

SPRING 2017

Physics 405: Electricity and Magnetism I

MWF 10:00-10:50 am, Rm. 184

Instructor: S. PRASAD, Rm 1119, 277-5876, sprasad@unm.edu

As the first course in a two-course sequence of electromagnetism (E&M) at the advanced undergraduate level, Physics 405 will introduce you to the fundamental concepts and mathematical underpinnings of classical E&M in a rigorous manner. Much of the course will be concerned with electrostatics and magnetostatics, but some discussion of electromagnetic induction (“Faraday’s law”) will be presented in the last two weeks. I will start by spending some time reminding you of some useful mathematical definitions and identities from vector analysis without which E&M cannot be developed fully at this level, but I will then quickly get to E&M proper by late 2nd week. Overall, this will be a difficult class, quite a step-up from the 300-level courses you have been taking until this point, but I will try to make the material as mathematically and conceptually accessible as possible.

D. Griffiths’ “Introduction to Electrodynamics,” 4th edition, will be the main text for the course for a number of reasons. Amongst competing texts it provides one of the best introductions to electrodynamics at the advanced undergraduate level. Further, the text contains a vast collection of useful problems that clarify and illustrate the subject at multiple levels from multiple angles, which is an essential part of any good conceptual discussion. It also has a wealth of references to more contemporaneous didactic material, typically published in the American J. of Physics, that greatly clarifies both the conceptual foundation of electrodynamics and its relationship to other branches of physics through specific examples. Occasionally I shall supplement my lectures with discussions drawn from other texts, most notably E. Purcell and D. Morin’s Berkeley Physics Course on “Electricity and Magnetism;” R. Feynman’s “Lectures in Physics,” vol. II; and Reitz, Milford, and Christy’s “Foundations of Electromagnetic Theory.” For this first course, I intend to cover Chapter 1 through Sec. 7.2 of Griffiths’ text.

Problems Class - Listed officially as Phyc 415.001 (CRN: 35469; M 12:00-12:50 pm, Rm 184), this is an important adjunct to the main lecture class. I cannot emphasize enough the importance of the problems class, and I strongly encourage you to enroll in it as well since it will provide you additional practice with solving problems beyond your homework assignments and self study. The class will also give you a valuable opportunity to bring to my attention your difficulties with any concepts covered in the lecture class and homework assignments so I can address them in a group setting.

Web-Based Course Materials - All course materials, including lecture notes, HW assignments, solutions, problem session notes, and supplements, if any, will be posted electronically on the course web page at physics.unm.edu/Courses/Prasad/Sp17/P405/. The passwd for the page is lobo405.

Grading - The grading in the course will be based on your performance in homework (HW) assignments (25%), two mid-term (MT) exam scores (20% each), and a final exam (35%). There will be 9-10 assignments in all with about 4-6 problems each. Each exam will be closed-book, but you will be allowed the use of a single sheet of personal notes for each MT exam and three sheets for the final exam. The MT exams are tentatively scheduled for two Fridays, Feb 24 and Mar 31, during (extended) class time, and the final exam will be held on Friday, May 12th.

Required Text - *Introduction to Electrodynamics* by David Griffiths, 4th ed.

TA - Zeke Carrasco (contact email: ezequiel@unm.edu)

Office Hrs: *Instructor's* – Tu Th 2 - 3 pm or by appointment;
TA's – to be announced

Schedule of Topics

- *Review of Vector Analysis* (4 lectures)
 - Vector algebra and calculus
 - Dirac delta function
 - Vector and scalar fields
- *Fundamental Concepts in Electrostatics* (9 lectures)
 - Electric field and laws of electrostatics
 - Electric potential
 - Work and energy
 - Conductors
- *Special Techniques of Electrostatics* (9 lectures)
 - Laplace and Poisson equations
 - Method of images
 - Separation of variables in Cartesian and spherical coordinates
 - Multipole expansions
- *Electric Field in Matter* (6 lectures)
 - Bound charges and electric polarization
 - Electric displacement field
 - Linear dielectrics
- *Magnetostatics* (6 lectures)
 - Lorentz force
 - Biot-Savart and Ampere laws
 - Correspondences between electrostatics and magnetostatics
 - Magnetic vector potential
- *Magnetic Fields in Matter* (5 lectures)
 - Magnetic dipoles and magnetization
 - Magnetic field of a magnetized object
 - Magnetic media
- *Electromagnetic Induction* (3 lectures)
 - Electromotive force
 - Faraday's law

In an effort to meet obligations under Title IX, UNM faculty, Teaching Assistants, and Graduate Assistants are considered "responsible employees" by the Department of Education

(see pg 15 - <http://www2.ed.gov/about/offices/list/ocr/docs/qa-201404-title-ix.pdf>).

This designation requires that any report of gender discrimination which includes sexual harassment, sexual misconduct and sexual violence made to a faculty member, TA, or GA must be reported to the Title IX Coordinator at the Office of Equal Opportunity (oeo.unm.edu). For more information on the campus policy regarding sexual misconduct, see: <https://policy.unm.edu/university-policies/2000/2740.html>