**Syllabus**

**ECE 445 - Senior Design Project Laboratory**

**Fall 2024**

| **Title** | **Rubric** | **Sec** | **CRN** | **Type** | **Hours** | **Times** | **Days** | **Location** | **Instructor** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Senior Design Project Lab | ECE445 | H | 29951 | LAB | 4 | 1600 - 1750 | T | 1002 Electrical & Computer Eng Bldg | [Arne Fliflet](https://ece.illinois.edu/directory/faculty/afliflet) [Kejie](https://ece.illinois.edu/directory/faculty/songp) Fang |

**Web Page**

<https://courses.engr.illinois.edu/ece445/>

**Official Description**

Team-based design projects in various areas of electrical and computer engineering; projects are chosen by students with approval of instructor. A professionally kept lab notebook, a written report, prepared to journal publication standards, and an oral presentation required. Course Information: 4 undergraduate hours. No graduate credit. Class Schedule Information: Additional Laboratory time to be arranged in 2070 ECEB.

**Subject Area**

* Core Curriculum

**Course Directors**

[Rakesh Kumar](https://ece.illinois.edu/directory/faculty/rakeshk) [Michael L Oelze](https://ece.illinois.edu/directory/faculty/oelze)

**Description**

Individual design projects in various areas of electrical and computer engineering; projects are chosen by students with approval of the instructor; a written report, prepared to journal publication standards, and an oral presentation are required.

**Notes**

Credit is not given toward graduate degrees in Electrical and Computer Engineering.

**Goals**

The objective is to understand the process of project design through experience. The student will produce a schematic drawing (design), breadboard a functional (working) product, test, and document the project. The project experience will exercise engineering skills with an emphasis on testing, as well as cost and scheduling. Students will also provide written documentation of their projects and learn writing skills through feedback from staff.

**Topics**

* Preliminary activity
* Initial design phase
* Construction and evaluation

**Detailed Description and Outline**

The objective is to understand the process of project design through experience. The student will produce a schematic drawing (design), breadboard a functional (working) product, test, and document the project. The project experience will exercise engineering skills with an emphasis on testing, as well as cost and scheduling.

Topics:

* Preliminary activity
* Initial design phase
* Construction and evaluation
* To broaden perspectives, a lecture module in the second lecture session will be provided by a female entrepreneur describing their experience(s) in design and translation. The speaker will also be asked to discuss their experiences related to challenges that may be encountered by female engineers and entrepreneurs in male dominated working environments and how to best mitigate them.

Credit is not given toward graduate degrees in Electrical and Computer Engineering.

**Computer Usage**

Computers are used wherever they can support the project design and documentation, or as part of the working project. Word processors, network simulators, drawing programs, schematic capture, printed circuit layout, cross assemblers and emulators, and direct digital I/O are all used.

**Lab Projects**

One self-chosen project is executed usually by a team of two or three persons. Standard bench equipment is supplemented, as needed, with curve tracers, digital oscilloscopes, logic analyzer, distortion analyzer, spectrum analyzers, and network analyzer.

**Texts**

No text.

**Course Goals**

The objective is to understand the process and elements of an electrical engineering project design through experience.

**Instructional Objectives**

The students (in teams of 2 or 3) will produce a project proposal with an original solution to a problem of the student’s choosing, a matched list of requirements and verifications (testing), schematic drawings, diagrams and simulations of the project components (design) and a functional (working) product. The course will provide resources which include circuit design and simulation tools, a laboratory equipped with design and test equipment and parts. A faculty of advisors will be available to steer and scope the initial concepts. The students will test functionality and document the project. The experience will include a design review, progress reports, laboratory notebooks, demonstration of the finished work and a formal project presentation. There will be an emphasis on modularity of design and testing. There will be realistic considerations estimating and controlling project cost and schedule. Ethical considerations in general and specific to the project will be addressed.

1. During the second lecture period, a module will be provided by a female entrepreneur describing their experience(s) in design and translation. Students should be able to
2. Identify contributions of women in the design process.
3. Identify contributions of women to entrepreneurship and translation.
4. By the time the students have submitted their Project Proposal, they should be able to

1. Define a clear motivation for the project chosen.

2. Select a team partner and develop a working relationship with that person.

3. Define a block level diagram of the project.

4. Assemble writing and graphical skills to assemble proposal.

5. Develop a schedule for the fabrication and assembly.

6. Investigate a project cost (parts and labor).

C) By the time of the Design Review, they should be able to

1. Create a complete, descriptive list of project requirements and match them with specific tests.

2. Assemble a detailed schematic of the board level design.

3. Perform a circuit simulation of the design (as appropriate).

4. Assemble a complete parts list.

5. Discuss the IEEE Code of Ethics and how the code relates to their work.

D) By the time they perform the Project Build, Fabrication and Testing, they should be able to

1. Follow procedures to acquire parts.

2. Assemble and test (using laboratory equipment), circuit elements.

3. Work with their partner, advisors, and shop personnel to accomplish project elements.

4. Be cognizant of schedule pressures.

5. Recognize the real fabrication world has an entire set of problems not defined in B) above.

E) By the time of the first Individual Report, they should be able to

1. Give a concise report of accomplishments and set-backs.
2. Identify next steps to overcome problems.
3. Update the early schedule.

F) By the time they perform the Project Demonstration, they should be able to

1. Describe engineering accomplishments and failures of the project.

2. Understand the failures and how approaches would be different.

3. Prepare for a hardware review in a timely manner.

4. Demonstrate teamwork through a shared presentation and team knowledge of the project.

G) By the time they perform their Project Presentation, they should be able to

1. Translate the essence of the design project to overheads.

2. Time share a presentation with their partner.

3. Organize so that all elements are presented in a logical order.

4. Develop electronic and oral communication skills.

5. Appear as a professional.

6. Review peers professionally.

7. Identify any ethical concerns with the project and discuss the IEEE Code of Ethics.

H) By the time they present their Final Report, they should be able to

1. Communicate their technical accomplishments with graphics in a logical manner.

2. Write a professional report with publication quality which:

a) Is written correctly for a defined format and

b) Is written with correct English grammar and spelling.

**ABET Programs Outcomes and Assessment. ECE 445 addresses the following:**

1*. Principles: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics*([1](javascript:null(0);))

This is an important attribute of successful project engineering in ECE445. Engineering principles and mathematics are used in analysis activities, designing of electronic components and integration and in calculations of circuit parameter values. Students formulate their own problems and solve them as engineering design projects. The project identification and formulation is supported by a staff of advising faculty as well as the Teaching Assistants assigned to the class. Most all projects require simulation of circuitry wherein the knowledge of mathematics and basic and engineering sciences are applied in solving the simulation problems. Plots and graphs of spectra are especially important. Advanced mathematical skills (EE) are employed by a few projects each semester in complex simulations and control projects.

*2. Design: an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors* ([2](javascript:null(0);))

The major focus of ECE445 is to exercise this activity. Students design a system that is functionally tested and demonstrated as part of the course grade.

*3. Communication: an ability to communicate effectively with a range of audiences* ([3](javascript:null(0);))

Both informal and formal communication skills are exercised and graded. Informal meetings including the design review require shared presentations by all participants on the team. Weekly design meetings by the TA and e-mail are all encouraged and used in the class. A discussion board is a new method which has proven effective for student discussions leading and formulating projects. Individual written reports are required, and graded with feedback for revisions. Formal presentations are required by all students in the final review of the projects, with formal attire and PowerPoint computer presentation of material.

*4. Professionalism: an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts* ([4](javascript:null(0);))

Team work and professionalism is emphasized throughout the class. Professionalism in presentation of material and is reinforced in the reviews including the design review, weekly team meetings, project demonstration, presentation, as well as the final report. Ethics are emphasized in the laboratory and reporting activities. The students are required to read the IEEE Code of Ethics and discuss how it relates to the project in the Design Review, the Project Presentation, and the Report. The student projects convey a wide range of interests on the part of the students regarding these issues. Projects include those which address technologies aimed at medical and helping handicapped people are an example of their awareness and interest in societal issues. They are required to discuss societal impact in the Design Review, Project Presentation, and Report.

*5. Teamwork: an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plans tasks, and meet objectives* ([5](javascript:null(0);))

Students work in pairs or threes (with few exceptions). The students divide work elements among the team and exercise teamwork. Students peer-review others design teams and critique their work. Teamwork is a graded element.

*6. Analysis: an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions* ([6](javascript:null(0);))

The whole of ECE445 is to design and implement a successful electrical engineering project with an emphasis on hardware and hands on experience. Test results and interpretation of test results are elements of the demonstration, presentation, and final report. Test tools are provided in the laboratory.

*7. Learning: an ability to acquire and apply new knowledge as needed, using appropriate learning strategies* ([7](javascript:null(0);))

The students are well aware of the need to keep up with the technology of their field which is ever changing. Many learn this directly as they design circuits which, through research, recent technologies have already solved.