University of Nebraska-Lincoln

ECEN 222: Electronic Circuits

Spring, 2026

Syllabus

Teaching Staff

Instructor: Maxx Seminario

Office hours: Mondays 1:30 – 2:30 PM, in SEC C215, or by appointment.
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Teaching Assistant: Thomas Gokie

Office hours: TBD,
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Class Meetings

- Lecture: Mondays, Wednesdays, and Fridays 12:30 – 1:20 PM at NH W131
- Laboratory: Date TBD
- If in-person classes are canceled due to inclement weather, you will be notified of the instructional continuity plan for this class via Canvas

Pre-Requisite

- Electronics and Circuits 1 (ECEN 215, ECEN 218)
- Basic Calculus

ECEN 222 Course Description

The objective of this course is to provide an introduction to the design and analysis of solid-state electronic circuits. The successful student will exhibit competence in a wide variety of topics pertaining to electronic circuits, including:

- Terminal characteristics and models of diodes, bipolar and field-effect transistors
- Design and analysis of diode circuits, bipolar and field effect transistor circuits
- Bias circuit designs
- Transistor amplifiers and switching circuits
- Digital logic circuits and their implementation using CMOS technology
- Practical circuit design and implementation through laboratory exercises

Course Outcomes

The students who successfully complete this course will be able to:

- Understand the fundamentals of semiconductor concepts and the operational characteristics of basic semiconductor devices: diodes, bipolar and field-effect transistors
- Understand the nonlinear current vs. voltage characteristics of diode and transistors
- Understand the principles of diode rectification and regulation, transistor amplification and switching
- Perform small signal modeling and analysis of transistors
- Analyze and implement single-stage transistor amplifier and switching circuits

Textbook

- "Microelectronic Circuits", 7th edition, A. S. Sedra and K. C. Smith, Oxford University Press, 2015.
- ISBN: 978-0-19-93913-6
- Lecture notes will cover all the material, but further reading of the textbook is encouraged.

Class website

The class website https://canvas.unl.edu contains

- Lecture notes, homework assignments, laboratory manuals, and SPICE simulation files.
- Homework and lab report submission will be online on Canvas.

Course Topics

Unit 1: Signals and Amplifiers
Introduction to the basic concepts of electronics, signals, frequency spectra in analog and digital forms. Amplifiers are introduced as circuit building blocks and various types and models are studied.

Unit 2: Operational Amplifiers
Introduction to the operational amplifiers, their terminal characteristics, simple applications, and practical limitations.

Unit 3: Semiconductors
This unit provides an overview of semiconductor concepts at a level sufficient for understanding the operation of diodes and transistors. Various semiconductors, current flow in semiconductors, pn junction and V-I characteristics.

Unit 4: Diodes
The ideal diode, the diode terminal characteristics, the circuit models that are used to represent it, and its circuit applications such as the rectifier circuits, limiting and clamping circuits.

Unit 5: MOSFETs
Device structure and physical operation, V-I characteristics, MOSFET circuits at DC. Introduction to biasing, small signal operation and models. Basic operation of MOSFET as an amplifier and as a switch. Depletion type MOSFET.

Unit 6: Bipolar Junction Transistors (BJT)
The device structure and its physical operation of BJT, description of its terminal characteristics, the operation of the transistor as a circuit element, DC circuits utilizing the device.

Unit 7: Transistor Amplifiers
Comparison of MOSFET and BJT, CS and CE amplifiers with loads, high frequency response of CS and CE amplifiers, CG and CB amplifiers with active loads, high frequency response of CG and CB amplifiers, cascade amplifiers. CS and CE amplifiers with source (emitter) degeneration, source and emitter followers, some useful transfer pairings, current mirrors with improved performance. SPICE examples.

Unit 8: CMOS Digital Logic Circuits
The foundation of CMOS logic-gate circuits, digital logic inverters with CMOS; its static and dynamic characteristics and its design.

Unit 9: CMOS Digital Integrated-Circuit Design
An overview of digital IC technologies, design and performance analysis of CMOS inverter. Logic gate circuits. Pass-transistor logic. Dynamic logic circuits. SPICE examples.

Laboratory Component

There will be approximately 11 weekly laboratories conducted in groups of two students, with individual lab reports submitted the following week.
Laboratory Topics:

1. I-V characteristics and large/small operations of junction and Zener diodes
2. Diode rectifiers
3. Bridge and center-tap rectifiers with shunt voltage regulation
4. I-V and voltage transfer characteristics of BJT
5. Large signal and resistive biasing of BJT
6. Variable DC power supply project
7. I-V and voltage transfer characteristics of MOSFET
8. Common emitter BJT amplifier
9. Emitter follower amplifier and buffering application
10. Common source amplifier and source follower buffering application
11. Transistor switching circuits and CMOS inverters

Evaluation Basis

In-Class Quizzes: 10%
Homework: 30%
Laboratory Reports: 30%
Exams: 30%

Homework Policy

- Problem sets will be assigned on Friday and will be due the following Friday by 11:59 PM.
- Assignments should be submitted online on Canvas. Submit a single .pdf file with your solutions.
- Homework grades will typically be available within a week of the due date.
- Discussion among students is encouraged, but individual solutions must be submitted.
- In general, late homeworks will not be accepted. Under extenuating circumstances, extensions must be approved by the instructor, and arranged prior to the deadline.

Laboratory Policy

- Laboratory attendance is encouraged. Lab sessions will be held weekly, and each session will last approximately 3 hours.
- Lab reports are due one week after the lab session by 11:59 PM on Canvas.
- Lab work will be conducted in groups of two students. Both students must participate actively.
- Lab reports should include: objectives, procedures, experimental results, analysis, discussion, and conclusions.
- Late lab reports will be penalized 20% per day unless prior arrangements are made with the instructor.

SPICE Simulation Exercises

Computer simulation exercises using Multisim will be integrated throughout the course. These simulations provide valuable learning opportunities to verify circuit designs and understand circuit behavior. You will be required to complete these assignments individually.

In-Class Quizzes

Periodic quizzes may be given. Usually we will use these to encourage student participation in assigned reading. This will allow us to cover course material more thoroughly and efficiently.

Exams

Two exams will be given during the semester. Make-up exams will be oral.
Final Exam will take place on Monday, May 4, 2026 from 3:30 PM to 5:30 PM in NH W131.

Personal Responsibility

Class attendance and participation is strongly encouraged. Late materials are not accepted unless previously approved.

Academic Integrity

As is always the case, you will be responsible for your own work in this class. Misrepresenting someone else's work as your own (that is, without clear attribution of source) is considered cheating. Cheating will result in a course grade of F.

Students with Disabilities

The Office of Civil Rights requires the following ADA language to be included in all syllabi (as per Dr. Horn, UNL ADA Compliance Officer, 2007):

"Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY."