

EE 438 – Antenna Engineering

Designation: EE elective course for electrical engineering majors.

University Bulletin Description:

Antenna Engineering (3): Radiation from small antennas, linear antenna characteristics, arrays of antennas, impedance concepts and measurements, multifrequency antennas, and aperture antennas
Prerequisite: EE 330.

Textbook/Required Materials:

ANTENNA THEORY, ANALYSIS AND DESIGN, Third Edition, Constantine A. Balanis, John Wiley & Sons, Inc., New York, 2005.

Learning Outcomes:

The student is expected to gain an understanding of the performance metrics, such as input impedance, radiation patterns, directivity, gain, polarization, and efficiency associated with various classes and types of antennas. The student will also learn to calculate and use these metrics through the study of specific antennas such as center-fed dipoles, monopoles, loops, phased arrays, broadband antennas, Yagi antennas, traveling wave antennas, and aperture antennas.

Topics:

1. Overview of Different Antenna Types (Ch.1 – 1 class)
2. Antenna Fundamentals and Definitions (Ch. 2 – 2 weeks)
3. Radiation Integrals and Auxiliary Potential Functions (Ch. 3 – 2 weeks)
4. Linear Wire Antennas: Infinitesimal Dipole, Small Dipole, Finite Length Dipole (Ch. 4 – 2 weeks)
5. Loop Antennas (Ch. 5 – 1 week)
6. Arrays: Uniformly Excited Equally Spaced Linear Arrays, Nonuniformly Excited Equally Spaced Linear Arrays (Ch. 6 – 3 weeks)
7. Input Impedance of Dipoles, Mutual Impedance of Arrays, Driving Point Impedance of Arrays (Sec. 2.13, Secs. 8.5-8.7 – 2 weeks)
8. Yagi-UDA Antennas (Sec. 10.3.3 – 1 week)
9. Broadband Antennas (Ch. 11 – 2 weeks)

Class/Laboratory Schedule:

Three 50 minute classes per week.

Computer Usage:

Each student is required to use a computer for the design projects. In most instances the student must write custom software for the particular design project assigned. Also students will be required to learn how to use an industry standard antenna modeling code.

Laboratory Projects/Assignments:

Throughout the course, students are introduced to and utilize an advanced antenna computer modeling software package for carrying out assigned projects and use in homework problems. They are also assigned a group design project during the last third of the course where extensive use of the software package is required. Each group gives an oral presentation of the project and the results during the last week of class and turns in a final report. There are a total of six laboratory assignments (each two weeks long) and a final project (three weeks long). The laboratory assignments are based on the six course topics. The final project is a design project in which students use a combination of the techniques learned in class to create their own unique version of the Penn State fight song, Fight On, State.

Contribution to Meeting the Requirements of Criterion 5. Curriculum:

This course contributes to both the engineering topics and design components.

Relationship to Program Outcomes:

- O.1.1. Graduates will possess mathematics skills necessary for electrical engineering.
- O.1.2. Graduates will have a theoretical and practical background in both physics and chemistry.
- O.1.3. Graduates will have attained computer proficiency.
- O.2.4. Graduates will understand fundamental electricity and magnetism concepts and be able to use them in applications.
- O.3.1. Graduates will have in-depth technical knowledge in one or more areas of specialization.
- O.3.2. Graduates will have practical understanding of the major electrical engineering concepts and demonstrate application of their theoretical knowledge of the concepts.
- O.4.1. Graduates will interact with industry both within and outside of a classroom setting.
- O.4.2. Graduates will develop an appreciation of continuing educational and professional development.
- O.5.1. Graduates will have good teamwork skills.
- O.5.2. Graduates will possess good oral and written communication skills.

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