ECE 305 **Spring 2002**

Course: ECE 305, Electromagnetic Fields and Waves I

Time and Place: MWF, 11:30-12:20, Room 2250 Engineering Building

Professor: Dr. Leo C. Kempel, kempel@egr.msu.edu, 353-9944

Text:

1. Cheng, David K., *Field and Wave Electromagnetics*, Addison-Wesley, 1989 (elementary).
2. ECE 305 Class Notes (available at the Anthony Hall Copy Center).

References:

1. W.H. Hayt, *Engineering Electromagnetics*, 5th Ed. (and earlier), MGH, 1989 (elementary).
2. N.N. Rao, *Basic Electromagnetics with Applications*, Prentice-Hall, 1972 (elementary).
3. N.N. Rao, *Elements of Engineering Electromagnetics*, 3rd Ed., Prentice-Hall, 1991 (elementary).
4. C.H. Durney and C.C. Johnson, *Introduction to Modern Electromagnetics*, MGH, 1969 (elementary).
5. C.T.A. Jhonk, *Engineering Electromagnetic Fields and Waves*, 2nd Ed., Wiley, 1988 (elementary).
6. R. Plonsey and R.E. Collin, *Principles and Applications of Electromagnetic Fields*, MGH, 1961 (elementary/intermediate).
7. S. Ramo, J.R. Whinnery, and T. VanDuzer, *Fields and Waves in Communication Electronics*, 2nd. Ed., Wiley, 1984, (intermediate).

Exams: Two one-hour exams and a 2-hour final are anticipated. See the course outline for projected dates. NOTE: All exams are **Closed Book**, **Closed Notes** (e.g. bring a pencil and a calculator) unless otherwise stated by the Instructor.

Problem Sets: Problems will be assigned regularly; some will be graded in detail and others only scanned; they will influence the final grade.

Final Grade Breakdown:

two 1-hour exams	40%
final exam	40%
problem sets	20%
total	100%

ECE 305 – Electromagnetic Fields and Waves I

Course Outline

I. The Electromagnetic Model: Chapter 1, pp. 1-10

1. Axiomatic and empirical expositions
2. Field quantities and source densities
3. Overview of EM field equations

II. Vector Analysis: Chapter 2, pp. 11-71

1. Vector algebra
   1.a. Orthogonal coordinate systems
   1.b. Arithmetic operations; scalar and vector products
2. Calculus of scalar and vector fields
   2.a. Line, surface and volume integrals
   2.b. Vector differential operations (gradient, divergence, and curl)
   2.c. Vector integral identities
   2.d. Helmholtz theorem

III. Static Electric Fields: Chapter 3, pp. 72-151,

1. Axiomatic statement of free-space electrostatics
2. Coulomb's law; electric field maintained by a source system
3. Gauss's flux theorem
4. Electrostatic potential
5. Conducting and dielectric media; behavior of conductors, electric polarization and flux density
6. Boundary conditions
7. Electrostatic capacitance
8. Electrostatic energy and forces

IV. Solution of Electrostatic Problems: Chapter 4, pp. 152-188, 192-197

1. Poisson's and Laplace's equations for electric potential
2. Uniqueness theorem for Poisson's equation
3. Method of images
4. Separation of variables solutions to boundary-value problems in rectangular and plane-polar coordinates

V. Steady Electric Currents: Chapter 5, pp. 198-224

1. Current density and Ohm's law
2. EMF and Kirchhoff's voltage law
3. Charge conservation and Kirchhoff's current law
4. Power transfer and Joule's law
5. Current boundary conditions
6. Resistance

VI. Static Magnetic Fields: Chapter 6, pp. 225-306

1. Axiomatic statement of free-space magnetostatics
2. Magnetic vector potential
3. The Biot-Savart law
4. The magnetic dipole field
5. Magnetization and equivalent magnetization currents
6. Magnetic field intensity and permeability
7. Magnetic circuits
8. Magnetic field boundary conditions
9. Magnetic forces and torques

First hour exam: about 02/11
Second hour exam: about 03/18

Final Exam: Monday, April 29, 7:45-9:45 a.m.