ENG EC 455 Electromagnetic Systems I

2008-2009 Catalog Data:
Prereq: CAS PY 212 and CAS MA 226. Electric and magnetic fields. Electromagnetic waves. Propagation, reflection, and transmission. Remote sensing applications. Radio frequency coaxial cables, microwave waveguides, and optical fibers. Microwave sources and resonators. Antennas and radiation. Radio links, radar, and wireless communication systems. Electromagnetic effects in high-speed digital systems. Includes lab. 4 cr.

Status in the Curriculum: Required

Class/Lab Schedule: 4 hours lecture/week; 1hour discussion.

Textbooks and other required materials:
K. Lonngren, S. Savov, and R. Jost, *Fundamentals of Electromagnetics with MATLAB,* SciTech Publishing, 2007.

Reference:
D. K. Cheng, *Fundamentals of Engineering Electromagnetics,* Addison-Wesley 1993.
L.C. Shen and J.A. Kong, *Applied Electromagnetism,* 3rd Ed., PWS 1995.
N. N. Rao, *Elements of Engineering Electromagnetics*, 5th Ed.**,** Prentice-Hall 2000.

Coordinator: Min-Chang Lee, ECE

Prerequisites by topic:
CAS PY 212 or PY 252, and CAS MA225 and MA 226

Goals:
To provide students with:
a thorough understanding of electromagnetic phenomena, as outlined in the catalog data above, in a broad frequency range based on Maxwell's Equations. Three demos: antenna systems, transmission lines, and microwave propagation with waveguides are used for teaching the key
elements of the course.

Course Outcomes:

As outcomes of completing this course, students should be able to:
(1) understand how to use Maxwell equations to study the reflection and refraction of electromagentic waves at plane boundaries for both normal and oblique incidence,
(2) analyze the wave characteristics of transmission lines in terms of propagation constants, input impedance, reflection coefficient, and standing wave ratio, and then solve the transmission
line circuit problems,
(3) understand the method for analyzing the wave behavior along uniform guiding

structures by solving homogenous vector Helmholtz's equations,
(4) examine the general characteristics of TM and TE waves, and know the cutoff and high pass properties of waveguides,
(5) examine wave modes, determine the resonance frequencies, and verify the high-Q property of cavity resonators,
(6) understand the general procedures for determine the electromagnetic fields radiated by an antenna with an assumed current distribution,
(7) understand the essential radiation characteristics (directive gain, directivity, power gain, radiation resistance, radiation efficiency) of an antenna, antenna patterns, antenna arrays,
(8) understand the concepts of effective area and backscatter cross section, and know how to derive the Friis transmission formula and the radar equation,
(9) understand some electromagnetic effects in high speed digital systems.

These outcomes will enhance students' knowledge of engineering electromagnetics and abilities of applied mathematics in solving practical problems, designing and conducting experiments.

Course Outcomes mapped to Program Outcomes:

Program Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**K**
Course Outcomes	**1-9**	**1,6,7,8**	**2, 4, 9**		**2,3, 4**	**9**	**6,7,8**	**1-9**	**1-9**	**9**	**1-9**
Emphasis (1-5)	**5**	**4**	**3**	**1**	**5**	**4**	**4**	**3**	**4**	**4**	**5**

1=not at all; 5=a great deal;

Contribution of Course to Meeting the Professional Component:
Engineering topics: 100%

Prepared by: Min-Chang Lee, Professor, ECE Department **Date:** 5/14/09