Physics 322

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December 2018

There are a few cases in physics where a theory arrives in more-or-less complete form. Newton's *Principia* ushered in a new model of mechanics in 1687. Joseph-Louis Lagrange reformulated Newtonian mechanics in 1788 creating Lagrangian mechanics which forms a bridge between classical mechanics and modern physics. In 1873, James Clerk Maxwell's *A Treatise on Electricity and Magnetism* did for electrodynamics what Newton and Lagrange had done for mechanics. Maxwell's accomplishment is significant, because his theory of electricity remained unchanged even after Einstein's discovery of Special Relativity.

You have previously studied both electrodynamics and special relativity in PHY 162. The first week of this course is a recapitulation of PHY 162, although at a much higher level. The remainder of this course will emphasize the following features of electrodynamics, which have already been hinted at in PHY 162. One of the amazing things about classical electromagnetic fields is that they can carry energy, momentum, and angular momentum in much the same manner as ordinary matter. Maxwell was able to use his equations to give a description of light in terms of more fundamental electromagnetic fields, but his description of light also explains how light interacts with ordinary matter. Most impressively, Maxwell's equations contained within them the fundamental symmetries of space and time that led Albert Einstein to formulate his theory of Special Relativity.

The purpose of this course is to understand these features and be able to apply these principles to solve both specific and fairly broad classes of physics problems. This level of understanding is essential to a future career in physics at a graduate level and is extremely useful for understanding the physical basis of electriciy and magnetism.

This course supports the Educational Priorities and Outcomes of Cornell College with emphasis on Knowledge and Reasoning.

Course prerequisites: MAT 122, PHY 162, and either MAT 221 or PHY 305.

The main text for this course is David J. Griffiths, *Introduction to Electrodynamics*, either 3rd Edition or 4th Edition. We'll also use Derin A. Sherman, *Real, Imaginary, Complex* (2009) Available online in the PHY-322 assignment folder and Moodle: `ric.pdf`

Class is held 9:00–11:00 AM and 1:00–3:00 PM in Law Hall room 313. The schedule for a typical day runs as follows. From 9:00–10:00 we'll review homework questions as a class. From 10:00–11:00, new material will be presented in lecture. From 1:00–2:30, I'll present some sample problems. From 2:30-3:00, the class may have a short open-note, closed-book quiz on the previous day's homework problems. The quiz will consist of a problem (or part of a problem) directly off the homework. It is *essential* that you read the material in the chapter before the lecture.

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Your grade is computed as follows:

Homework/Quizzes/Class participation	25%
Exams 1 and 2	30% each
Exam 3 (group exam)	15%

You are encouraged to work together on homework assignments, but you may not work together on any quizzes or exams. There will be a lot of in-class work on the homework, so class attendance is essential.

The first exam will cover vector calculus, electrostatic, magnetostatic, and Faraday's law. The second exam will cover Maxwell's equations, conservation laws, Maxwell stress tensor, Laplace's equation, multipole expansions, and electric and magnetic fields in matter. The third exam will cover functions of complex numbers used to solve electrostatic and magnetostatic problems.

Date	Text Material	Topics	Problems
Day 1 - Mon	Ch 1	Vectors Vector Calculus Line Integrals Surface Integrals	Homework 1 handout
Day 2 - Tue	Ch 1.3, 1.4, 2.1, 2.2	Vector calculus Electrostatics	Homework 2 handout
Day 3 - Wed	Ch 2.3–2.5	Vector calculus electric potential	Homwork 3 handout
Day 4 - Thur	Ch 5.1–5.3	Vector calculus Magnetostatics	Homework 4 handout
Day 5 - Fri	Ch 5.3, 5.4, 7.1, 7.2	Vector potential Faraday's Law	Homework 5 handout
Day 6 - Mon	Exam 1	(Ch 1, 2, 5, 7)	
Day 7 - Tue	Ch 7.3, 8.1, 8.2	Maxwell's equations Conservation laws	Homework 7 handout
Day 8 - Wed	Ch 8.2	Electromagnetic momentum	Homework 8 handout
Day 9 - Thur	Ch 3.1-3.3	Laplace's equation	Homework 9 handout
Day 10 - Fri	Ch 3.4	Multipole expansion	Homework 10 handout
Day 11 - Mon	Ch 4	Electric fields in matter	Homework 11 handout
Day 12 - Tue	Ch 9.1–9.3, 9.5	Electromagnetic waves	Homework 12 handout
Day 13 - Wed	Exam 2	(Ch 3, 4, 7, 8)	
Day 14 - Thur	RIC Ch. 2 , Ch. 9	Complex Integration	2.1-2.5, 9.1-9.3, 9.4aceg, 9.5
Day 15 - Fri	RIC Ch. 10	Contour Integration	10.1-10.3, 10.5*, 10.6, 10.7, 10.9
Day 16 - Mon	RIC Ch. 11	Conformal Mapping	11.1-11.5
Day 17 - Tue	RIC Ch. 12	Conformal Mapping - Fields	12.1-12.4, 12.6
Day 18 - Wed	Exam 3	(RIC Ch. 9-12)	

Purpose of assignments:

Reading material is assigned each day in class. The purpose of the reading is to acquire basic *knowledge* of the material before the class lecture. This will better help you understand the material presented during the lecture.

Homework problems serve to both reinforce *knowledge* as well as developing mathematical and problem-solving *reasoning*. Each night's homework problems will cover the topics for that day, although they may also reinforce topics from previous days. The first few homework problems tend to emphasize *knowledge* while later problems will emphasize *reasoning* although both objectives are covered by most problems.

Grade: There are three exams: each exam is 25% of your grade. 15% of your grade consists of homework and quizzes. 10% of your grade consists of electronic class notes/class participation (more about this later).

Assignments: Homework is due the next afternoon in class. For example, the "Day 1" homework assignment is the one you will start work on during the first day of class, but will be due the second day. There may be a quiz on the homework in class. Solutions to the homework problems will be posted on Moodle. You can access Moodle at `http://moodle.cornellcollege.edu/`

Unlike the tests, you are encouraged to work with your classmates on the homework assignments. However, regardless of your methods for solving the homework problems, you must gain sufficient proficiency with the material that you are able to do the homework problems on your own.

Absence from class and late assignments: You may be absent from class due to a few reasons. Your absence is excused if either 1) you obtain permission from your instructor in advance of the absence or 2) the absence is of an emergency or medical nature. If your absence is excused, you will need to make up the material that you missed, but there will be no other penalty. If your absence is not excused then you will not be allowed to make up the work. If you turn in an assignment late, then you will not receive full credit.

Academic Integrity: Unless otherwise stated, assignments are for you to complete on your own. In some cases, they will be based on group work done in class. In these cases, please provide proper attribution to other's ideas. Failure to properly reference other people's ideas may result in a failing grade.

Cornell College expects all members of the Cornell community to act with academic integrity. An important aspect of academic integrity is respecting the work of others. A student is expected to explicitly acknowledge ideas, claims, observations, or data of others, unless generally known. When a piece of work is submitted for credit, a student is asserting that the submission is her or his work unless there is a citation of a specific source. If there is no appropriate acknowledgement of sources, whether intended or not, this may constitute a violation of the College's requirement for honesty in academic work and may be treated as a case of academic dishonesty. The procedures regarding how the College deals with cases of academic dishonesty appear in The Catalogue, under the heading "Academic Honesty."

Any student found cheating on a test will receive a zero on the test. The Registrar will also be notified.

Students with disabilities: Cornell College makes reasonable accommodations for persons with disabilities. Students should notify the Coordinator of Academic Support and Advising and their course instructor of any disability related accommodations within the first three days of the term for which the accommodations are required, due to the fast pace of the block format. For more information on the documentation required to establish the need for accommodations and the process of requesting the accommodations, see `http://cornellcollege.edu/academic-support-and-advising/disabilities/index.shtml`