Classical Electrodynamics

Classical Electrodynamics:	Astronomy 9620b / Physics 9302b (Winter 2010)
Lecturer:	Prof. Martin Houde mhoude2@uwo.ca http://www.astro.uwo.ca/~houde
Location:	PAB Room 36
Lectures:	Monday, 10:30 am – 12:20 pm Friday, 10:30 am – 11:20 am
Recommended text:	**Classical Electrodynamics**, 3rd edition (John Wiley and Sons), by John D. Jackson.
Useful references:	See the bibliography below.

Contact information:

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I can be reached at my office, especially after class where I will do my best to reserve time to answer your questions. I can also be reached during the week through e-mail for simple inquiries, or to make an appointment. I will try to reply to e-mails within two working days of reception.

Students should regularly check my website to find out about course material or announcements (at http://www.astro.uwo.ca/~houde/courses/physics9302.html).

Evaluation: The course will contain regular assignments, a mid term exam, and a final exam, worth 40%, 30%, and 30% of your final mark, respectively. *The exams will be closed book, and no electronics equipment (e.g., calculators, computers, etc.) will be allowed unless explicitly authorized ahead of time*. Students absent on an examination day may be allowed to take a make-up exam if they present a note from a medical doctor within a reasonable amount of time. Similar consideration may be given under other exceptional circumstances.

Assignments: You will receive three or four lists of suggested problems during the semester. I will indicate, for each list, which ones should be turned in for your assignments. Some of these problems may be chosen as material for the exams. Students will be allowed to discuss the material amongst them, *and only one copy can be turned in for a small group of students (two or three) if the group worked out the assignment together*. Assignments must be turned in at the requested date. However, a student may miss a due date *once* during the semester, and hand in the late assignment on the following lecture day without incurring any penalty. Otherwise, for *every day* for which they are late, assignments will automatically have a third of the maximum number of points subtracted from their total.

Plagiarism: Students must write their assignments on their own. Whenever students take an idea, or a passage, or a solution to a problem from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar)

Description

This course is intended to provide the student with the necessary tools to tackle more complex problems than those usually covered in undergraduate courses in electromagnetism. Although the contents of the course will often require some degree of sophistication in the development of the theoretical formalism, numerous examples and problems will be used throughout to help the students grasp the underlying physics.

Course Outline

1. Electrostatics: review, boundary problems, multipoles, macroscopic media.
2. Magnetostatics: review, forces and torques on current distributions, Ampère's Law, magnetic dipoles.
3. Maxwell's equations: macroscopic electromagnetism, conservation laws.
4. Wave propagation, waveguides, and resonant cavities.
5. Magnetohydrodynamics and plasma physics.
6. Radiating systems: spherical (scalar) wave solutions, multipoles expansion of the electromagnetic field.
7. Covariant formulation of electrodynamics: special relativity, four-vectors, Thomas precession, the electromagnetic tensor, and the relativistic origin of magnetic fields.
8. Radiation by moving charges: Liénard-Wiechart potentials, accelerated charges (non-realtivistic and relativistic), radiation damping, Abraham-Lorenz evaluation of the self-force, synchrotron and bremsstrahlung radiation.

Bibliography

1. **Classical Electrodynamics**, J. D. Jackson, 3rd edition (John Wiley and Sons). *This is the classic textbook on electrodynamics. Despite having acquired a reputation for being "too difficult" or "too mathematical" in some circles, in my opinion, it is still the best book on the subject. It is beautifully written, although it is true that some of the problems are very difficult to solve. The author is a graduate of Western.*

2. **Classical Electromagnetism**, J. Franklin, 1st edition (Pearson – Addison Wesley). *An excellent and modern approach to classical electromagnetism. The author does not cover quite as much material as Jackson, but the level of the treatment is similar without "skipping" too many steps... The needed mathematics is introduced as the author goes along. An excellent alternative to Jackson.*

3. **Classical Theory of Electromagnetism**, B. Di Bartolo, 2nd edition (World Scientific Publishing Co.). *An excellent book at a level similar to Jackson's. Its big advantage resides in the fact that the author does not "skip steps" in demonstrations. Previously out-of-print, a new edition came out a few years ago.*

4. **Radiative Processes in Astrophysics**, G. B. Rybicki and A. P. Lightman, (John Wiley and Sons). *An absolutely fantastic book on radiative processes. Although it emphasizes astrophysical processes, physicists can beneficially use it in general. The chapter on special relativity is one of the best I know. The only drawback is the lack of treatment of processes that primarily involve the magnetic field (e.g., magnetohydrodynamics, plasma orbit theory). I will probably refer to it on occasion.*

5. **Introduction to Electrodynamics**, D. J. Griffiths, 3rd edition (Prentice Hall). *A good book, up to the advanced undergraduate level. A fine source for problems.*

6. **Electricity and Magnetism, Berkeley Physics Course, Volume II**, E. M. Purcell, (McGraw-Hill). *A very good introductory book on electromagnetism. It is a good source to go back to, when reviewing the fundamentals.*

7. **The Physics of Fluids and Plasmas. An Introduction for Astrophysicists**, A. R. Choudhuri, (Cambridge). *In my opinion, the best introductory book on the physics of fluids and plasmas. I may refer to it when dealing with magnetohydrodynamics and plasmas.*