Advanced Electricity and Magnetism

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Office Hours:	1:00-3:00 TTh or by chance encounter		

Text: Griffiths, *Introduction to Electrodynamics*, Third Edition.

Supplementary Texts:

Corson and Lorrain, Electromagnetic Fields and Waves, Third Edition.
Feynman, Leighton, and Sands, *The Feynman Lectures on Physics*, Volumes I & II.
Jackson, *Classical Electrodynamics*, Third Edition.
Reitz, Milford, and Christy, *Foundations of Electromagnetic Theory*, Fourth Edition.

The primary text is readable and complete. The supplemental texts will provide you with an alternative exposition of the topic at different levels as well as supplemental material for your term papers. Feynman provides a more elementary view but in his usual way manages to get a full formulation of relativistic electrodynamics into his introductory lectures. Jackson provides a more complete treatment at the level found in most graduate programs. The other texts are pitched at about the same level as Griffiths.

Course Elements:

Lectures and problem presentations: The early portion of the course will consist of lecture, problem presentation and discussion. When you have a problem assigned for presentation, Present a compact, to the point presentation of the problem. If you have a problem to present, please see me at least one day prior to explain your problem.

Homework Problems: Homework problems are to be submitted each Monday and include problems assigned in the syllabus through the previous Wednesday. Turn whatever fraction of the problems you complete by class time on Monday for grading. Problems will be graded as complete or incomplete and will not be assigned numerical scores. Solutions will be available after the due date. Illegible, unorganized solutions will be considered incomplete.

Final Exam: A take-home final examination will be given during the ninth week of the term. Classes will not meet during the exam. This exam will constitute 70% of your grade.

Term Paper and Presentation: Electricity and Magnetism consists of a basic theory (Maxwell's Equations) and a large number of applications. We will consider many of the applications during the course but we cannot cover all topics. You will select a topic beyond the course to explore independently. Below is a suggestive, but not complete set of topics.

1. Wave Guides and Cavity Resonators
2. Transmission lines
3. Phenomenological (London) Theory of Superconductivity
4. Multipole Radiation
5. Synchrotron Radiation and Insertion Devices
6. Green's Functions
7. Numerical Solutions to Laplace's/Poisson's Equations (2D and 3D)
8. Relativistic Radiation Reaction
9. Scattering of radiation by particles.
10. Frequency dependence of the dielectric constant (Kramers-Kronig relations).
11. Propagation of light in anisotropic crystals
12. Wave propagation in nonlinear media

By May 12, the end of week 7, you need to submit a proposal and a bibliography for your paper. The proposal will consist of one or two paragraphs that outline your plan of study for the last two weeks of the term. The content of the proposal should be comparable to a one-week section of the course. Presentations will be a twenty minutes in length during the last week of the term. I will try to schedule some time on Thursday, June 4, so that all presentations can be done in the last two days of the term.

Grading:

Homework & Presentations:	15%
Final Exam:	70%
Paper & Presentation:	15%

Honor Code: Each student is expected to present his or her own work on the examination and the term paper. You are encouraged to work together on homework problems, but do not fall into the trap of passively obtaining assistance from classmates. Collaboration is most beneficial when all members of a group contribute more or less equally to the discussion. If you get a major portion of the solution to a problems from a classmate, please acknowledge the assistance in your written work. To be sure that you have understood the approach, I suggest that you attempt to work another similar problem on your own.

Course Schedule

Date	Day	Topic	Problems
April 1	1	Introduction: Electrostatic Potential, Work, & Energy	Read Chapter 2 Problems 2.39, 2.40, 2.46, 2.48,2.49
April 3	2	Laplace's Equation & Poisson's Eq.	Read Chapter 3.1-3.5 Problems 3.3, 3.4,3.9,3.15,3.23,3.24
April 5	3	Laplace Problems	
April 8	4	Multipole Expansions	Read 3.6 Problems 3.31,3.41,3.45
April 10	5	Polarization & Dielectrics	Read Chapter 4.1-4.2 Problems 4.11, 4.13,4.21
April 12	6	Electric Displacement	Read 4.3-4.4 Problems 4.27, 4.28, 4.32, 4.33
April 15	7	Magnetostatics & Vector Potential	Read Chapter 5, especially 5.3-5.4 Problems 5.3, 5.14, 5.18, 5.25, 5.33, 5.36, 5.39, 5.56, 5.57, 5.59
April 17	8	Magnetic Fields in Matter	Read Chapter 6 Problem 6.7,6.12, 6.21, 6.25, 6.26
April 19	9	Magnetic Problems	
April 22	10	Ohm's Law, *emf* , Faraday's Law, Maxwell's Displacement Current	Read Chapter 7.1-7.3 7.1, 7.11, 7.16, 7.17, 7.23,7.42 7.53, 7.58, 7.59
April 24	11	Energy and Momentum	Read 8.1-8.3 Problems 8.1, 8.4, 8.11, 8.12,
April 26	12	Problems	
April 29	13	EM Waves	Read 9.1-9.2 Problems 9.4, 9.7, 9.10, 9.12, 9.32
May 1	14	Fresnel Equations	Read 9.3 Problems 9.14, 9.16, 9.37
May 3	15	Waves in Conductors & Plasmas	Read 9.4 Problems 9.18, 9.19, 9.25
May 6	16	Potentials for time dependent Fields	Read 10.1-10.2 Problems 10.4, 10.8, 10.10
May 8	17	The fields of moving point charges	Read 10.3 10.13, 10.17,
May 13	18	Dipole Radiation	Read Chapter 11.1-11.2.1 Problems 11.3, 11.4, 11.5, 11.8, 11.14
May 15	19	Problems	
May 17	20	Relativity & Relativistic Mechanics Four-vectors	Read 12.1-12.2 Problems 12.17, 12.19, 12.20, 12.24, 12.34, 12.36
May 20	21	Transforming E & M Fields, the Field Tensor	Read Chapter 12.3 Problems 12.43, 12.44, 12.45, 12.46,

			12.67
May 22	22	Relativity Problems	
May 24	23	**Final exams Available**	
May 29	24	No Class	
May 31	25	**Final Exams Due @ 11:10 AM**	
June 3	26	Presentation Conferences No Class	
June 5	27	Presentations	
June 7	28	Project Presentations	**Papers due @ 5:00 PM**