Introduction to Antennas 1

Prerequisite
Introductory course covering electromagnetism in electrical engineering (Maxwell's equations, electric and magnetic fields, boundary conditions) or closely related course.

Description
This course contains is an in-depth exploration and analysis of the basic antenna types: small dipoles, half wave dipoles, image theory, monopoles, and small loop antennas. These concepts are applied to the completion of realistic projects utilizing the commercial electromagnetic simulator package (HFSS) for antenna analysis and design. Emphasis will be on using simulation to visualize a variety of antenna radiation patterns, fabrication of antennas using a milling machine and measuring the reflection coefficient and radiation pattern of the designed antenna using the Network Analyzer.

Course Objectives
After completing this course, students will be able to:
- Articulate the principles of electromagnetic energy radiation in free space by antennas.
- Examine antenna fundamentals, antenna parameters, characteristics of various antenna types such as dipole antenna, monopole antenna, loop antenna, etc.
- Utilize commercial simulation software (HFSS) for antenna performance analysis.
- Design a single antenna using HFSS.
- Fabricate a single antenna to operate in microwave frequency range.
- Clarify measurements of reflection coefficient of the antenna and its radiation pattern.
- Clarify the process and function of the Network Analyzer.

Textbook
Warren L Stutzman and Gary A. Thiele, Antenna Theory and Design, 3rd edition, Wiley 1998.

Specific topics (Chapters 1, 2, 3, 5, 11):
1. Introduction of antennas concepts.
2. Review of transmission line theory.
3. Electromagnetic spectrum.
4. Antenna characteristics (radiation pattern, directivity, gain, impedance, bandwidth, and polarization).
5. EM fundamentals (quick review of Maxwell's equations).
6. Ideal dipole antenna.
7. Antenna near and far field approximations.
8. Radiation pattern of ideal dipole and E- and H- planes.
9. Line source antenna of arbitrary length.
10. Ray approximation of antenna far field.
11. Radiation pattern of line source fed with uniform current.
12. Half wavelength dipole and monopole antennas.
13. Small loop antenna.
14. Microstrip patch antennas.
15. Visualization using HFSS package (recorded lab tutorial).
16. Final project to design specific microstrip antenna, fabrication and measurement.
17. Fabrication tutorial using milling machine (recorded lab tutorial).
18. Measurements tutorial using the Network Analyzer (recorded lab tutorial).

Course Certificate
In order to receive a certificate of completion for this course, you need to submit the required reports of Project 1, Project 2 and Final Project. In the meantime, the Teaching Assistant will help you in revising your projects to achieve satisfactory reports. The fabrication and measurement of your designed antenna will be conducted by the Teaching Assistant as part of your fees paid in this course.