ELECTRICAL, COMPUTER, AND SYSTEMS ENGINEERING DEPARTMENT

ABET COURSE SYLLABUS

ECSE-2100: Fields and Waves I

Course Catalog Description:

Development and application of Maxwell's equations in free space and within materials. Introduction to vector calculus and computer-aided analysis and design methods in electromagnetics. Applications include calculation of lumped circuit elements from field theory, plane wave propagation in various materials, and reflection from boundaries. Transmission line concepts, Smith charts, and other design tools for distributed circuits.

Pre-Requisite Courses:

ECSE-2010 Electric Circuits

Co-Requisite Courses:

None

Prerequisites by Topic:

1. Ohm's Law
2. Passive Circuit Analysis
3. Thevenin and Norton Equivalent Circuits
4. Transformers
5. Frequency Response
6. Phasors
7. Familiarity with PSpice
8. Elementary static field theory
9. Elementary wave theory
10. First and second order differential equations

Textbook:
(and/or other required material)

Fawwaz T. Ulaby, "Fundamentals of Applied Electromagnetics" Prentice Hall 5th Edition, 2006

References:

Course notes by Connor and Salon.

Course Coordinators:

Kenneth A. Connor & Sheppard J. Salon

Overall Educational Objective:

To prepare junior EE and EPE majors to utilize basic electromagnetic field concepts

Course Learning Outcomes:

Students will be able to:

1. Obtain solutions to Laplace's and Poisson's equations for simple configurations of materials and sources.
2. Determine the capacitance of simple practical systems of conductors
3. Determine the self and mutual inductance of simple practical current carrying systems
4. Apply the basic principles of electromagnetic motors and generators
5. Determine the transmission of power by low loss TEM transmission lines from a simple source to a passive load
6. Determine the reflection and transmission of power for uniform plane waves incident on planar material boundaries for low loss or conducting media

How Course Objectives are Assessed:

3 Tests	34.5%
8 Homework Assignments	18.4%
25 Online Quizzes	12.6%
2 Design Projects	11.5%
Final Exam	23%

Relation to EE/CSE/EPE Outcomes

Outcome	Level	Demonstrate Proficiency
	N, M, H	e.g. Exams, Projects, HW
Mathematics, science and engineering	H	Exams, Projects, HW

N = none
M = moderate
H = high

Basic disciplines in Electrical Engineering	H	Exams, Projects, HW
Depth in Electrical Engineering	N	
Basic disciplines in Computer & Sys. Eng.	N	
Depth in Computer and Systems Eng.	N	
Basic disciplines in Electric Power Eng.	H	Exams, Projects, HW
Conduct experiments and interpret data	M	Projects, HW Experiments
Identify, formulate and solve problems	H	Projects, HW, Exams
Design a system, component or process	M	Projects
Communicate in written and oral form	M	Projects
Function as part of a multi-disciplinary team	M	Projects
Preparation for life-long learning	N	
Ethical issues; safety, health, public welfare	N	
Humanities and social sciences	N	
Laboratory equipment and software tools	M	HW, HW Experiments , Projects
Variety of instruction formats	M	Lecture, recitation, studio

Topics Covered:
(number of hours or classes for each)

1. Transmission Lines – 11.5 classes
2. Electrostatics – 10.5 classes
3. Magnetostatics & Magnetodynamics – 8.5 classes
4. Plane Electromagnetic Waves – 8.5 classes

Computer Usage:

Students use the RPI Mobile Studio Hardware/Software Platform, PSpice to analyze transmission lines, Excel to solve Poisson's and Laplace's Equations, Maple to evaluate integrals, Matlab for various purposes, Agilent Intuilink for capturing data from 'scopes, various applets for capacitance, inductance and resistance calculations, Agilent AppCad for a variety of applications

Laboratory Experiences:

1. Introduction to Electromagnetics Lab: Coaxial cable transmission line, artificial transmission line, electromagnetic noise measurement, two-wire line capacitive coupling, building and characterizing a simple transformer, simple magnetic motion sensor
2. Building a small DC motor, measuring motor speed, circuit modeling of the motor

Design Experiences:

1. Cable TV Channel Blocker – Application of Transmission Line Concepts, measurement of frequency response at CATV frequencies
2. Beakman's Motor – A small DC motor
3. Extra Credit – Paper Clip Launcher – simple electromagnetic launcher

Independent Learning Experiences:

1. Some research required for projects and homework

Class/Lab Schedule:

Monday and Thursday Lectures from 4 – 5:50 pm, Wednesday Recitation or Studio Session (2 Hrs each section)

Contribution to the Professional Component:

(a) College-level mathematics and basic sciences:	1.5 credit hours
(b) Engineering Topics (Science and/or Design):	2.5 credit hours
(c) General Education:	0 credit hours

Prepared by:	Kenneth A Connor
Date:	14 September 2009