Phys 110: Electrodynamics Core
University of California, Merced
Fall 2012

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Class times: Lecture: TR 9:00-10:15; Classroom Bldg. 127
Discussion: W 3:30-4:20; Classroom Bldg. 263

Text: *Introduction to Electrodynamics*, third edition, by Griffiths. We will primarily cover material from Chapters 1–9. Griffith's text is a classic book, used by most universities, and for good reason. It is written in a lucid and precise style, and is a real pleasure to read.

Prerequisites: It is presumed that all students in this course have taken lower division electromagnetism (PHYS 9) and vector calculus (MATH 23). We will build extensively on this material.

Overview: In lower division courses, you learned the basic physics of electric and magnetic fields and how these fields are generated by charges and currents. In a nutshell, the objective of this course is to approach this topic afresh from a more sophisticated perspective, both in terms of the physical principles and (especially) in terms of the mathematical sophistication. Whereas your prior exposure to electromagnetism was likely in terms of the "integral" formulation of Maxwell's Laws, the present course will stress the "differential" formulation. This means that we will extensively use the vector calculus you learned in Math 23. In fact, for many Physics students, upper division E&M is where they truly *learn* vector calculus.

As for material, we will cover most of Chapters 1–8 and part of Chapter 9 in the text. This will provide you with a solid foundation in electro- and magnetostatics, as well as the full electrodynamics of Maxwell's equations.

Course learning objectives: By the end of the course...

- Students will be able to compute electrostatic and magnetostatic fields of stationary charges and currents.
- Students will be able to solve basic problems involving the dynamics of changing electromagnetic fields and changing charge and current distributions.
- Students will be able to incorporate the influence of matter (e.g. conducting, dielectric, diamagnetic) in analyzing electromagnetic phenomena.
- Students will understand how conservations laws (e.g. energy, momentum, and angular momentum) are incorporated in E&M, and they will be able to use these laws to analyze physical phenomena.
- Students will solidify their ability to use the mathematics of vector calculus. In particular, they will be able to use the concepts of the gradient, divergence, and curl, and related theorems, to solve real physical problems.

Rough outline:

- *Review of vector calculus*; Chapter 1 (1 week)
- *Electrostatics*, electric field and potential formulations; Chapter 2 (2 weeks)
- *Electrostatics techniques*, image charges, separation of variables, etc; Chapter 3 (2 weeks)
- *Electric fields in matter*, dielectrics; Chapter 4 (2 weeks)
- *Magnetostatics*, magnetic field and vector potential formulations; Chapter 5 (2 weeks)
- *Magnetic fields in matter*, diamagnetism; Chapter 6 (2 weeks)
- *Electrodynamics*, Maxwell's Equations; Chapter 7 (2 weeks)
- *Conservation of energy and momentum*; Chapter 8 (1 week)
- *Electromagnetic waves*; Chapter 9 (1 week)

Time permitting, we may be able to cover some special topics.

Discussion sections: The purpose of the weekly discussion sections is primarily to help you with problem solving. This is a great opportunity for you to ask questions about the assigned homework or any other material in the course. This often leads to lively discussions, and should not be missed!

Homework: Each week you will receive a set of homework questions. These problem sets are designed to be both challenging and rewarding. They are critical to honing your understanding and proficiency with the material. You are allowed one free late homework during the semester, at no penalty. Otherwise, homework turned in late will receive only half credit. Late homework can be turned in no later than one week late.

Finally, you are encouraged to work together on solving the problem sets. However, all work that you turn in should be your own writeup, written in your own words.

Grading: Your grade will be based on a midterm exam (25 %), final exam (40 %), and the graded homework (35 %).

UCM Crops: The UCM Crops site "F12-PHYS 110" will be used for periodic course announcements, and for the distribution of weekly homework sets, solutions, and class notes. You should make sure that you can access this site and that you are familiar with its contents. **Warning: The Crops site may generate its own letter grade throughout the semester. However, you should pay no attention to any letter grade that is reported on Crops, except for the final course grade.**

Academic honesty: As with any course, students are expected to abide by the UC Merced academic honesty policy, which can be found on the Student Life website http://studentlife.ucmerced.edu/ under the "judicial affairs" link. As mentioned above, you are encouraged to work together on learning the material in this class, including working together to understand the homework problems. However, all work that you turn in should be your own writeup, written in your own words.