

ECE 1228 Electromagnetics Theory

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Course Name and number: Electromagnetics Theory, ECE 1228F

Starting date: September 07, 2010

Date and Time: Every Tuesday from 10:00 A.M. to 11:00 A.M. and from 3:00-4:15 P.M.

Location: BA4164

Final Exam: November 30, 2010 location and time to be announced later

Course Description: This course is intended to benefit graduate students with interest in Electromagnetics and Photonics. It revisits and expands some of the more fundamental electromagnetic laws and theories. The course provides the students with the necessary foundation and specific knowledge of electromagnetic theory and the dynamics of wave propagation and interaction with materials and structures.

Topics covered in the course:

Maxwell equations in differential and integral forms; constitutive relations; electric field and electrostatic potential, electric and magnetic polarization; boundary conditions, energy and power, material dispersion (electric response), material dispersion (magnetic response), conductors and conductivity, Maxwell-Helmholtz wave equations, solutions to Maxwell-Helmholtz wave equations, plane waves, polarization, reflection and transmission at interfaces, the other wave equation (Schrödinger wave equation), electron-photon analogies, waveguides, optical multilayers and transfer matrix method, dynamics of wave propagation (phase velocity, group velocity, energy velocity, forerunners), dispersive effects, introduction to waves in periodic structures, wave equation as operator, operator calculus and bases, anisotropic and bi-anisotropic medium, electromagnetic principles and theorems (duality, uniqueness, reciprocity theorem), and if time permits Green functions and Hamilton-Jacobi canonical equations.

Important note: As you can see the proposed topics are very extensive. I do not think we will have a chance to cover all of them, but intend to cover as much as possible without flying through the materials. At points, I will ask you to do self study of a given topic.

Recommended Books and Readings: Unfortunately, there is not one book that covers all the subjects we intend to discuss during this semester. However, I have typed the notes for this class which you can access through my web site. There are few books that you may find useful. They are *Classical Electrodynamics* by J.D. Jackson, *Electrodynamics of Continuous Media* by L. D Landau, E. M. Lifshitz, and L.P. Pitaevski, *Advanced Engineering Electromagnetics* by C. A. Balanis, *Lectures on Physics* by R. P. Feynman, R. B. Leighton, and M. Sands, *Optical Waves in Crystals* by A. Yariv and P. Yeh, *Quantum Mechanics* by C. Cohen-Tannoudji, B. Diu, and F. Laloe, *Wave Propagation and Group Velocity* by L. Brillouin (A. Sommerfeld), and *Optics* by M. V. Klein and T. E. Furtak.

Grading and Marks: There will be assigned homework, exams, and a project. HW 40%, Final 40%, project 20%.

Web site: <http://www.waves.utoronto.ca/prof/mojahedi/ECE1228/Course%20Materials.html>