. Tell me what you found especially challenging, confusing, or noteworthy in the reading or the assigned problems, or about a possible extension or application of the material. The TQ should be submitted by 9am on Monday (whether or not we have class that day).

Problem sets: Each week there will also be a problem set, usually due on Thursday. You are encouraged to work together in solving the problems (or at least to check your solutions), but you must write the problem set up by yourself—copying is not allowed. (Allegations of academic dishonesty will be forwarded to the Director of Academic Integrity. Sanctions for academic dishonesty can include failing grades and/or suspension from the university.) You should treat the write-up as a writing assignment. Imagine that you are writing an extra paragraph of the textbook. You should present the statement of the problem and why it’s interesting, emphasize the key points in your solution, and leave out trivial mathematical steps. Your write-up should also, of course, be legible and neat. Problem sets will be graded based on both the correctness of the solution and the quality of the presentation. Specifically, they are graded based on the following criteria (the fraction of the points for that problem to be taken away if the solution fails to meet the criterion is given in parentheses):

- It is neat and legible and written on a clean piece of paper. (10-20%)
- It is written in complete and grammatically correct English sentences. (10-20%)
- It is self-contained, in the sense that it would be understandable to a reader who has read the relevant portion of the textbook but NOT the statement of the problem. Merely copying the statement of the problem does not count. (10-20%)
- Some motivation for the problem is given. (10-20%)
- The problem is correctly solved. (10-50%)
- The key tools or ideas that enter into the solution are stated. (10-20%)
The main steps are clearly stated, so that the reader is guided through the solution. Straightforward mathematical manipulations do not have to be spelled out. (10-30%)

Since the material in the course is highly cumulative, it is crucial for you to hand in problem sets when they are due. However, it’s better to do them late than never. Therefore, late problem sets (or portions thereof) will be given 50% credit if handed in within one week of the original due date.

Exams: There will be two in-class midterms, tentatively scheduled for Oct. 4 and Nov. 1. The dates will be fixed early in the semester. If either of these dates is problematic for you, due to a conflict with another exam or any other reason, please let me know as soon as possible. There will also be an in-class final exam.

Class participation: Large parts of the class time will be spent on activities to help you learn the material better, and to help me understand what aspects are particularly challenging and interesting to you. Therefore, attendance and participation are required.

Grade: Your letter grade for the course will be based on a numerical average calculated as follows: 10% for attendance and participation; 10% for submission of TQs; 30% for problems sets; 10% for each midterm; and 30% for the final exam. The attendance and participation grade is calculated by deducting 1/2 point (starting from 10) each time you are absent or don’t make a good-faith effort to answer when called upon (it does not depend on answering questions correctly). The TQ grade is calculated by deducting 1 point (starting from 10) each time you don’t submit a good-faith TQ.

Communication: All assignments will be posted on the Latte page for the class. Important announcements will be posted on the ”Course news and announcements” forum, to which you should be subscribed.

Other books: The material we will cover in this course is very standard and can be found in innumerable places besides Griffiths’ textbook, including on the web and in other textbooks. Therefore, if for any reason you are not satisfied by Griffiths’ discussion (or mine) of a particular topic, there are many places you can go for one that suits you better. Useful books include:

- *Electricity and Magnetism* by Purcell and Morin, the textbook for Physics 15b. This is at a lower level than Griffiths, and could be very useful for those who took Physics 11b.
- *Classical Electromagnetic Radiation* by Heald and Marion. This book is slightly more advanced than Griffiths.
- *Classical Electrodynamics* by Jackson. This is the standard graduate textbook for electromagnetism.
- *Mathematical Methods in the Physical Sciences* by Boas. This book very nicely covers all the math you will need in this course (or indeed in any undergrad physics course).
- *Classical Electromagnetism* by Fitzpatrick. This book, which is available for free at [http://farside.ph.utexas.edu/teaching/jk1/jk1.html](http://farside.ph.utexas.edu/teaching/jk1/jk1.html) has been recommended to me, although I’m not personally familiar with it.
- *A History of the Theories of Aether and Electricity, Part I* by Whittaker. This weighty tome is the standard history of the development of electricity and magnetism through the end of the nineteenth century.

With the exception of the one by Fitzpatrick, these books have been placed on reserve in the library.

Disabilities: If you are a student with a documented disability on record at Brandeis University and wish to have a reasonable accommodation made for you in this class, please see me immediately.