14:332:382 Electromagnetic Fields
Spring 2012

Instructor: Prof. Wei Jiang
Time & Place: MW 1:40-3:00 PM; SEC-205
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Course Catalog Description: 14:332:382 Electromagnetic Fields (3)
Pre-Requisite Courses 01:640:252 Elementary Differential Equation or 01:640:244 Differential Equation for Engineering & Physics; 01:750:227 Analytical Physics IIA; and 14:332:222 Principles of Electrical Engineering II; or 50:640:314 Elementary Differential Equation and 50:750:234 Electric Circuits II

Textbook:
Engineering Electromagnetics/7ed, William H. Hayt, Jr. and John A. Buck, McGraw-Hill, 2006. 9780073104638
Supplemental:
Joseph A. Edminister, *Schaum's outline of theory and problems of electromagnetics*, McGraw-Hill; 2 edition (1994) ISBN 9780070212343.
Lecture notes will be available in pdf format on course website at http://sakai.rutgers.edu.

Overall Educational Objective: This course provides an introduction to electromagnetic theory and principles. Electromagnetics provides the fundamental basis for many subfields of electrical and computer engineering. Electromagnetics is the foundation for wireless communications, solid state electronics, optoelectronics, microwave electronics, telecommunications, computer engineering, and other EE areas. The objectives of this course are to develop a clear understanding of following topics and briefly introduce their applications.

* Electric fields, electric energy and potentials (photocopier)
* Concepts of dielectrics and capacitance (high-k CMOS, p-n junction)
* Magnetic fields, magnetic energy, flux, forces
* Magnetic materials and inductance (hard drives)
* Time varying fields and waves (wireless/optical communications)
* Transmission Lines (cables for TV or internet)

Week-by-Week Syllabus (Tentative)
Week 1: Introduction and Review of vectors and coordinate systems
Week 2: Coulomb's Law and Electric Field Intensity (Xerox copier)
Week 3: Gauss' Law and Maxwell's First Equation
Week 4: Energy and Potential: potential gradient, dipole, and energy density
Week 5: Current and Conductor; Dielectric and Capacitance (high-k CMOS, p-n junction);
Week 6: Poisson's and Laplace's Equations (**Matlab PDE toolbox demo**); Ampere's Circuital Law, Curl and Stoke's Theorem,
Week 7: **Review 1; Exam 1** (cover week 1-5); Magnetic Field
Week 8: Magnetic Materials and Forces (Hard drives)
Week 9: Spring Break
Week 10: Faraday's Law; Time-varying Field; Maxwell's Equations (Transformers)
Week 11: Wave Motion in Free Space and Polarization (Wireless/Optical communications)

Week 12: Plane Wave in Dielectrics; Skin Effect; Reflection at Planar Boundaries;
Week 13: Dispersion, **Review 2**; **Exam 2** (cover week 6-11);
Week 14: Transmission Line Equations;
Week 15: Transmission Line Parameters; Examples (Cable for TV antennas)
Week 16: Impedance Match and VWSR; Review for final exam

Grading
Homework (15%); Two In-Class Exams (25% each); Final Exam (30%); Others(pre-requisite Quiz, attendance, class participation, etc. 5%)

Course policies
Homeworks

- About 8 homework assignments (only count the best eight of each student)
- Show relevant steps and circle your final answer
- Homework solutions will be available on line after homework has turned in during class.

Exams

- All quizzes and the final exam will be closed book
- Two 80-minute in-class exams.
- Show relevant steps and give final answer.
- No make-up exams will be given.
- Students may bring one letter-size (8”x11”) formula sheet (both sides) with them to each exam and the final exam.

Computer Usage: Simulations using MATLAB.
Independent Learning Experiences: 1. Home-Work, 2. Exams