

## EE 402W – Senior Project Design in Electromagnetics

**Designation:** Required course (or replaced by EE 403W) for electrical engineering majors.

**University Bulletin Description:** EE 402W: (3) Project designs of antenna and microwave systems, with an emphasis on technical communication skills. Lab.

Prerequisite: EE 330. Prerequisite or Concurrent: ENGL 202 C.

### Prerequisites by Topics:

1. Fundamentals of technical writing
2. Fundamentals of public speaking and discussions
3. Competency in all core EE "C-or-better" material
  - Basic circuits and devices (EE 210)
  - Electronic circuit design (EE 310)
  - Embedded microcontrollers (EE 324)
  - Engineering electromagnetics (EE 330)
  - Continuous time linear systems (EE 350)
  - Basic digital systems (CSE 271)
4. Competency in two EE technical electives.

**Textbook/Required Materials:** *Microwave Engineering*, 2<sup>nd</sup> edition, by David Pozar, Wiley, 1998.

**Learning Outcomes:** Upon completion of this course, students should be able to:

1. complete a capstone design project integrating the knowledge obtained in previous EE classes,
2. accurately communicate their project results, both in written report and in oral presentation formats
3. understand how teams work and how to interact in a team setting,
4. understand schedules and deadlines,
5. understand what it is like to work in industry,
6. appreciate the role of engineering in society, and the complexity of ethical issues.

### Topics:

Throughout the semester, most of the lecture periods are devoted to general topics concerning professional engineering issues. The subjects of these lectures vary but generally are concerned with “life as an engineer” topics that are not purely technical in nature. Topics typically include entrepreneurship, job interviewing, whether to go to graduate school, ethics, intellectual property, presentation techniques, technical writing, project management, engineering economics, etc. Many of these lectures are held jointly with students from EE 403W, which is an alternative course. Roughly one-half of the weekly lectures are provided by the instructors of the course, and the remainder of the lectures are provided by guest speakers from industry.

**Class/laboratory schedule:** Two 50-minute lectures, one 180-minute laboratory per week

### Computer usage:

The students use design software such as Microwave Office to optimize a microwave filter or conformal antenna that is designed, built and tested to compare the simulation with the measured performance. All teams use application software to prepare written reports and create presentations.

### Laboratory Projects/Assignments:

The students complete 3 two-week projects that relate to the type of design project used for the semester in either conformal antennas or microwave filters. The first assignment is introductory and develops the computer software to the point that the students can utilize its basic functions. The second assignment applies the software to a specific problem in design to illustrate the capability of the software. The third

assignment is similar to a student design project and demonstrates the expectation of a final project in scope and depth of analysis. These 3 assignments are designed to bring the student to a point that they can manage a semester project and complete a unique design in electromagnetics on their own.

The projects are developed by each group individually with the guidance of the instructor at an appropriate depth that an industrial capability is required. The students present the initial concept in a proposal and then develop it into a Preliminary Design Review (PDR) for the class. Near the end of the semester a Critical Design Review (CDR) is presented to the entire class by each group and the class joins in the final development of the project which is presented to the class and an outside evaluator who has not seen the project materials before. A project presentation utilizes Power Point and must compare simulations with actual measurements on the same graphics. The groups describe why the observed performance is different or similar to the simulated results. Oral presentations are evaluated and a formal written report is required.

**Contribution to Meeting the Requirements of Criterion 5. Curriculum:**

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

Most of the course is devoted to a major design experience that builds on knowledge gained in previous courses. Text material that was covered in ED&G 100 (The Design Process, Development Processes and Organization, Identifying Customer Needs, Product Specifications, Concept Generalizations, Concept Selection, The Role of Ethics in Engineering Design, Engineering as Social Expression, Workplace Responsibilities and Rights, Global Issues) is provided again as a required reference for guidance during the design process. Professional lectures and discussions provide help for students in the transition from the academic environment to the working world.

**Relationship to Program Outcomes:**

- O.1.1. Graduates will possess mathematics skills necessary for electrical engineering.
- O.1.3. Graduates will have attained computer proficiency.
- O.2.1. Graduates will understand how to analyze and design simple electrical/electronic circuits.
- O.2.3. Graduates will understand the basic concepts of linear systems and how they interact with continuous-time signals.
- 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.
- O.6. Graduates will appreciate their role as engineers in society.

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