University of Manitoba | Electrical and Computer Engineering

24.8200 Advanced Engineering Electromagnetics
COURSE OUTLINE - September 2006

Course Objectives

The purpose of this course is to expand on elementary level electromagnetic theory, as taught in the undergraduate electrical engineering curriculum, by investigating advanced mathematical techniques used for applications as well as studying the foundations of the subject. By applying these techniques to various problems the student will gain a deeper understanding of electromagnetic theory and be better able to investigate the founding principles on which the theory is built.

Contact Hours and Location

Tuesdays and Thursdays, 10:00-11:30 p.m., 13 weeks, Room E2-164

Prerequisites

A firm grasp of undergraduate level engineering electromagnetics as well as the mathematical concepts normally contained in an undergraduate electrical engineering curriculum: multivariable vector calculus, linear analysis.

Course Content

The following topics will be covered (emphasis will depend on interests of the class):

1. Review of the Maxwell equations, energy/power concepts, and the constitutive relations.
2. Concepts of time-harmonic fields: waves, waveguides, radiation.
3. Electromagnetic theorems: duality, uniqueness, image theory, the equivalence principle, the induction theorem, reciprocity, Green's functions, TE/TM decompositions.
4. Applications using rectangular coordinates, cylindrical coordinates, and spherical coordinates.
5. Perturbational and variational techniques.
6. Microwave circuit concepts.
7. A deeper look at the foundations of electromagnetic theory.

Recommended Reference Books

1. Julias A. Stratton, *Electromagnetic Theory*, McGraw-Hill Book Company, 1941.
2. Philip M. Morse & Herman Feshbach, *Methods of Theoretical Physics*, Vols. I & II, McGraw-Hill, 1953.
3. Roger F. Harrington, *Time-Harmonic Electromagnetic Fields*, McGraw-Hill Book Company, 1961.
4. Douglas S. Jones, *Acoustic and Electromagnetic Waves*, Clarendon Press, Oxford, 1986.
5. Robert E. Collin, *Field Theory of Guided Waves,* 2nd Edition, IEEE Press, 1991.
6. John D. Jackson, *Classical Electrodynamics*, 3rd Edition, Wiley, 1998.

Evaluation

The final course grade will be determined from a student's performance in assignments, class participation, and the final examination. The weighting of each of these components will be as follows:

Component	Weight
assignments	40%
class participation	10%
final exam	50%

Reading assignments will be given regularly with a sets of problems that each student is asked to attempt a solution to. The reading material and some of the problems will be discussed during class time and students will be expected to participate by presenting their own draft solutions of some of the problems to the class—no penalty will be assigned for incorrect solutions during class discussions, but students are expected to show that they have done the reading and attempted the problems. Students will be asked to hand in formal solutions to *some* of these problems at the beginning of the following class; these assignments will be marked. All handed in assignments will have to be neatly written with all steps of each solution shown (in logical order).

Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations and Requirements of the University of Manitoba, Section 7.1, students are reminded that "plagiarism or any other form of cheating in examinations or term tests (e.g. crib notes) is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty."

Instructor

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