PHYS 409 Syllabus

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Primary Texts:

- *Introduction to Electrodynamics*, third edition, by David J. Griffiths, Prentice-Hall, 1999. ISBN 0-13-805326-X.
- Your old General Physics textbook.

Optional Texts:

- *A Student's Guide to Maxwell's Equations* by Daniel Fleisch, Cambridge U. Press, 2008. ISBN 978-0521701471.
- *Mathematical Tools for Physics* by James Nearing, U. Miami, http://www.physics.miami.edu/~nearing/mathmethods/
- *Mathematical Methods for Physicists*, 6th edition, by George B. Arfken and Hans J. Weber, Elsevier, 2005. ISBN 0120598760. Many other excellent texts are available, especially *Mathematical Methods in the Physical Sciences*, 3rd edition by Mary Boas, Wiley, 2005. ISBN 0471198269.
- *Div, Grad, Curl, and All That*, 4th edition, by H. M. Schey, W. W. Norton, 2005. ISBN 0-393-92516-1. A good review of vector calculus.
- *Classical Electrodynamics*, 2nd edition, Hans C. Ohanian, Infinity Science Press, 2006. ISBN 0-977-85827-8.
- *Classical Electrodynamics*, 3rd edition, J. D. Jackson, Wiley, 1998. ISBN 047130932X. The standard graduate text.
- *A Treatise on Electricity & Magnetism*, 3rd edition, in two volumes, by James Clerk Maxwell, reprinted by Dover Publications, 1954.
- *The Feynman Lectures on Physics*, in three volumes, by Richard P. Feynman, Addison-Wesley, 1970.
- *The Maxwellians* by Bruce J. Hunt, Cornell U. Press, 1991. A study of FitzGerald, Lodge, Heaviside (and others), and how they made Maxwell's work accessible to scientists everywhere.

Lecture: TR 10:50–12:05, Room 126.

Office Hours: M–R 9–10, T–W 2–3, or by appointment.

Course Description: One of the upper-level Classical Physics courses, usually taken as a Junior or Senior. Electrodynamics in a vacuum, more or less. The development of the Maxwell Equations (Gauss's Law, Ampère's Law, Faraday's Law, and the Law With No Name) and applications to light and optics. There will be a strong emphasis on visualization of complicated 2- and 3-D vector and scalar fields with mathematical tools.

Spring of odd years a second semester may be offered (PHYS 410) that covers electrodynamics in matter (dielectrics and magnetic materials), production of electromagnetic radiation, and relativistically covariant electrodynamics. Sound cool?

Prerequisites: MATH 323 (DEQ) and PHYS 112 (General Physics sequence), or permission of the instructor. Some prior experience with MATHEMATICA, especially graphing, is expected. This webcast (http://url.wolfram.com/6hKla0/) gives a 20-minute introduction to using MATHEMATICA.

Instructor Bio:

Education: B.S. in Physics from M.I.T. (1975) followed by a disastrous year of Astronomy graduate school at U. of Chicago. Brain healed while teaching at the McCallie School (a boys prep-school) for seven years, then earned a Ph.D. in experimental condensed-matter physics from M.I.T. (1990). Thesis title: "Transport and Localization in Oxygen- and Sr-Doped La_2CuO_4". Eight years teaching at Eastern Oregon University (La Grande, OR), and now in twelfth year at the College of Charleston.

Research: Current research interests in computational and experimental biomedical optics (specifically Monte Carlo simulations of treatment of Barrett's esophagus by photodynamic therapy in collaboration with Dr. Linda Jones and physicians at the Mayo clinic in Jacksonville, FL.) and simulations of surface charges of simple circuits.

Personal: Married to Dr. Lucy Preyer, a psychiatrist in private practice in Charleston. Two ex-male cats allow us to live in their home.

Web: This class has a WebCT page at http://webct.cofc.edu. All students will be automatically enrolled. This gives you access to chat rooms with other students in the class for solving homework problems, finding a study partner, the latest homework assignment, etc. Some simulations and other materials may be added during the semester.

Attendance: Curiously, I think attending and participating in class is to your advantage, and I expect you to attend each class. I will. You are also expected to **read** the appropriate sections of your text. Rather than repeat verbatim what is in the text, we will work problems, answer questions, talk about topics that your book does not discuss, or which I want to handle differently. **You are responsible for what is discussed in class. If you miss class the day assignments or new test dates are announced, it is your responsibility to find out about it.**

Homework: There will typically be one homework set per week. Homework is due at the beginning of class, and late homework will not be accepted except by pre-arrangement. You are **encouraged** to work together on the homework, but each person must turn in their own problem solutions. The problems will be a mix of by-hand analytic solutions (to build knowledge and skills), computer plotting (to build intuition), and numerical solutions (to explore non-analytic solutions to more challenging problems). There will be occasional checking of reading notes.

Tests: There will be two tests throughout the semester (see dates below). No formula cards or symbolic math programs are allowed for class-room test problems, only calculators, sharp pencils, and sharp minds. You will be notified at least a week in advance (and the WebCT page will be updated) if there are any changes in the test dates. An excuse from the Dean of Undergraduate Studies is required to make up an examination. The lowest test grade will be replaced by the final exam grade when computing your final grade, if this is to your advantage.

Each test will be one period long, but the tests and the exam may include more time-consuming "take-home" problems calculating or plotting numerical solutions.

Project: Full details to follow, but in short, a 5–10 page paper and short presentation on a topic from classical electrodynamics, quantum electrodynamics (on your own!), plasma physics, optics, etc. Your project may be analytic, computational, experimental, or a mix of all three. These projects can usually develop into independent research projects and perhaps senior research projects.

Disabilities If you have a documented disability and have been approved to receive accommodations through SNAP Services, please come and discuss this with me early in the semester.

Honor Code: The Honor Code of the College of Charleston specifically forbids cheating, attempted cheating, and plagiarism. A student found guilty of these offenses will receive a failing grade (XF) in the course. Additional penalties may include suspension or expulsion from the College at the discretion of the Honor Board.

Grading:

Homework:	25 %
Tests:	30 %
Project:	20 %
Final:	25 %

A:	90-100	C+:	74-76
A-:	87-89	C:	70-73
B+:	84-86	C-:	67-69
B:	80-83	D:	64-66
B-:	77-79	F:	Below 64

Schedule (**Tentative**)

T	Aug	25	Diff. Vector Calculus	1.1,1.2 (skip 1.1.5)
R	Aug	27	Int. Vector Calculus	1.3, 1.4, 1.6
			Meet about projects this week	
T	Sep	1	Electric Potential of Charges	2.3.2, 2.3.4
R	Sep	3	Work & Energy I, E from V	1.5, 2.4.1, 2.4.2
T	Sep	8	E from Charges	2.3.1, 2.1
R	Sep	10	Energy II, Conductors	2.4.3, 2.4.4, 2.5
T	Sep	15	Laplace's Equation, Relaxation	3.1
R	Sep	17	Images, Separation of Vars (Cartesian)	3.2, 3.3.1
T	Sep	22	Separation of Vars (Cartesian)	3.3.1
R	Sep	24	Separation of Vars (Spherical)	3.3.2
T	Sep	29	Separation of Vars (Spherical)	3.3.2
R	Oct	1	**Test #1**	1–3.3.1
T	Oct	6	Elec. Fields in Matter	4
R	Oct	8	Lorentz Force Law	5.1
T	Oct	13	**Fall Break!**	
R	Oct	15	Magnetic Vector Potential	5.4
T	Oct	20	Biot-Savart Law	5.2
T	Oct	20	**Rough draft due**	
R	Oct	22	E and B in Diff. & Int. forms	2.2.2, 2.2.4, 5.3.2d, 5.3.4
T	Oct	27	Gauss's and Ampère's Laws	2.2.1, 2.2.3, 5.3.3
R	Oct	29	Multipole expansion, Elec. and Mag. Dipoles	3.4, 5.4.3, 6.1.2
T	Nov	3	Dipoles (cont), Circuits	6.1.2, 7.1
R	Nov	5	Mag. Fields in Matter	6
T	Nov	10	**Test #2**	3.3.2–5
R	Nov	12	Faraday's Law	7.2.1, 7.2.2
T	Nov	17	Electromagnetic Induction	7.2.3, 7.2.4
T	Nov	17	**Paper due**	
R	Nov	19	Maxwell's Equations	7.3
T	Nov	24	Energy Conservation	8.1
R	Nov	26	**Thanksgiving!**	
T	Dec	1	E&M Waves	9.1, 9.2
R	Dec	3	**Project Presentations**	
T	Dec	15	**Final Exam!**	