Course Syllabus
Southeast Missouri State University

Department of Physics **Course No. PH371/PH504**
Title of Course: Electromagnetics **Revision: Spring, 1999**

I. Catalog Description

Electric field concepts; potential, dielectrics, magnetic fields, magnetic properties; Maxwell's equations and electromagnetic waves. Fall of odd years only. Prerequisites: PH231 and MA245. (3)

II. Prerequisites

PH231 General Physics II
MA245 Vector Calculus

III. Course Objectives

A. To provide the student with the fundamental concepts of electricity and magnetism.

B. To provide an understanding of the physical laws derived from the fundamental concepts of electricity and magnetism.

C. To apply the physical laws to solve simple problems in electro-magnetic theory.

IV. Expectations of Students

A. All students
1. To demonstrate a general understanding of the laws of electricity and magnetism.
2. To develop the ability to analyze and interpret problems dealing with electromagnetic fields.
3. To develop the ability to solve selected problems in electromagnetic theory and applications.

B. Graduate students - Demonstrate research ability by submitting an original term project related to Electromagnetics. The project will involve (1) computer programming (2) use of selected periodicals in the field of Electromagnetics (3) technical writing. The completed project report will be due one week before the final exam.

V. Course Outline (Hours)

A. Vector Calculus (6)
1. Orthogonal coordinate systems
2. Gradient of a scalar field
3. Divergence theorem

4. Divergence theorem
5. Curl of vector fields & Stokes' Theorem
6. Vector identities and tensor notation

B. Electrostatic fields (7)
1. Fundamental Postulates
2. Coulomb's Law
3. Gauss' Law and applications
4. Conductors in static electric fields
5. Dielectrics and fields
6. Boundary conditions and dielectric fields
7. Energy in electrostatic fields

One-hour examination #1 (1)

C. Solution of Electrostatic problems (5)
1. Poisson's and Laplace's equations
2. Method of images
3. Boundary-value problems in Cartesian coordinates
4. Boundary-value problems in curvilinear coordinates
5. Numerical methods of solution

D. Static Magnetic Fields (9)
1. Fundamental Postulates of Magnetostatics
2. Vector magnetic potential
3. Biot-Savart Law and applications
4. Magnetic dipole and quadrupole
5. Boundary conditions for current density and magnetic fields
6. Magnetic forces and torques
7. Self-inductance and mutual inductances
8. Magnetic circuits
9. Numerical methods of magnetic field computations

One-hour examination #2 (1)

E. Time-Varying Fields and Maxwell's Equations (15)
1. Faraday's Law of electromagnetic induction
2. Applications of time-varying magnetic fields
3. Maxwell's equation in free space
4. Integral form of Maxwell's equation
5. Potential functions
6. Wave equations and their solutions
7. Plane electromagnetic waves in lossless media
8. Polarization of E & M waves
9. Electromagnetic power transmission

One-hour examination #3 (1)

Total Hours: 45

VI. Textbook

Field and Wave Electromagnetics, David K. Cheng, Addison-Wesley, 1998.

VII. Basis for Student Evaluation

A. Undergraduate students
   1. Three 1-hour unit exams - 120 points
   2. Final exam - 80 points
   3. Homework - 100 points
   Total: 300 points

B. Graduate students
   1. Three 1-hour unit exams - 90 points
   2. Final exam - 80 points
   3. Homework - 80 points
   4. Term project - 50 points
   Total: 300 points