EECE 174
Fall 1999

EECE 174 - Antenna Theory and Design

Course Description:
Design and use of antennas of varying types, including wire, broadbands, horn, and reflector antennas in transmitting and receiving applications. The application and design of antenna arrays, and an introduction to diffraction theory.

Prerequisites: EECE 122

Course Materials:
Required: W. L. Stutzman and G. A. Thiele, Antenna Theory and Design, 2nd Ed., John Wiley & Sons, 1998.
Optional: None

Course Goals:
To enable the students to understand, analyze, and design antennas and arrays of varying types and to introduce numerical methods, including the method of moments, and high frequency techniques.

Course Objectives
By the end of this course, you should....
- Be able to compute the far field distance, radiation pattern and gain of an antenna given the current distribution.
- Be able to estimate the input impedance, efficiency and ease of match for antennas.
- Be able to compute the array factor for an array of identical antennas.
- Be able to design antenna arrays for various desired radiation pattern characteristics.
- Be able to design wire antennas, including dipoles, monopoles, folded antennas, Yagi-Uda antennas.
- Be able to design traveling wave wire antennas, including Beverage antennas and rhombic antennas.
- Be able to design helical antennas for both the normal mode and axial mode of operation.
- Be able to design broadband and frequency independent antennas.
- Be able to analyze and design horn antennas and reflector antenna systems.
- Be able to use the concepts of diffraction theory and physical optics to develop intuition regarding radiation and scattering of fields.
- Be able to use the method of moments to analyze wire antennas.

Course Topics:
Antenna Fundamentals
- Radiation Pattern
- Antenna Impedance and Efficiency
- Antennas in Comm. Links and Radar
- Receiving Properties of Antennas
- Power Budget Calculations

Simple Radiating Systems
- Image Theory

- Small Antennas
  - Half Wave Dipole
- Arrays of Antennas
  - Uniform Linear Arrays
  - Endfire Arrays
  - Pattern Synthesis
- Line Sources
  - Uniform Line Source
  - Tapered Line Sources
- Wire Antennas and Moment Methods
  - The NEC Code
  - Dipoles (straight, folded, vee)
- Wire Antenna Feeds
  - Traveling Wave Wire Antennas (including Beverage, vee, and rhombic antennas)
- Broadband Antennas
  - Aperture Antennas
- High Frequency Techniques

Class Schedule: 3 Credit course, meeting the equivalent of 3-50 minute class periods per week.

Contribution to Professional Component:

Engineering Science	50 %
Engineering Design	50 %

Contribution to Program Objectives: partial fulfillment of Criterion 3 objectives A, C, E, G, K, L

Prepared by: James E. Richie January 12, 2000
Course Coordinator: James E. Richie

Last modified: July 13, 2000

EECE 174: Antenna Theory and Design
ABET Objectives,
Assessment Instruments, and
Assessment Criteria

(A) An ability to apply knowledge of mathematics, science, and engineering:
Demonstrated competence in course work to learn materials and concepts of antennas and propagation as listed in the Goals document for EECE 174 (attached).
Tests and homework will demonstrate such competence. Minimum competence is defined to be a 75% average on all tests and homework assigned during the semester.

(C) An ability to design a system (sic) to meet desired needs:
Design Project work - for each design project, students are required to design an incompletely defined system to satisfy typical needs. Choices made are to be justified and explained with respect to the implications for the final design.
Minimum competence - grade of C on written design reports where grade includes engineering development, use of concepts, etc.

(E) An ability to identify, formulate, and solve engineering problems.
Demonstrated competence in course work to learn materials and concepts of antennas and propagation as listed in the Goals document for EECE 174 (attached).
Design Project work - for each design project, students are required to design an incompletely defined system to satisfy typical needs. Choices made are to be justified and explained with respect to the implications for the final design.
Minimum competence - grade of C on written design reports where grade includes engineering development, use of concepts, etc. Tests and homework will demonstrate such competence. Minimum competence is defined to be a 75% average on all tests and homework assigned during the semester.

(G) An ability to communicate effectively
Design Project work - for each design project, students are expected to write a report detailing the task, ideas, tradeoffs, and proposed solution. In addition, a term-paper on a topic of the student's choice related to antennas is completed.
Minimum competence - grade of C on written design reports where grade includes English, use of references, structure of the report, etc.

(K) An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.
Use of Method of Moments - This course includes the use of a program that solves integral equations (a topic in higher engineering mathematics) as related to antenna design. The theory and application of the Numerical Electromagnetics code is covered in class, and the code is applied to homework assignments, with optional use in design projects, term papers, etc. Demonstrated competence in course work to learn materials and concepts of antennas and propagation as listed in the Goals document for EECE 174 (attached).
Tests and homework will demonstrate such competence. Minimum competence is defined to be a 75% average on all tests and homework assigned during the semester.

(L) An ability to apply probability and statistics and higher mathematics to the solution of

engineering problems.
Use of Method of Moments - This course includes the use of a program that solves integral equations (a topic in higher engineering mathematics) as related to antenna design. The theory and application of the Numerical Electromagnetics code is covered in class, and the code is applied to homework assignments, with optional use in design projects, term papers, etc.

Evaluation of Objective Attainment - Continuing Course Review

At the end of each semester, instructors of this course will submit a short written report to the Course Coordinator for EECE 174 which

a) discusses their perceptions of student knowledge and ability to apply the listed prerequisites, and
b) provides qualitative and quantitative information which discusses the attainment of objectives listed above for EECE 174.

The Course Coordinator will review these reports with the instructors and in consultation with the instructors recommend modifications and/or enhancements to the objectives and criteria as needed. The recommendations will be forwarded to the EECE Undergraduate Committee for approval.

Last modified: July 13, 2000