# Physics 2555: Advanced Classical Electricity and Magnetism

## Spring 2018

- Recommended textbooks:
  F. Melia: "Electrodynamics,"
  J. Jackson: "Classical Electrodynamics," 3rd edition
- Prerequisites: Physics 2373
- Lectures: MF 10:00-10:50am, W 9:00-10:50am (106 Allen Hall)

## Course description

This class discusses the static and dynamic properties of classical electrodynamics at the graduate level. Among the topics emphasized are solutions to problems in electrostatics, magnetostatics and electrodynamics, wave equations, effects of boundaries, propagation of electromagnetic radiation, response of dielectrics to electromagnetic fields, and special relativity.

There is no official required textbook for this class. The "standard" text by Jackson is very comprehensive and detailed and serves as a good reference. However, the essential concepts might be learned better from the more compact (although not fully comprehensive) book by Melia. The lecture will be based on several sources, including but not limited to these two books. Therefore it is essential that you attend lectures throughout the semester.

I will also post handwritten lecture notes for the majority of the course content on CourseWeb. This will free up time for exercises and group work during class. The notes will also spare you from having to simply copy everything that is written on the blackboard. However, they are not claimed to be fully self-explanatory and replace the need to attend the lectures. One possible strategy is to print the notes ahead of time and then make your own annotations during class time.

This course is a graduate level core course.

## Learning goals

After completing this course, students are expected to be able to

- analyze the symmetries of a problem, choose appropriate coordinates, and systematically construct a solution approach;
- solve boundary value problems of partial differential equations, as they are commonly encountered in electricity and magnetism, using Green's functions and/or decomposition into orthogonal functions;
- construct solutions for electric and/or magnetic fields generated by compact sources using multipole expansion;
- compute the propagation of waves in free space, dielectric media, wave guides and resonant cavities, as well as understand the transport of energy and momentum by these waves;

- describe applications in special relativity using 4-vector Miskowski formalism;
- analyze the emission and scattering of electromagnetic radiation off a point charge moving at relativistic speeds.

## Homework

Homework is an essential part of learning the material of this course. Homework will be assigned each week on Friday and collected next week on Friday. You are encouraged to discuss the homework problems with each other after you have tried them to the best of your ability, but you cannot copy the solutions from each other. The homework assignments and solutions will be available for download on CourseWeb.

Some of the homework problems will be discussed in class (after they have been graded and returned). For this purpose I will occiasionally pick one student at random to present her/his solution on the board. In this way, you can learn from each other's solutions, and also practice your presentation skills.

## Grading scheme

There will be one mid-term exam and a comprehensive final exam. The dates for the exams will be announced several weeks in advance. The final grade will be determined by the homework submissions (30%), and mid-term (25%) and final exam (45%).

## Disability resources

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services, 216 William Pitt Union, (412) 648-7890/(412) 383-7355 (TTY) as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.