ELEG 4783 - INTRODUCTION TO ANTENNAS
TECHNICAL ELECTIVE

Credits and Contact Hours

Three credit hours, 45 hours of instructor contact

Instructor's Name: Magda El-Shenawee

Textbook
Warren L Stutzman and Gary A. Thiele, Antenna Theory and Design, second edition, Wiley 1998.
Reference
C. A. Balainis, *Antenna Theory: Analysis and Design*, John Wiley & Sons, 1997.

Catalog Description: Basic antenna types: small dipoles, half wave dipoles, image theory, monopoles, small loop antennas. Antenna arrays: array factor, uniformly excited equally spaced arrays, pattern multiplication principles, nonuniformly excited arrays, phased arrays. Using the commercial electromagnetic simulator package (HFSS) for antenna analysis and design. Emphasis will be on using simulation to visualize variety of antenna radiation patterns, fabrication of antennas using photolithography and measuring the reflection coefficient of the designed antenna using the Network Analyzer.

Prerequisite: ELEG 3704.

Prerequisites by Topics
1. Maxwell's equations
2. Boundary conditions for electric fields
3. Boundary conditions for magnetic fields
4. Vector analysis and integration
5. Divergence and Stocks Theorem and the Image Theory

Course Objectives
After completing this course, electrical engineering students should be able to learn the following:
- The principles of electromagnetic energy radiation in free space by antennas.
- A basic understanding of antenna fundamentals, antenna parameters, characteristics of various antenna types such as dipole antenna, monopole antenna, loop antenna, etc
- Computer techniques for antenna performance analysis
- Design of single antenna
- Design of array of antennas for beam focusing
- Fabricate single antenna to operate in microwave frequency range
- Conduct measurements of reflection coefficient of the antenna (S11)
- Basic knowledge of using the Network Analyzer

Topics
1. Introduction to antenna types (2 classes)
2. Potential functions (3 classes)
3. Radiation by a current element (2 class)
4. Radiation from current sheet (1class)
5. Quarter-wave Monopole or Half-wave dipole (1 class)
6. Loop antenna (1 class)
7. Near field to an antenna (1 class)
8. Far field approximation (1 class)

9. Visualization using HFSS package (3 classes in the computer lab)
10. Antenna fundamentals, network theorems (1 class)
11. Traveling wave Antenna (1 class)
12. Antenna arrays (6 classes)
13. Design of antenna arrays (4 classes)
14. Final Project discussion and clarifications (1 class)
15. Fabrication in the photolithography lab (1 class)
16. Measurements in the Network Analyzer Lab (1 class)
17. Examinations (2 take home projects)

There are two (2) 80-minute class periods per week for a total of 15 weeks. 3 Credit hours class

Computer Usage

- Extensive learning experience to use the electromagnetic simulator (HFSS) to design and analyze the antenna performance.
- The students are required to use the computers to plot their results in project reports

Oral/Written Communications

Not addressed

Design Activities

The students practice on several design problems regarding single antenna of specific performance and array of antennas for beam focusing. The antenna will be fabricated and measured at the end of class. Each student will design his/her own antenna.

Relationship of Course to ABET Program Outcomes

OUTCOME	HOW IT WAS ADDRESSED
(a)	Ability to solve the potential function, deriving the electric and magnetic fields in the far- and near- regions, deriving the radiation using current sources
(b)	Ability to muse the HFSS to design a single antenna and ability to use the material data sheet obtained from the manufacturer. The learning of conducting actual measurement of the reflection coefficient of the designed and fabricated antenna
(c)	Ability to design several antennas either single element or in a linear or two-dimensional array of elements
(d)	Not addressed
(e)	Ability to identify the requirements of certain simple antennas and work out the design of the antennas along with proving the performance as required
(f)	Not addressed
(g)	Not addressed
(h)	Understanding the relationship between the subjects of antennas as related to everyday life of the students through the use of cell phones or satellite communications. These issues are often discussed when designing the antennas and showing the antenna performance.
(i)	Not addressed
(j)	Not addressed
(k)	Ability to use of HFSS antenna design and visualize the radiation pattern of the antenna on the computer. Using the commercial electromagnetic simulator package (HFSS) is a highly preferred skill for antenna engineers

Professional Components

Mathematics:	30%
Sciences:	5%
Engineering Science:	10%
Engineering Design:	50%
General Education:	5%

Prepared by: Magda El-Shenawee **Date**: October 2013