Syllabus

EECE 380- Engineering Electromagnetics (3 Credits)

(Fall 2010-2011)

Instructors

Name: Riad Chedid
Office: Bechtel Room 303
Extension: 3542
Email: rchedid@aub.edu.lb

Name: Shahwan Khoury
Office: RGB, Room
Extension:
email: shahwank@aub.edu.lb

Catalogue description

This course covers the fundamentals of applied electromagnetics by emphasizing physical understanding and practical applications in Electrical and Computer Engineering systems. It deals with the study of static electric fields in vacuum and dielectrics, conductors, capacitance, electrostatic energy and forces, Poisson's equation, static magnetic fields, Biot-Savart law, Ampere's law, vector magnetic potential, inductance, Maxwell's equations for time varying fields, Faraday's law, plane wave propagation, time-harmonic fields, propagation in lossless media, and wave reflection and transmission at normal incidence. The bridge between electric circuits and electromagnetics is done through the study of transmission lines and their lumped-element model, transmission line input impedance, and power flow on lossless transmission line.

Required or Elective

Required for EE and CCE

Prerequisites

By courses:
ASST 312: Application of Analytical Methods in Engineering I
ASST 313: Application to Analytical Methods in Engineering II.

By topic:
Electricity and magnetism
Vector algebra and Vector Calculus
Differential Equations

Textbook(s) and/or required materials

F. T. Ulaby. Electromagnetics for Engineers. Pearson Education, Inc., 2005.

Course objectives

The objectives of this course are to give students:
1. An introduction to the general field of electromagnetism.
2. An understanding of basic electromagnetic concepts and parameters necessary for the analysis and design of electromagnetic systems.
3. Mathematical and scientific skills relevant to electromagnetic systems.
4. Basic analysis techniques needed when formulating and solving electromagnetic problems.
5. A broad outlook and appreciation of the contribution of electromagnetics to the fields of electrical, computer, and communication engineering.
6. The technical foundation required for more advanced future courses in applied electromagnetics engineering.
7. An understanding of how to bridge between the concepts of electric circuits and the concepts of electromagnetics as presented.

Course Management

No.	Topic	Hours
2	**Vector Analysis** 2.1 Basic Laws of Vector Algebra 2.2 Orthogonal Coordinate Systems 2.3 Transformations between Coordinate Systems 2.4 Gradient of a Scalar Field 2.5 Divergence of a Vector Field 2.6 Curl of a Vector Field 2.7 Laplacian Operator	**3**
3	**Electrostatics** 3.1 Maxwell's Equation 3.2 Charge and Current Distributions 3.3 Coulomb's Law 3.4 Gauss's Law 3.5 Electric Scalar Potential 3.6 Electrical Properties of Materials 3.7 Conductors 3.8 Dielectrics 3.9 Electric Boundary Conditions 3.10 Capacitance	**8**
4	**Magnetostatics** 4.1 Magnetic Forces and Torques 4.2 The Biot-Savart Law 4.3 Magnetic Forces between Two parallel Conductors 4.4 Maxwell's Magnetostatic Equations 4.5 Vector Magnetic Potential 4.6 Magnetic Boundary Conditions 4.7 Inductance	**8**
5	**Maxwell's Equations** 5.1 Faraday's Law 5.2 Stationary/moving loop in a Time-Varying Magnetic Field 5.3 Displacement Current	**7**
6	**Plane-wave Propagation** 6.1 Review of Waves and Phasors 6.2 Time-Harmonic Fields 6.3 Plane-Wave Propagation in Lossless Media 6.4 Wave Polarization	**5**
7	**Transmission Lines** General Considerations Lumped-Element Model Transmission-Line Equations Wave Propagation on a Transmission Line The Lossless Transmission Line Input Impedance of the Lossless line Special Cases of the Lossless Line Power Flow on a Lossless Transmission Line	**8**
8	**Wave Reflection and Transmission** 8.1 Wave Reflection and Transmission at Normal Incidence	**3**

Course outcomes

At the end of the course, students:
1. Are knowledgeable in static electric and magnetic fields.
2. Demonstrate an ability to apply Gauss' law, Ampere's Law, Biot-Savart law, Faraday's law and Maxwell's equations in the analysis of electromagnetic systems.
3. Are familiar with the different vector operators used in Maxwells' equations and plane wave analysis.
4. Are familiar with the four Maxwell's equations used to study time-varying EM or dynamic fields.
5. Are familiar with Lenz's law and the concept of induced emf.
6. Understand the concept of uniform TEM plane-wave propagation.
7. Understand the concept of plane-wave polarization.
8. Understand the concept of electromagnetic power density flow in lossless medium.
9. Are able to apply Electromagnetics boundary conditions to solve for fields at interface between two different charge-free mediums.
10. Understand the concept of plane wave reflection and transmission at normal incidence.
11. Are able to come up with a basic transmission line analogue for the case of a plane wave incident at multiple dielectric interfaces
12. Understand the voltage and current wave equations along a transmission line.
13. Understand the concepts of incident and reflected waves, reflection coefficient, and Standing-Wave Ratio along a transmission line.
14. Understand the concepts of power flow, power loss, and maximum power transfer along a transmission line.
15. Understand basic concepts of matched line and quarter-wave transformer.
16. Have been exposed to at least one electromagnetic system application.

Resources of the course

Textbook, problem solving sessions, previous tests, WebCT

Course Composition:

3 Lectures/week, Problem Solving Sessions, 2 quizzes and a Final Exam.

Assessment

Final exam	35%
Quiz1	30%--Nov. 8, 2010 at 18:00 Hrs in Wing D
Quiz 2	30%--Dec 14, 2010 at 18:00 Hrs in Wing D
Class attendance	5%