

ECE 302H: Introduction to Electrical Engineering

Class:	MW 1:30p-3:00p	Labs:	Unique 18215 – Thu 9a-11a
Room:	BUR 212		Unique 18220 – Tue 11a-1p
			Unique 18225 – Tue 1p-3p
			Unique 18229 – Wed 9a-11a
		Room:	EER 1.826
Instructor:	Alex Hanson ajhanson@utexas.edu	Lunch	TBD
	EER 7.866	Hours	Open to all including ECE 302
Office Hours:	<u>Instructors</u> – open to all 302 students	<u>Graduate TAs</u> – open to all 302 students	
	Alex TBD ajhanson@utexas.edu	Yihao Wu TBD yw25243@utexas.edu	
	Prof. Fan TBD linran.fan@utexas.edu	Chankeun Yoo TBD chyoon@utexas.edu	
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UG TAs:			
URL:	https://canvas.utexas.edu/		
HW Due:	Fridays 11:45p	Due dates in Canvas will be for 11:59p in case of technology issues only. The due time is still 11:45p.	
Prelab Due:	By your lab time		
Project Due:	(select) Sundays 11:45p		
Textbook	Ulaby, Mahariz, and Furze, Circuit Analysis and Design, 2 nd Edition		
	Available as free PDF at cad2e.eecs.umich.edu		

Section Coordination and Versions of ECE 302

ECE 302 is taught across 5 distinct sections in the Fall, each section having one instructor and 3-4 “unique” course numbers. The honors version of the class, ECE 302H, is one of those sections. In 2023, we rolled out a new, completely revamped version of ECE 302 that had been piloted in 2022. Most current students have taken this version.

ECE 302 is a highly coordinated class. Each section, though independent, maintains the same pace and uses the same homework, labs, exams, and exam times as the other sections. The exception is ECE 302H, which may go above-and-beyond in terms of class pacing and is expected to have about 20% different material on exams. Labs and exam times are expected to be identical with ECE 302. This means that **you can rely on any and all of the five instructors, five graduate TAs, and ten undergraduate TAs for support**, and all of your first-year friends are

available to form study groups and support each other. Other sources of support are listed farther along in the syllabus.

Lecture and Exam Schedule (Subject to Change)

#	Date		Topic	HW Due Fri 11:45p	Lab	Prof. Project Due Next Sun 11:45p
1	M	8/25	Electrical concepts + solving circuits			
2	W	8/27	Passive Sign Convention			
				HW1		
	M	9/01	Labor Day No Class			
3	W	9/03	Components, One-Ports, and Equivalents		Lab 1: Lab Skills	
				HW2		Unit A: Resume
4	M	9/08	Node Analysis			
5	W	9/10	Linearity and System Identification		Lab 2: Lab Skills cont	
				HW3		
6	M	9/15	Superposition and Thevenin Equivalents			
7	W	9/17	Thevenin – applications and max power		Lab 3: Recitation	
				HW4		
8	M	9/22	Duality			
--	W	9/24	Optional Exam Review		Lab 4: PCBs	
	Th	9/25	Exam 1 - up to HW4			
9	M	9/29	Feedback – Solving and Golden Rule			
10	W	10/01	Feedback – Op amp circuits and control		Lab 5: DAC	
				HW5		Unit B: Ethics 1
11	M	10/06	Conductors and Semiconductors			
12	W	10/08	Diodes, capacitors, and MOS capacitors		Lab 6: Soldering	
				HW6		
13	M	10/13	MOSFET and operating regions			
14	W	10/15	PMOS and Small Signal Analysis		Lab 7: Buck Converter PCB	
				HW7		
15	M	10/20	MOSFET Circuits			
--	W	10/22	Optional Exam Review		Lab 8: Variable-Gain Amplifier	
	Th	10/23	Exam 2 – up to HW7, esp HW5-7			
16	M	10/27	Sine Waves Review, Fourier Series, Graphing			
17	W	10/29	Log plots		Lab 9: Common-Source Amplifier	
				HW8		Unit C: Ethics 2
18	M	11/03	Linear Sinusoidal Response/Transfer Functions			
--	W	11/05	“Final Advice” (moved before registration)		Lab 10: Recitation	
				HW9		Unit D: Current
20	M	11/10	Complex #s			
21	W	11/12	Rapid Transfer Functions + Impedance		Lab 11: Buck Assemble and Test	
				HW10		
22	M	11/17	Non-Sinusoidal Signals			
--	W	11/19	Optional Exam Review		Lab 12: Buck Assemble and Test	
	Th	11/20	Exam 3 – up to HW10, esp HW8-10			
--	M	11/24	Thanksgiving No Class			
--	W	11/26	Thanksgiving No Class			
23	M	12/01	Frequency Response of MOSFET Circuits			
24	W	12/03	Feedback Stability in the Frequency Domain		Lab 13: Buck Buffer	
				HW11		Unit E: IEEE
25	M	12/08	TBD			

Exams:

Midterm 1:	Thu 09/25/2024, 6p-8p, WAG 101
Midterm 2:	Thu 10/23/2024, 6p-8p, PMA 4.102
Midterm 3:	Thu 11/20/2024, 6p-8p, CPE 2.208
Final Exam:	TBD

Course Description

This course provides an introduction to some of the central elements of electrical engineering. **Nevertheless, this is not a survey course!** The goal of this course is not to sample a little bit from many disciplines within electrical engineering. Instead, we have identified some of the central concepts that are foundational and common to wide swaths of electrical engineering; we will be mastering those concepts. In this way, we achieve both breadth and depth.

In particular, we will begin with the study of circuits. Along the way, you will master circuit analysis of course, but more importantly, you will be mastering the analysis of **linear systems** and will be introduced to the mathematics to understand these systems, called **linear algebra**. Linear systems and linear algebra underpin most of circuits, but also machine learning and artificial intelligence, signal processing, control theory, and electromagnetics – not to mention most of the problems in other engineering disciplines as well.

We will follow up our study of linear systems (through circuits) by digging deeper into individual circuit **devices** and the physics that makes them work. We will learn those topics in a very targeted way so that we can build up to the **MOSFET** – the fundamental building block of computing and most other forms of electrical information and energy management. It is difficult to think of an invention that has had a greater impact on the world than the MOSFET.

Finally, we will end the semester by learning to think about problems in the **frequency domain**. Nicola Tesla said “If you want to find the secrets of the universe, think in terms of energy, frequency, and vibration.” That is certainly true in electrical engineering. Using the frequency domain is like learning a different language from the one that you’re used to, which is the language of time. Yet, frequency-domain thinking is so second-nature for electrical engineers, it’s arguably their primary language. This applies to circuits and physical systems, but it also applies to signal processing, image and video processing, audio engineering, and a variety of other computational subdisciplines.

Substantial teamwork experience is included in the laboratory component of this course. The course will help students to build and understand the intellectual foundations that underlie much of electrical engineering, and to establish and appreciate connections between electrical engineering and basic sciences, mathematics, and liberal arts.

This course may be used to fulfill the natural science and technology (Part II) component of the university core curriculum and addresses the following four core objectives established by the Texas Higher Education Coordinating Board: communication skills, critical thinking skills, teamwork, and empirical and quantitative skills.

Reality Check

Do not underestimate this course. Every student entering UT ECE was “the best” in high school. Every student has been told many times that the next step in life would finally be hard, only to find out that it wasn’t. We have approximately 400 students pass through ECE 302 every year, many of whom think it will follow the same pattern. All of them have been wrong. ECE 302 stretches *every single student*.

We hope that ECE 302 will be fun and engaging, not overbearing, and will inspire you to leverage your unique ECE education no matter what tech core you eventually choose. It will still be challenging! If you accept this early and stay on top of the class, you will have a very educational and enjoyable experience. If you wait a few weeks to realize the effort that 302 requires, you will already be very behind.

Course Format

Course content will be delivered through our regular class periods and lab sessions. Class attendance is required in the sense that there are no textbooks, online materials, etc. that cover the same material in the same way that we do. If you do not attend class, you will be lost! Lab and exam attendance is required in a stricter sense – if you do not

show up for the lab/exam, you will get a 0 on the lab/exam. All other resources, including lunch hours, office hours, and others listed below are purely optional but highly recommended. All assignments will be submitted online.

Prerequisite

Completion of, credit for, or concurrent enrollment in Mathematics 408D or equivalent is required for 302H.

Helpful Prerequisite Knowledge

To master the material in ECE 302, it will be important for you to have a strong working knowledge of pre-calculus-level mathematics and, ideally, high-school-level physics.

The basic topics you will find helpful to understand, and the ideal level of understanding, are as follows. We will discuss many of the ideas listed under “Physics” below, but some prior familiarity with them will still be helpful.

1. Mathematics
 - a. Excellent proficiency with elementary algebra
 - b. Good proficiency with linear, polynomial, exponential, and logarithmic functions
 - c. Some proficiency with systems of linear equations and (ideally) matrices
 - d. Basic knowledge of differential calculus by mid-semester, and integral calculus by late in semester
2. Physics
 - a. Some familiarity with basic concepts of charge, current, voltage, and resistance
 - b. Some familiarity with basic concepts of energy and power
 - c. Some familiarity with proper use of significant figures in calculations
 - d. Some familiarity with proper use and essential nature of units in calculation of physical quantities
 - e. Some familiarity with the concept of physically “reasonable” quantities

It is particularly important that you understand how to solve systems of equations and use matrices. Your Algebra 2 class should have covered this. If it didn't, never fear – you can review a wonderfully simplified version here: <https://www.mathsisfun.com/algebra/index-2.html> under the heading “Systems of Linear Equations.”

Required Text and Equipment:

Students are required to purchase the microcontroller development kit LP-MSPM0G3507, available for about \$20 from TI.com, Digikey.com, or Mouser.com. Note that this same microcontroller is used for ECE 319k, a required course for the major, and you are encouraged to re-use the kit.

You are required to have the following textbook, available as a free PDF online or as a low-cost hard copy through the internet or the UT COOP:

F. T. Ulaby, M. M. Maharbiz, & C. M. Furse, Circuit Analysis and Design (Michigan Publishing, 2018) [same as Circuits (National Technology & Science Press, Third Edition, 2016) by the same authors].

You can get a **free PDF** version here: <https://cad.eecs.umich.edu/>. Many students also find it helpful to purchase a paper copy. I personally prefer paper copies, and have both.

The following texts are also recommended:

C. K. Alexander and M. N. O. Sadiku, Fundamentals of Electric Circuits, 4th Edition (McGraw Hill, 2009).

I recommend this book as a second reference for ECE 302. Multiple textbooks will give you multiple perspectives on the same content, which is very helpful for learning and curating what you learn.

A. Sedra, K. C. Smith, T. C. Carusone, and V. Gaudet, Microelectronic Circuits, 8th Edition (Oxford, 2019).

There are many books with good introductions to MOSFETs. This one does so in a more circuits-oriented way, which is more helpful for 302.

Sources of Help

Like most engineering courses, ECE 302 builds knowledge in a rapid step-by-step process throughout the semester. Each step assumes you have mastered the prior material. If you fall behind by even a few class days, it can be difficult to catch up. If you do not understand something, ask questions in class, come to office hours, and/or take advantage of the other sources of help that are available. Get help quickly; do not wait! UT also provides resources to help you with nonacademic issues. A search of the UT website is often a good place to start.

Your first line of defense is to have a good **study group**. Your peers are equally incentivized to spend a long time working on the same problems with you, and you can usually learn from each other.

I also strongly recommend attending the **office hours** offered by all of the instructors and some of the graduate TAs. If you are not able to make it to any of the scheduled office hours, you are welcome to arrange a time and location with the TA or with me in advance to meet and discuss. You may use email or the class Discord to reach me or the TAs. Please mention ECE 302H in the subject of any email. The other faculty members teaching ECE 302 will also be able to help. All sections are on almost identical schedules.

Advice: Please please please come to office hours. Failing to take advantage of one-on-one or few-on-one time with faculty is probably the #1 mistake that undergraduates make. Your professors can help you with course content and with advice on professional development, course selection, and most other aspects of your education. Even if you have no questions, come to office hours anyway and stay as long as you can. You can learn from other students' questions and/or just build a relationship with the faculty (AKA your future letter-of-recommendation writers).

Students often express that they don't come to events like office hours because they're intimidated, they don't want to waste the professor's time with dumb questions, they don't want the professor to know that they're struggling, etc. Please banish these thoughts from your minds! Every professor teaching ECE 302 is strongly invested in your learning and your long-term success. And frankly, they're all very nice people. There's nothing that disappoints us more than seeing a student struggle alone, and there's nothing we enjoy more than a student success story. Take advantage of your professors!

The EE honor society, **HKN**, provides **free tutoring** for Basic Sequence ECE courses including ECE 302 in EER. They also provide limited assistance with basic math and science courses. HKN has a help desk service where you can "ask anything about anything"; just drop by their office at any time. Their web site is <http://hkn.ece.utexas.edu/>. The **UT Sanger Learning Center** provides **free tutoring** in JES. Consult their website for hours of operation and programs. The UT Sanger Learning Center also provides one-on-one tutoring free or for a reasonable hourly charge. Visit their web page at <https://ugs.utexas.edu/slc>.

This course is supported by **Supplemental Instruction (SI)** sessions. Our SI session will be specifically tailored to 302H. SI Sessions are led by experienced and trained students who develop engaging, structured, small-group activities for you to work through. These sessions are a consistently scheduled time for you and your classmates to tackle difficult content and learn the best approaches to the course! More information on session times and how to access them will be available on the Canvas page. You're welcome to attend sessions at any point in the semester but regular participation in SI Sessions has been shown to improve students' performance by an average of one-half to a full letter grade higher than the class mean. It is highly recommended for everyone.

The ECE Undergraduate Student Advising Office in EER is the best place to start if you have issues related to advising, registration, add/drop, or issues with the UT bureaucracy in general.

The Engineering Student Services and Advising (ESSA) Office in ESS can assist with many issues. Their web page is <http://www.engr.utexas.edu/academics/undergraduate-education/academic-advising>.

You can access videos from the University of California, Berkeley and the University of Utah for courses based on the Ulaby textbook at the links below:

https://cad.eecs.umich.edu/berkeley_videos.html

<https://utah.instructure.com/courses/473597>

Homework

Homework assignments are intended to give you practice in problem-solving, and to enable you to apply and further explore concepts and techniques introduced in lecture and/or assigned reading. Typically, there will be one homework assignment per week, except during weeks for which an exam is scheduled. Homework assignments are due at 11:45p on Friday nights. This is to encourage you to work on the homework during the week and to not burn out on Friday night. Late assignments will not be accepted except possibly in cases of serious, documented illness. Please see the sections of this syllabus addressing Policy on Collaboration and Policy on Academic Integrity for information on working with your classmates on homework assignments. I will set the “due time” on Canvas to be a few minutes later than midnight to relieve some stress about technology flubs, internet speed, and so forth – but this also means an almost-no-excuses policy on homework submitted after that time. The due time is still 11:45p! *Advice: Each homework is only worth ~1.5% of the total grade, but this is still substantial. Submitting late homework will almost certainly result in losing all 1.5%. Even if you’re crunched for time and have done only 4 out of 6 problems, for example, submitting a partial homework on time means you’ll only lose about 0.5%. It’s completely worth it.*

Laboratory

The laboratory sessions for this class meet once per week for two hours at the times indicated for your unique class number (recall that we have 4 unique numbers in 302H this year), in EER 1.826. All students are required to purchase the microcontroller development kit for the lab. The instructor for the laboratory component is your TA. All lab issues, including lab grading, should be discussed with your TA. Participation in all lab sessions is required except for documented illness or religious observance approved in advance. Per University policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. In these extraordinary circumstances, you will complete that lab with another section. Laboratory sessions will follow the schedule posted earlier in the syllabus, with lab documents posted to Canvas.

Professionalism Project

There is a project for this course which allows you to learn more about the engineering profession. The project consists of a series of assignments that are due on specified dates (see class schedule in this syllabus) throughout the semester. Details will be provided in a separate handout and on the class web site.

Grading:

Homework	13%	
Laboratory	20%	
Prof. Project	05%	
Semester Exams	40%	[3 exams during semester, best 2 count 20% each]
Complete All Exams	02%	[While we drop the lowest exam score, this incentivizes trying your best on all midterms]
Final Exam	20%	

Each course component may be curved, and the final grade may also be curved. You will never be curved down, meaning you will not get a lower grade if you did well in the course but not “as well” as someone else. Class attendance is not considered explicitly in computation of your course grade, but failing to attend class will all-but-guarantee poor performance on the graded components.

Notes on exam grading: For exam problems, reasoning and analysis are typically as or more important than the final answer. You should explain your reasoning clearly and show all work. Be sure to erase or cross out any work you do not want to be considered in grading. If you demonstrate mastery of the key concepts required to solve a problem, you will receive substantial credit even if the final answer is not completely correct. Conversely, a correct final answer without explanation or justification will typically receive very limited credit. *Any requests for exam*

regrades must be made through Gradescope with an explanation of the issue in question, and within one week of your receiving your original graded exam. If an exam regrade is requested, the entire exam may be regraded and your total score may increase or decrease. Abuse of the regrade system, such as shotgun requests to regrade every problem without a good-faith basis, may result in no regrades being performed and loss of points as penalty.

Note on fairness: This is a team-taught course with multiple sections. The exam will be composed of problems contributed by every participating professor. Grading is also done by a mixture of TAs and professors on a problem-by-problem basis, rather than a student-by-student basis. Therefore, each professor has limited control over the outcome of a student's exam grades, and even less control over HW/lab grades.

Assorted Course and University Policies

Missing Exam/Lab/Class Policy

If you absolutely must miss an exam, that's okay – that's one reason we drop the lowest exam score. For this reason, makeup exams will be given only under truly extraordinary circumstances and at the instructor's sole discretion.

Per University policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.

Drop Policy

All adds and drops should be discussed with your academic advisor. The last day to drop this course without permission from the Dean and the department advisor is the twelfth class day. After this day, drops are not approved unless students can demonstrate "good cause", i.e. health or personal problems that did not exist at the end of the official add and drop period. Academic performance, such as making poor exam grades, is not a valid reason to drop. University add/drop policies and information may be found at the UT Austin Registrar's web site: <https://registrar.utexas.edu/students/registration/after/add-drop>.

Accommodation for Religious Observances

By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence. If there is uncertainty regarding the precise date of a religious observance due to lunar cycles, etc., you still must inform me at least 14 days prior to the earliest possible date of the observance and provide the probable range of dates for the observance.

Students with Disabilities

The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of Disability and Access (formerly Services for Students with Disabilities). Additional information on this subject is posted on the UT Austin web site at <https://diversity.utexas.edu/disability/>.

If you feel you may be entitled to accommodation under these policies, please consult with the appropriate offices early in the semester. Evaluation and approval take time, and typical adjustments cannot be applied retroactively.

Emergency Preparedness and Classroom Evacuation Instructions

Every member of the university community must take appropriate and deliberate action when an emergency strikes a building, a portion of the campus, or entire campus community. Emergency preparedness means we are all ready to act for our own safety and the safety of others during a crisis. It takes an effort by all of us to create and sustain an effective emergency preparedness system. Information on emergency preparedness is posted on the class Canvas site. In addition, specific instructions provided to us on classroom evacuations is included just below for your reference.

Classroom Evacuation for Students

All occupants of university buildings are required to evacuate a building when a fire alarm and/ or an official announcement is made indicating a potentially dangerous situation within the building.

Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.

If you require assistance in evacuation, inform your instructor in writing during the first week of class.

For evacuation in your classroom or building:

1. Follow the instructions of faculty and teaching staff.
2. Exit in an orderly fashion and assemble outside.
3. Do not re-enter a building unless given instructions by emergency personnel.

Policy on Collaboration:

Discussion of course material and homework problems is permitted (and encouraged!). However, each student should work through the homework problems (and write up their solutions) independently. For additional details please see the section of this syllabus on Policy on Academic Integrity.

Course Policy on Academic Integrity:

Ethics and integrity in both academic and professional affairs should be part of your education at UT Austin. Academic integrity is a serious matter and will be treated as such in ECE 302. My hope is that this will be beneficial to your education both technically and in a much broader sense.

While I am confident that the large majority of students will naturally adhere to the university's guidelines and regulations regarding academic integrity, I provide below an explicit statement of course policy in this regard.

Homework: ECE 302 course policy is that discussion of course material, including homework problems, is allowed and indeed encouraged. However, each student should work through assigned homework problems and write up his or her solutions independently. Problem-solving is an extremely useful skill in itself, and in addition is the only really effective way to learn the material!

Specifically, each student is responsible for working out and writing up their own solutions to each homework assignment. Discussion of the course material and problems is encouraged, but practices such as allowing a classmate to copy your homework solutions, or a group working out a problem solution together which everyone then copies down and turns in, are forbidden. Use of problem solutions obtained from other students, over the web, etc. is forbidden. Students violating course policy on homework may receive a warning, a grading penalty, or further disciplinary action, at the professor's discretion and in accordance with university policy.

Labs: The lab policy is in the same spirit as the homework policy. Some labs are team labs, in which case each *team* is responsible for working out their own solutions, etc. In addition, while it is natural to divide tasks in team environments, it is inappropriate for some team members to avoid certain categories of tasks altogether (e.g., one person assembles the circuit and another is responsible for the written components).

Examinations: In general you will be allowed to use a calculator, writing implements and erasers, and blank writing paper during exams. No other materials will be allowed. Students who are caught using unauthorized materials during an exam, copying from a classmate on exams, continuing to work on an exam after time has been called, or violating exam or course rules in some other manner are likely, at a minimum, to receive a score of zero on that exam and may be subject to further disciplinary action, again in accordance with university policy.

AI Tools like ChatGPT: I will not be policing the use of ChatGPT and other large language models/chat bots for homeworks, labs, and the professionalism project. I neither encourage nor discourage its use as a study aid, but we warn that those who lean too heavily on AI are likely to have their jobs replaced by AI. Be aware that you will not have access to such resources on the exams. Please see UT Austin's acceptable use of AI tools here: <https://security.utexas.edu/ai-tools>.

For further information: Additional information concerning UT Austin's policy on conduct and academic integrity is posted on the UT Austin web site at <http://deanofstudents.utexas.edu/conduct/>.

Consequences of Academic Misconduct: The Provost of UT Austin announced on 8/11/2025 that "Beginning on Aug. 25, 2025, the ability of faculty members to handle academic misconduct on their own...will no longer be an

option. ... All suspected misconduct must be formally referred to SCAI [Student Conduct and Academic Integrity].” This means that I must report all academic misconduct cases to be handled by the central administration, and it is not within my discretion to forgive. Do not commit academic misconduct with the hopes that your instructor will be lenient – the instructor will not have control over the outcome.