

**ECEN 2060 • Electronic and Semiconductor Device Laboratory
Fall 2019**

Class times: Lecture: T 8:30 – 9:20 am, ECEE 287 **Dates:** 8/27/19 – 12/12/19
Lab: T, Th 1:00 – 2:50 pm, ECEE 282

Instructor: Prof. Sean Shaheen
e-mail: sean.shaheen@colorado.edu
Office hours: Th, 3:00 - 4:00 pm, room ECEE 241, or by appointment

Graduate Learning Assistant: Vesta Zhelyaskova
e-mail: vesta.zhelyaskova@colorado.edu
Office hours: by appointment

Textbook: No textbook is required. Readings will be assigned each week.

Course Description

Investigates the operation of electronic and semiconductor devices, including: resistors, transparent conductors, capacitors, inductors, diodes and light emitting diodes, photovoltaics, bipolar junction and field effect transistors, and organic electrochemical transistors. Laboratory work will provide learning of the basic operation of the devices and how underlying material properties influence their operation. Some of the labs will involve a fabrication component.

Recommended pre/corequisite: PHYS 1140.

Course Learning Goals

- Learn the basic operation of electronic and semiconductor devices relevant to the ECEE undergraduate curriculum
- Understand the connection between conducting/semiconducting materials properties and the behavior of devices resulting from them
- Gain familiarity with electronic test equipment and techniques required to probe electronic and semiconductor devices
- Learn techniques of materials processing and device fabrication (for a select number of labs in the course)
- Improve skills in experimental data taking, error analysis, and curve fitting
- Develop research and design skills for emerging electronic device concepts and implementations
- Advance proficiencies in written and oral communication of scientific and engineering concepts

Laboratories

Basic electronic devices

Lab 1: Resistors and transparent conductors

Lab 2: Capacitors

Lab 3: Inductors

2-terminal semiconductor devices

Lab 4: Diodes

Lab 5: Light Emitting Diodes (LEDs)

Lab 6: Photovoltaic Devices I

Lab 7: Photovoltaic Devices II

Lab 8: Organic Photovoltaic Devices (OPVs)

Lab 9: Photodetectors

3-terminal semiconductor devices

Lab 10: Bipolar Junction Transistors (BJTs)

Lab 11: Field Effect Transistors (FETs)

Lab 12: Organic Electrochemical Transistors (OECTs) I

Lab 13: Organic Electrochemical Transistors (OECTs) II

Grading

Weekly Laboratories (650 total points)

Each lab is worth 50 points according to the following distribution:

- Pre-lab problems..... 10 points (due Tuesdays at 1:00 pm, hardcopy submission)
- End-of-lab oral report out...10 points (presented to instructors upon completion of each lab)
- Lab report..... 30 points (due Fridays at 5:00 pm, electronic submission)

Midterm and Final R&D Projects (150 total points)

In addition to the weekly labs, there will be Midterm and Final Research and Design Projects required for the course. Each will have an oral presentation and a written report due, for a total of 75 points for each project. The projects can be done in teams.

Grading Criteria

Grading for individual problems will be based on the following general criteria:

- 100% – Answer is fully correct and was arrived at through sound reasoning.
- 90% – Answer is wrong due to a minor math or algebraic error; reasoning was sound.
- 75% – Substantial effort was put into the problem, but a conceptual error was made near the end of the solution.
- 50% – Substantial effort was put into the problem, but a fundamental conceptual error was made near the beginning of the problem.
- 25% – Only a cursory attempt was made at the problem.
- 0% – No attempt made.

The final grading scale for the class will be determined by the instructor according to the following rationale:

- A – Mastery or near mastery of course material, concepts, and problems.
- B – Demonstrated understanding of most of the concepts covered in the course; good proficiency at problem solving.
- C – Reasonable effort was put into the class, but substantial gaps in conceptual understanding and low performance on problem solving tasks were demonstrated.
- D – Little effort was put into the class, and little was learned.
- F – No attendance or attempt at material.

ABET Learning Outcomes

This course strives to provide the student with a variety of specific learning outcomes. These include the student outcomes identified by ABET, and adhered to by the ECEE department, related to the skills, knowledge, and behaviors that students acquire as they progress through the program. The specific Student Outcomes can be found

here: <http://ecee.colorado.edu/academics/courses/criterion3.html>.

Missed Assignment Policy

Late submissions or missed examinations or project reports cannot be accepted without a pre-approved reason. Make-up examinations, project reports, or other assignments can be given for documented reasons of a medical issue, an unplanned family emergency, a religious observance, or attendance at a professional conference or other academic obligation. Please contact the instructor before the due date of the assignment to make other arrangements.

Course Ethics

Discussion and group brainstorming about concepts and problems in the course is strongly encouraged. However, copying of assignments, project reports, or examinations, or any other form of academic dishonesty is strictly forbidden. For homeworks and other out-of-class work, as a general rule one should not visually look at another person's solutions; however, it is acceptable to verbally discuss the general problem-solving strategy and its conceptual basis. In case of doubt on a particular assignment, please consult the instructor.

FERPA

The privacy of student's education records is protected by regulations set by the Family Educational Rights & Privacy Act (FERPA). Details can be found at <http://www.colorado.edu/registrar/annual-ferpa-notification>.

Required Syllabus Statements

Further information and description of campus policies regarding *Accommodation for Disabilities, Classroom Behavior, the Honor Code, Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation*, and *Religious Holidays* can be found online in the [Required Syllabus Statements](#) document.