PY 522 – Electromagnetic Theory II
( Contemporary Classical Electrodynamics )
Syllabus, Fall 2008

Instructor: Prof. Richard Averitt
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Lecture: MWF 9:00 AM – 10:00 AM SCI 111
Discussion: F 12:00 PM – 1:00 PM BRB 121

Course Description: The goal of this course is to expose students to advances topics in classical electromagnetism with a contemporary point of view. Broadly, three areas will be considered: Electromagnetic sources, propagation of electromagnetic radiation, and the interaction of electromagnetic radiation with materials. Specific topics include antennas, Lienard-Wiechert potentials, synchrotrons, lasers, Gaussian beam propagation, electrodynamics of materials (electrons, phonons, plasmons, artificial materials, mageto-electrics), and nonlinear “optics”. Connections with current research will be made for each of these topics. An approximate lecture schedule is included below. The emphasis on this course is not mathematical physics, but rather stepping back and developing some physical insight into modern topics in E&M. This field of research is alive and well and directly impacts many other areas of research as well!

(1) Text: There is no required text. I will hand out notes and also various chapters from books that are of relevance to a given topic.

Course Grade: Several components will make up your final grade:

(1) Homework Problems (33%): There will be approximately 15-30 problems covering the topics listed above. This could also involve some computer assignments using MATLAB or whatever program you like.

(c) Presentations (33%): Each student will give a presentation on an interesting topic relevant to contemporary EM. Each student must select a different topic and discuss their choice with me before Oct. 1st. Your talk will be 20 minutes with 15 minutes to present and 5 minutes for questions. Your talk must adhere strictly to this time limit just as at professional meetings. The presentations should not just rehash the results of your topic / paper but should strive achieve clarity, context, and physical insight. Some suggested topics are listed below. There are, of course, many others from which you may choose.

(d) Final exam (33%): The written exam will consist of four problems. The test will be open book (any book or books you would like) and open note.

Approximate Lecture Schedule: There will be ~30 lectures depending on, mainly, my travel schedule.

Sept. 3, 8, 10, 12, 15, 17, 19, 29. These lectures will cover dipoles, radiation from moving charges, and synchrotrons.

Sept. 5, 22, 24, 26 Lectures cancelled due to travel.
October 1, 3, 6, 8, 10, 17, 20, 22. These lectures will cover lasers, resonators, Gaussian beams, etc.

October 14, 15 Cancelled due to travel.

Oct. 24, 27 Miscellaneous topics: short optical pulses, optical coherence.

Oct. 29, 31, Nov. 3, 5, 7, 17, 19, 21, 24 These lectures will cover electrodynamics of materials. General constitutive relations, metals, phonons, superconductors, semiconductors, plasmons, metamaterials, nonlinear optics, etc.

Nov. 10, 12, 14 Lectures cancelled due to travel
Nov. 26, 28, no lecture, Fall recess.

December 1, 3, 5, more electrodynamics of materials, nonlinear optics, miscellaneous – depending on how far we get with Oct. 29 – Nov. 24 lectures.

December 8, 10 Student presentations during class. Three per lecture.

Final exam date. To be announced.
PRESENTATION TOPIC LIST (note: I have all of these in PDF format – I can email if needed):

1. Femtosecond Pulses from Synchrotrons [1]
3. Laser Wake-Field Acceleration of Particles [3, 4]
4. Purcell Effect (Inhibited /Enhanced Spontaneous Emission) [5, 6]
5. Casimir Effect [7]
7. Negative Refractive Index [9]
8. Electromagnetic Cloaking [10, 11]
10. Slow light [13]
11. Fast light [14]
13. Point Dipole Crystal [16]
14. Plasmonics [17]
15. Magneto-electrics (Multiferroics) [18]
17. Electrodynamics of graphene [20]
18. Localized vibrational modes in helices [21]


