Syllabus for UCSD ECE 45 in Spring 2025

Instructor: Prof. Ken Zeger, Jacobs Hall Room 6605, email: ken@zeger.us

Teaching Assistant:
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Tutors:
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Office Hours:

Mondays:	12:00pm- 1:00pm	(Kalkin, in-person, Jacobs Hall 5101E)
Tuesdays:	10:00am-11:00am	(Jay, in-person, Jacobs Hall 5101C)
	3:30pm- 4:30pm	(Marco, in-person, Jacobs Hall 5101E)
Thursdays:	10:00am-11:00am	(Jay, in-person, Jacobs Hall 5101C)
	11:00am-12:00pm	(Philip, in-person, Jacobs Hall 4506)
	3:30pm- 4:30pm	(Marco, in-person, Jacobs Hall 5101E)
Fridays:	11:00am-12:00pm	(Philip, in-person, Jacobs Hall 4506)
	1:00pm- 2:00pm	(Kalkin, in-person, Jacobs Hall 5101E)
	5:00pm- 5:50pm	(K. Zeger, Zoom)
Saturdays:	12:30pm- 1:30pm	(QUIZ REVIEW, by Zoom)

Lectures and Followups:

This class will be taught as a "flipped class". That is, all lectures are prerecorded and are available on-line. See Canvas $\longrightarrow$ Lectures for a table of links to the videos and the due dates for watching them. Each Tuesday/Thursday 6:30pm - 7:50pm class will be a Lecture Followup, where the ideas from the pre-recorded lecture due by that date will be discussed in a more casual and problem solving environment. It it inteded to be interactive, with questions from students. If there are no questions, the instructor will create a range of items to go over to help reinforce learning the lecture material.

All of the Tuesday Lecture Followups will be in-person in Warren Lecture Hall 2005 (without any Zoom connection) and all of the Thursday Lecture Followups will be on-line via Zoom. None of the Tuesday/Thursday classes will be recorded, but pdfs of handwritten notes generated during the classes may be posted.

Discussion:

Mondays 4:00pm-4:50pm In person at Ledden Auditorium and by Zoom.

Class web site:
All information for the class will be distributed through UCSD Canvas and the course Piazza site. However, Piazza will only be used for postings/questions/answers and Canvas will be used for all other matters (grades, practice exams, syllabus, etc.). It is helpful if you are able to post equations etc. using latex style input in Piazza.

Prerequisites:
Here are the REAL prerequisites for ECE45: Math 20A-B, ECE35, and a basic understanding of complex variables.

From Math 20AB you need to be able to differentiate and integrate. You also need to be able to do sums such as geometric series. Regarding complex variables, you need to know how to add, multiply, and divide complex numbers, how to to convert from rectangular to polar form and back, know conjugates, and Euler's formula. Also, brush up on trig functions and their derivatives and integrals.

Discussion Classes:
The discussion classes will be in-person and also by Zoom. The actual Discussion session from 4:00pm-4:50pm each Monday will consist of a 15-minute quiz (see the "Quizzes" section below) followed by quiz solutions, and review of course material if time permits.

Quizzes: There will be a 15-minute quiz every Monday during the 1st fifteen minutes of Discussion, starting the second week of the quarter. The last (9th) quiz will be on June 3, 2025. All Monday quizzes will be 4:00pm-4:15pm, Each quiz will be online via Zoom. You may take the quiz anywhere you want (e.g. at home or library or outside), including in the class room where the discussion will be given.

However, there is one Monday holiday (i.e. May 26), so the quiz for this one day will instead be the next day (Tuesday May 27) during the first 15 minutes of the Lecture Followup. More precisely, there will be 9 quizzes as follows: April 7, 14, 21, 28, May 5, 12, 19, June 2, during 4:00pm-4:15pm; and May 27 during 6:30pm-6:45pm.

All of the Discussion classes will start in person at 4:15pm, right after the quizzes end. Each quiz will typically consist of three questions. The material for each quiz will roughly focus on the two lectures preceeding it (i.e. the on-line material for the Tue and Thu from the previous week), but could include any material covered in prior lectures. The lowest of the 9 quiz grades will be dropped, and the remaining 8 grades will collectively count towards 35% of the class grade. Missed quizzes count as zero and cannot be made up.

Many copies of old quizzes, midterm exams, and final exams are posted. Solutions may not be posted, but feel free to discuss them publicly on piazza or at office hours. Copies of final exams from other web sites are also posted.

Final Exam:
Tuesday, June 10, 2025, 7:00pm-10:00pm.

Proctoring:
All quizzes will be proctored on Zoom with cameras turned on.

Grading: Your final grade will count as follows:
Homework = 0%
Quizzes = 35%

Final exam = 65%

At the instructor's discretion, more weight may be given to a student's final exam score if it is significantly higher or lower than their quiz score average, after normalization.

What Can Be Used During Exams Policy:
The Quizzes will be open books/notes and you may search the internet at will for previously posted results. You may use calculators and computers if you think it will help you. However, you may not consult with any people during the exam, nor email, text, post, or otherwise send any portion of the exam to any person or website during the exam.

The Final exam will be in person, closed book, and no electronic devices will be allowed. However, one sheet of 8.5 x 11 paper with writing or typing on both sides is allowed during the exam.

All headphones, earbuds, and other listening accessories are **prohibited** during quizzes and the final exam.

Missed Quiz Policy:
No makeup quizzes will be given.

Homework:
There are no formal homeworks and none are are to be handed in nor graded. Instead, (many) old quizzes, midterm exams, and final exams are given for practice. Many of these have answers or solutions written up, but others do not. You are however encouraged to work them out and check the posted solutions. You can also ask the TA for help or post questions to Piazza about them. These will serve as "homeworks" in a sense.

Text:
"Analog Signals and Systems"
1st Edition
Pearson, 2007
Erhan Kudeki and David C. Munson Jr.
ISBN-13: 978-0131435063

This is a very nice and helpful book. You can find the "International Edition" online for much cheaper (i.e. under $20) which is fine for this course. Perhaps there are legal pdfs available too.

Academic Integrity:
Photographs and videos may be taken by the instructors during exams in order to maintain academic integrity.
Don't cheat. Be honorable.

Approximate Schedule of Topics Covered:

- **Week 1 (lectures 1, 2)**: Review: Complex numbers, Euler's formula, Ohm's law, KVL, KCL, resistors, capacitors, inductors, Thevenin, Norton, phasors, sinusoidal steady-state, impedences. Phasors, frequency response of RLC circuits, low-pass filter, high-pass filter, band-pass filter, magnitude and phase plots.
- **Week 2 (lectures 3, 4)**: Phasors, frequency response, complex exponential inputs, eigenfunctions, systems, linear, time-invariant, causal. LTI sytems, frequency response properties, conugate symmetry, even amplitude, odd phase, DC response, superposition, periodic functions, period, fundamental frequency, Fourier series, Fourier series coefficients.
- **Week 3 (lectures 5, 6)**: Fourier series, ecponential form, Fourier series coefficient formula, trigonometric form. Fourier series properties, time shift property, derivative property, multiplication property, Parseval's theorem, LTI systems with periodic inputs.
- **Week 4 (lectures 7, 8)**: Fourier transforms, input-output properties of LTI systems with aperiodic inputs, unit rectangle function, sinc function. Inverse Fourier transform. Fourier and inverse Fourier transforms, LTI systems and I/O. Delta functions, impulse response, convolution, delta function properties, unit step function, Fourier transform of delta functions, shifted signals.
- **Week 5 (lectures 9, 10)**: Fourier transform properties, Fourier transform of sines and cosines, DC value in time, DC value in frequency, Fourier transform of sinc, symmetry (i.e. duality) property, time-derivatives, frequency deriviatives. Fourier transforms to calculate impedences of RLC components, Fourier transform of convolution, Fourier transform of product, Fourier transform of real signal (conjugate symmetry), Fourier transform of real and even signal, Fourier transform of real and odd signal, Parseval's theorem for Fourier transforms, Time scaling.
- **Week 6 (lectures 11, 12)**: Convolution properties: commutative, distributive, associative, shift, derivative. Convolutions and delta functions, Fourier transform of periodic signals and relationship to Fourier series, impulse trains, Fourier transform of impulse trains.
- **Week 7 (lectures 13, 14)**: Applications of LTI systems, speech coding, sampling. Sampling, block diagrams, bandlimited, Nyquist sampling theorem, reconstruction, sampling rate, aliasing, interpolation formula.
- **Week 8 (lectures 15, 16)**: Sampling theorem, ideal low-pass filter, AM radio, modulation, carrier frequency. AM radio, demodulation, Laplace transforms, bilateral Laplace transform.
- **Week 9 (lectures 17, 18)**: Laplace transform, region of convergence, poles, causal, anti-causal.

  Laplace transform, inverse Laplace transform, properties: derivative, shifting, method of partial fractions.
- **Week 10 (lectures 19, 20)**: Laplace transforms, partial fractions, derivatives, convolutions, LTI systems, causal and anti-causal inverses, system functions.