EE 310 Electronic Circuit Design I
Fall 2024 Syllabus

Professors:	***Section 001***	***Section 002***
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Office Hours:	Zoom appointment at following times (by appointment **only**): W 9:45- 10:45 AM F 9:45 – 10:45 AM https://psu.zoom.us/j/92893183449?pwd=QU9IL1NhY2t2N0IxUnVBbXpUbnIvdz09	In person (by appointment **only**) M 2:30-3:30 PM W 2:30-3:30 PM

Teaching Assistants: Joseph Lange, Ritwik Ashok, Anupama Rajeeth, Rashed Aldhafeeri

Lab Assistants: Harsha Kumari, Aafiya Saleem Shaikh, Pavithra Panchatcharam

Course Web Site: The course web page is hosted on Canvas (canvas.psu.edu). You are responsible for all information put on Canvas. Course communication will be done via Canvas. You can set up Canvas to send you email and/or smartphone alerts. It is **your responsibility** to make sure that you are receiving course communications.

Evening Exams
There are two evening exams scheduled for EE 310. See the course schedule for the dates and times. Add these to your personal calendar now.

If you have a conflict, you **MUST** complete the "**Exams Conflict Quiz**" on CANVAS by **August 31**.
No late request will be accepted under any circumstances.

Exam 1: Oct. 4, 2024; 8:00 – 10:00 pm (Thomas Building, room 100)
Exam 2: Nov. 8, 2024; 8:00 – 10:00 pm (Thomas Building, room 100)

TA Office hours (309 EEW)

Date	Time	TA
Friday	10am-11am	Joseph Lange
Friday	11am-12pm	Ritwik Ashok
Friday	12pm-1pm	Anupama Rajeeth
Friday	9am-10am	Rashed Aldhafeeri

1. Meeting Times

Lecture	Sections 1 – Aida Ebrahimi	M W F	11:15 AM - 12:05 PM	Willard Bldg 362
	Sections 2 – Morteza Kayyalha		1:25 PM-2:15PM	Willard Bldg 262

Labs:

Section#	Day	Time	Staff 1	Staff 2
Section 1	Tuesday	11:15AM - 2:15PM	Rashed Aldhafeeri	Harsha Kumari

Section 2	Tuesday	2:30PM - 5:30PM	Anupama Rajeeth	Aafiya Saleem Shaikh
Section 3	Wednesday	8:00AM - 11:00AM	Joseph Lange	Pavithra Panchatcharam
Section 4	Wednesday	2:30PM - 5:30PM	Anupama Rajeeth	Pavithra Panchatcharam
Section 5	Wednesday	6:00PM - 9:00PM	Ritwik Ashok	Joseph Lange
Section 6	Thursday	11:15AM - 2:15PM	Rashed Aldhafeeri	Harsha Kumari
Section 7	Thursday	2:30PM - 5:30PM	Ritwik Ashok	Aafiya Saleem Shaikh

2. Introduction

In this course we learn about the electrical properties of different fundamental semiconductor devices and their basic circuit design applications. This course deals explicitly with both linear and nonlinear applications of devices, and with the practical aspects of design such as the inherently nonlinear nature of semiconductor devices. The analysis concepts introduced in your previous networks course are utilized and advanced in their treatment of nonlinear devices. In the laboratory we put the theory into practice.

Before considering further the scope of this course let us examine the electronics area as it relates to the curriculum. Electronics is a very broad discipline that encompasses the characterization of basic materials, the fabrication of electronic devices, and the interconnection of devices into useful circuits/systems. The opportunity exists for you to learn about each of these areas. The courses that serve as the cornerstone for your electronics education are EE 310 and EE 340 *Introduction to Nanoelectronics*. These required courses provide the background for the technical electives offered in the following areas:

A. Electronic Circuit Design Suggested Electives

EE 311 Electronic Circuit Design II: Electronic circuit design with consideration to single and multi-device subcircuits, frequency response characteristics, feedback, stability, efficiency, and IC techniques (prerequisites: EE 310, EE 350).

EE 410 Analog Integrated Circuit Design: Integrated circuit design in CMOS; device physics and fabrication, single-stage and multi-stage operational amplifier design, compensation, common-mode-feedback circuits, noise analysis, layout (prerequisite: EE 311).

EE 413 Power Electronics: Switch-mode electrical power converters. Electrical characteristics and thermal limits of semiconductor switches (prerequisites: EE 310, EE 350).

EE 416 Digital Integrated Circuits: Analysis and design of digital integrated circuit building blocks including logic gates, flip-flops, memory elements, analog switches, multiplexers and converters (prerequisite: EE 310).

EE 417 Digital Design Using Field Programmable Devices: Field programmable device architectures and technologies; quick response systems (prerequisite: CMPEN 331)

CMPEN 411 VLSI Digital Circuits: Digital integrated circuit device design, layout, masking, simulation and fabrication; VLSI design techniques and system architecture; computer-aided design and interactive graphics (prerequisites: CMPEN 471, EE 310).

CMPEN 471 Logical Design of Digital Systems: Basic switching theory and design of digital circuits including combinational, synchronous sequential and asynchronous sequential (prerequisite: CMPEN 271).

B. Other Courses That are Tangentially Related to Electronic Design

EE 432 RF and Microwave Engineering: Transmission line and wave guide characteristics and components; design of RF-microwave amplifiers, oscillators and filters; measurement techniques; design projects (prerequisites: EE 310, EE 330).

EE 441 Solid State Device Technology: The fundamentals of device technology including oxidation, diffusion, photoresist, metallization, epitaxy, and material preparation (prerequisites: EE 310, ESC 314).

EE 442 Solid State Devices: The physics of semiconductors as related to the characteristics and design of solid-state electronic devices (prerequisites: EE 310, E SC 314).

IE 464 Assembly of Printed Circuit Boards: This lab-oriented course deals with the manufacturing aspects of electronics and is a good complement to the theoretical EE electronics courses.

Completing Senior Project Design (EE 403W) satisfies the senior capstone design requirement.

3. Prerequisite

You must have completed EE 210 with a grade of "C" or better for admission into this course.

4. Textbook

Required: Adel S. Sedra, Kenneth C. Smith, *Microelectronic Circuits*, Oxford University Press, **8th Edition**, The ISBN for the enhanced e-Book is **9780190853532.**

Students will need to purchase the **digital version of the enhanced e-book**.

5. Supplemental Materials (required):

1. Laboratory Notebook—bound, quadrille-ruled, with numbered and duplicate detachable pages
2. Prototyping Board (Protoboard)—for individual assembly, testing, and retention of circuits. These are available from Amazon.com, Digi-Key, Radio Shack, etc. A typical example is Ramsey WBU206.
3. EE 310 Parts Kit – contains electronic parts used in the experiments. EE 310 lab kit will be sold from the stock room for $24.66. Payments in the stockroom are by LionCash only. Kits are available for sale starting on the first day of class.

6. Educational Objectives

The combination of lecture and laboratory sessions provides learning opportunities that should enable you to do the following upon completion of this course:

A. Analyze and design basic electronic circuits, particularly with application to the following devices:

i. *Diodes:*
Analyze circuits containing junction diodes; apply the small-signal diode model to circuit analysis problems; design rectifiers, limiters, clippers, and clamping circuits;

ii. *Field Effect Transistors:*
Understand the physical structure and operation of Metal-Oxide Semiconductor Field-Effect Transistors (MOSFETs); understand the terminal I-V characteristics of both enhancement mode and depletion mode MOSFETs; design circuits containing MOSFETs, analyze for gain, input and output resistance and be able to apply the small-signal model; understand the operation of both NMOS and CMOS digital logic inverters, NAND gates and NOR gates;

iii. *Bipolar Junction Transistors:*
Understand the physical structure and operation of BJTs; analyze different transistor properties by using the small-signal BJT model; design bias circuits for operating BJTs in the linear region; analyze gain, input and output resistance of various amplifiers; design common-emitter, common-base, common collector amplifiers and saturated switches using BJTs;

iv. *Op Amps:*
Analyze circuits containing ideal op amps; understand the effects of non-ideal op-amp characteristics on circuits; design op-amp buffers, inverting/noninverting amplifiers, summers, integrators, differentiators, instrumentation amps and comparators.

B. Become proficient with computer skills (e.g. Multisim) for the analysis and design of circuits.

C. Learn technical writing skills important for effective communication.

D. Develop teamwork skills for working effectively in groups.

7. Grading Policy

Lecture Related:	Homework	10%
	Exam 1	20%
	Exam 2	20%
	Final Exam	20%
Laboratory Related:	Lab Notebook and Design Projects	25%
Attendance and Participation:	In lecture and in lab	5%
	Totals:	100%

The final grading scale is as follows:

A	≤90-100
A-	≤ 87-<90
B+	≤84-<87
B	≤ 80-<84
B-	≤78-<80
C+	≤74-<78
C	≤70-<74
D	≤60-<70
F	<60

In accordance with EE Department policy, a grade of "C" or better (nominally a 70% average) is required in this course to graduate with a degree in Electrical Engineering.

8. Evening Exams

There are two evening exams scheduled for EE 310. See the course schedule for the dates and times. Add these to your personal calendar now.

If you have a conflict, you **MUST** complete the "**Exams Conflict Quiz**" on CANVAS by **August 31**. **Failure** to do so will indicate that you will participate in the exams on dates/times listed below.

Exam 1: Oct. 4, 2024; 8:00 – 10:00 pm
Exam 2: Nov. 8, 2024; 8:00 – 10:00 pm

Before the end of the drop/add period, you must determine if you have a conflict with the exam dates and times, or if you need special service with a letter from ODS. If you do, complete the conflict exam application form by filling out the corresponding Quiz on Canvas.

Note

1. If you do not file your request on time, then you will not be permitted to take a conflict exam.
2. The make up exam is on the following Tuesday from 7-9 pm. No additional make up exams will be arranged.
3. These exam dates and times represent a commitment on your part so do not schedule any other activities at the announced exam times. If another professor schedules a conflicting evening exam on one of these dates after EE 310 has announced their exam dates, then you must file for a conflict in the other professor's class.
4. For all three exams, if you are so sick that you cannot attend the exam, you need to visit a doctor on the SAME DAY and ask for an official doctor note. You should send this note to us BEFORE the exam to qualify for any makeup exam. If you don't have a note, please do NOT email us and attend the exam. Those students, who do not provide an official note, won't be able to take a makeup exam. Please note that this policy is to ensure that we are fair to all students in both sections. Without an official doctor's note, you must take the exam on the scheduled time/date.

9. Homework

EE 310 is the type of technical course that requires active participation. Being a passive observer will generally not lead to success in EE 310. Lots of problem-solving practice is needed in order to understand the material at an acceptable level of proficiency. The weekly homework assignments in the course will give you this practice. For a specific list of homework assignments and due dates see the course calendar on CANVAS.

Note

1. HW will be collected electronically on CANVAS. Because solutions to homework problems are posted online after homework is due, **no late HW will be accepted** and all email submissions of HW after due time will be disregarded.
2. Homework scores will be posted on Canvas by the 7^{th} day after the due date. It's your responsibility to verify your HW grades on Canvas regularly.
3. If you have any dispute about your HW grade, you should resolve this with the instructors within 3 weeks after the due date. HW scores will be finalized (not allowed to change) after 21 days past the due date.

10. Laboratory

The laboratory work in EE 310 provides an important learning opportunity for putting classroom concepts into practice. Maximum benefit from each laboratory exercise comes from the efficient use of lab time. Thus, you are expected to prepare for each lab assignment through study of course materials and by project design, where appropriate. A laboratory notebook record will be kept of all work relevant to the experiments.

Lab assignments sometimes require more than one session of scheduled laboratory time and are of two types: *Experimental Exercises*, which involve the submission of a copy of your lab notebook pages, and *Design Projects*, which have more formal reporting requirements. *Design Projects* are more open-ended and will require more decisions and the advanced preparation of a project proposal. A number of laboratory exercises require Multisim circuit simulations.

Note

1. The due date for each lab report (except the last one) is the following week's Sunday at 11:59 pm. These due dates for lab reports have already been posted on CANVAS.
2. Lab scores will be posted on Canvas within two weeks after the due date. It's your responsibility to verify your Lab grades on Canvas regularly.
3. If you have any dispute about your Lab grade, you should resolve this with the instructors within 3 weeks after the due date. Lab scores will be finalized (not allowed to change) 21 days past the due date.
4. Every student gets one "freebie" where they can turn in a lab up to 2 days late and won't lose any points. If a student turns in a lab after the two day "freebie period" or has already used their freebie the point deductions are as follows:
    a. Lab report is turned in less than one week late: 10% point deduction
    b. Lab report is turned in 1-2 weeks late: 20% point deduction
    c. Lab report is turned in more than 2 weeks late: student receives a zero for the report
    d. Please note that the 10-20% point deductions are taken because the report was turned in late – not because of errors in the report. In other words, if a student turns in a lab report less than one week late then their report will be graded starting from a 90.

Lab Exemption: In order to be exempt from the lab this semester, you must satisfy one of the following have successfully completed the lab at least once with lab score greater than 70 in previous semesters. To get a lab exemption, complete the quiz on CANVAS. If you get lab exemption, your final course grade will be calculated based on the grading policy in the course syllabus using your prior lab grade.
Deadline to file: 11:59pm, first Wednesday of the semester.

11. Academic Integrity

Academic integrity is the pursuit of scholarly activity in an open, honest, and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights, and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment by all members of the University community not to engage in or tolerate acts of falsification, misrepresentation, or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

12. Accommodations for Students with Disabilities

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. Student Disability Resources (SDR) website provides contact information for every Penn State campus (https://equity.psu.edu/offices/student-disability-resources/campus-offices). For further information, please visit Student Disability Resources website (http://equity.psu.edu/sdr/).

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: See documentation guidelines (http://equity.psu.edu/sdr/guidelines). If the documentation supports your request for reasonable accommodations, your campus disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early as possible. You must follow this process for every semester that you request accommodations.

13. Counseling and Psychological Services

Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of

confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation.

Counseling and Psychological Services at University Park (CAPS)
(http://studentaffairs.psu.edu/counseling/): 814-863-0395

Counseling and Psychological Services at Commonwealth Campuses
(https://senate.psu.edu/faculty/counseling-services-at-commonwealth-campuses/)

Penn State Crisis Line (24 hours/7 days/week): 877-229-6400
Crisis Text Line (24 hours/7 days/week): Text LIONS to 741741

14. Educational Equity and Reporting Bias

Penn State takes great pride to foster a diverse and inclusive environment for students, faculty, and staff. Acts of intolerance, discrimination, or harassment due to age, ancestry, color, disability, gender, gender identity, national origin, race, religious belief, sexual orientation, or veteran status are not tolerated and can be reported through Educational Equity via the Report Bias webpage (http://equity.psu.edu/reportbias/)

15. Reporting Sexual Misconduct

Sexual misconduct is never tolerated at Penn State. Prohibited conduct includes sexual and gender-based harassment, stalking, sexual assault, and dating violence. These behaviors are not allowed in the classroom, the campus community, labs, or anywhere students, staff, and faculty are located. Prohibited behaviors can include degrading comments such as belittling female-identified students, LGBTQ+ individuals, and gender-diverse students. It can also include harassment, touching someone without their consent, following someone without consent, repeated calls or messaging, physical acts of violence, and more. In other words, professional and appropriate behavior is always expected, and inappropriate or unprofessional behavior is never tolerated. For more information, please refer to the Student Code of Conduct and Penn State Policies AD85 and AD91. (Title IX Sexual Harassment | Penn State Policies (psu.edu) and Discrimination and Harassment and Related Inappropriate Conduct | Penn State Policies (psu.edu))

If you or anyone you know has experienced or is concerned about inappropriate or unprofessional behavior, you can talk with College, or School leadership, your instructor, academic advisor, or another trusted faculty/staff member, report to police or the Office of Sexual Misconduct Reporting & Response (titleix.psu.edu), or you can seek confidential support and assistance from the Gender Equity Center. The Gender Equity Center supports any student who has had negative relationship experiences including those impacted by sexual violence, relationship violence, stalking, harassment, and other campus climate issues. Services include one on one crisis intervention/support, advocacy, exploring options, accommodations, safety planning, and referrals. They also promote awareness, build support for survivors, and conduct educational programs and events. All services are free and confidential. Gender Equity Center | Penn State Student Affairs (psu.edu)