EE 301: Signals & Linear Systems

Term: Fall 2026
Credits: 3.0
Lecture Times & Location: Tuesday & Thursday 2:30–3:45 p.m., Rowan Engineering Center 110
Modality: In-Person

Instructor Information

- **Instructor:** Dr. Elif Kaya (Associate Professor of Electrical & Computer Engineering)
- **Email:** ekaya@university.alkimi.ai
- **Office:** Rowan Engineering Center 216
- **Office Hours:**
  - Monday & Thursday: 1:00–2:30 p.m. (In person, Rowan Engineering Center 216)
  - Friday: 4:00–5:00 p.m. (Virtual via Zoom; link posted in Canvas)
  - Also available by appointment.

Course Description

Continuous- and discrete-time signals, linear time-invariant systems, convolution, Fourier series and transforms, Laplace and z-transforms, and sampling. EE 301 provides a thorough mathematical and practical foundation in the analysis of continuous-time and discrete-time signals and linear time-invariant (LTI) systems. Students study time-domain system representations via convolution, frequency-domain representations via Fourier series and transforms, and complex-frequency methods using the Laplace and z-transforms. The course bridges theoretical transform calculus with physical applications in communications, audio signal processing, biomedical instrumentation, and control system engineering.

Prerequisites

EE 201 and MATH 340.

Measurable Student Learning Outcomes

Upon successful completion of EE 301, students will be able to:

1. **Classify Signals and System Properties:** Characterize continuous- and discrete-time signals and rigorously evaluate system linearity, time-invariance, causality, memory, and bounded-input bounded-output (BIBO) stability.
2. **Compute System Convolution:** Calculate time-domain system responses by evaluating the continuous-time convolution integral and discrete-time convolution sum using graphical and analytical methods.
3. **Apply Fourier Analysis:** Determine Fourier series and Fourier transforms of continuous- and discrete-time signals, and utilize transform properties to analyze filtering and amplitude modulation.
4. **Evaluate Sampling and Reconstruction:** Explain the Nyquist-Shannon sampling theorem, calculate minimum sampling rates to prevent aliasing, and formulate time- and frequency-domain signal reconstruction.

5. **Utilize Laplace and z-Transforms:** Determine regions of convergence, locate poles and zeros, invert rational transfer functions, and evaluate stability and causality for continuous and discrete LTI systems.

Required Course Materials & Approximate Costs

1. **Oppenheim, Alan V., Alan S. Willsky, and S. Hamid Nawab. *Signals and Systems*. 2nd ed., Pearson, 1996.** Approx. $75 digital rental ($190 purchase; reserve copies available in Alkimi Library).
2. **MATLAB and Signal Processing Toolbox (available through Alkimi University campus software license).** Free to registered engineering students.
3. **Total estimated cost:** Approx. $0 (library reserve & campus software) to $75 (textbook rental).

Generative AI Policy (AI Level 2: AI Permitted with Disclosure for Specified Tasks)

In accordance with Alkimi University Academic Policies (Student Handbook §5.8), EE 301 operates under **AI Level 2**.

- **What is permitted:** Students may use AI assistants to generate MATLAB or Python scripts for plotting signal waveforms, computing numerical Fast Fourier Transforms (FFT), and graphing pole-zero constellations.
- **What is prohibited:** AI tools must not be used to perform analytical signal transformations, derive convolution integrals or sums, or generate complete mathematical proofs for graded homework sets. All exams and quizzes are strictly closed-book and AI-free.
- **Disclosure:** Any computational script or figure in project submissions that was generated or refined with AI assistance must include a citation noting the tool used, the prompt supplied, and the mathematical verification performed.

Grading Components and Weights

- **Weekly Problem Sets:** 15% (Due Wednesdays at 11:59 p.m. in Canvas (weeks 2–14; lowest dropped))
- **Biweekly Mathematical Concept Quizzes:** 10% (Administered in class on alternate Thursdays (weeks 3, 5, 9, 13; lowest dropped))
- **Midterm Exam 1 (LTI Systems, Convolution & CTFT):** 20% (In class, Thursday, October 1)
- **Midterm Exam 2 (Sampling, DTFT & Laplace Transform):** 20% (In class, Thursday, November 5)
- **MATLAB Audio Filtering & Spectral Analysis Project:** 10% (Due Friday, November 20 at 11:59 p.m.)
- **Comprehensive Final Examination:** 25% (Thursday, December 17, 2026, 1:00–3:00 p.m.)

Grading Scale (Alkimi University Standard)

- **A:** 93–100% | **A-:** 90–92%
- **B+:** 87–89% | **B:** 83–86% | **B-:** 80–82%
- **C+:** 77–79% | **C:** 73–76% | **C-:** 70–72%
- **D+:** 67–69% | **D:** 60–66% | **F:** Below 60%
- **Extra credit:** No individual extra credit assignments will be granted in EE 301.

Course Schedule (Fall 2026)

Week	Dates	Topics & Readings	Assignments & Deadlines
Week 1	Aug 27	**Continuous-Time and Discrete-Time Signals:** Signal classification, time shifting, time reversal, time scaling, periodic signals, even and odd components, energy signals, and power signals. *Reading: Oppenheim & Willsky Ch. 1.1–1.3*	*First day of classes: Wed Aug 26.*
Week 2	Sep 1, 3	**Elementary Signals and System Properties:** Exponential and sinusoidal signals, unit impulse and unit step functions, singularity functions, and foundational system properties:	*Wed Sep 2: Add/section change deadline.*

Week	Dates	Topics & Readings	Assignments & Deadlines
		linearity, time-invariance, causality, and BIBO stability. *Reading: Oppenheim & Willsky Ch. 1.4–1.6*	
Week 3	Sep 8, 10	**Linear Time-Invariant Systems and Continuous Convolution:** Impulse response characterization of LTI systems, derivation of the continuous-time convolution integral, graphical convolution techniques, and system interconnects. *Reading: Oppenheim & Willsky Ch. 2.1–2.2*	*Mon Sep 7: Labor Day (no classes). Wed Sep 9: Census date (last day to drop without a W).*
Week 4	Sep 15, 17	**Discrete-Time Convolution and Differential/Difference Equations:** Discrete-time convolution sum, properties of convolution (commutative, associative, distributive), and LTI systems described by differential and difference equations. *Reading: Oppenheim & Willsky Ch. 2.3–2.4*	—
Week 5	Sep 22, 24	**Fourier Series Representation of Periodic Signals:** Response of LTI systems to complex exponentials, continuous-time Fourier series (CTFS), Dirichlet conditions, Gibbs phenomenon, and Parseval's relation. *Reading: Oppenheim & Willsky Ch. 3.1–3.8*	—
Week 6	Sep 29, Oct 1	**The Continuous-Time Fourier Transform and Midterm Exam 1:** Aperiodic signals and development of the CTFT, convergence considerations, standard transform pairs, and administration of Midterm Exam 1 in Thursday class. *Reading: Oppenheim & Willsky Ch. 4.1–4.2*	**Midterm Exam 1 (LTI Systems, Convolution & CTFT) (in class).**
Week 7	Oct 6, 8	**Properties of the Continuous-Time Fourier Transform:** Linearity, time shifting, frequency shifting, differentiation, integration, time and frequency scaling, duality, convolution property, and energy density spectra. *Reading: Oppenheim & Willsky Ch. 4.3–4.6*	—
Week 8	Oct 15	**Frequency-Domain Characterization and Ideal Filtering:** Magnitude and phase of frequency response, group delay, ideal frequency-selective filters (low-pass, high-pass, band-pass), and non-ideal filter roll-off. *Reading: Oppenheim & Willsky Ch. 6.1–6.4*	*Oct 12–Oct 13: Fall break (no classes).*
Week 9	Oct 20, 22	**The Sampling Theorem and Signal Reconstruction:** Representation of continuous signals by samples, impulse-train sampling, the Nyquist-Shannon sampling theorem, aliasing distortion, and ideal low-pass filter reconstruction. *Reading: Oppenheim & Willsky Ch. 7.1–7.4*	—
Week 10	Oct 27, 29	**The Discrete-Time Fourier Transform (DTFT):** Development of the DTFT, periodicity of the discrete-time frequency response, DTFT properties, duality with continuous-time Fourier series, and discrete filtering. *Reading: Oppenheim & Willsky Ch. 5.1–5.6*	—
Week 11	Nov 3, 5	**The Laplace Transform and Midterm Exam 2:** Definition of the two-sided and one-sided Laplace transform, relationship to CTFT, region of convergence (ROC) properties, and administration of Midterm Exam 2 in Thursday class. *Reading: Oppenheim & Willsky Ch. 9.1–9.3*	*Fri Nov 6: Last day to withdraw (W) or elect Pass/No Pass.* **Midterm Exam 2 (Sampling, DTFT & Laplace Transform) (in class).**
Week 12	Nov 10, 12	**s-Domain Analysis of LTI Systems:** Poles and zeros of rational transfer functions, geometric evaluation of frequency response, causality and BIBO stability criteria in the s-plane, and inverse Laplace transforms. *Reading: Oppenheim & Willsky Ch. 9.4–9.7*	—
Week 13	Nov 17, 19	**The z-Transform and Discrete System Analysis:** Definition of the z-transform, relationship to Laplace transform and DTFT, region of convergence properties, and inverse z-transform; Project due Friday. *Reading: Oppenheim & Willsky Ch. 10.1–10.3*	**MATLAB Audio Filtering & Spectral Analysis Project due Fri Nov 20 at 11:59 p.m.**
Week 14	Nov 24	**z-Domain System Functions and Stability:** Transfer function H(z), pole-zero representations in the z-plane, unit circle frequency response mapping, causality, and stability of discrete LTI systems. *Reading: Oppenheim & Willsky Ch. 10.4–10.7*	*Nov 25–Nov 27: Thanksgiving break (no classes).*

Week	Dates	Topics & Readings	Assignments & Deadlines
Week 15	Dec 1, 3	**Introduction to the Discrete Fourier Transform (DFT):** Frequency sampling of discrete-time signals, circular convolution, formulation of the Discrete Fourier Transform (DFT), and Fast Fourier Transform (FFT) algorithms. *Reading: Selected course notes on DFT/FFT*	—
Week 16	Dec 8	**Comprehensive Synthesis and Final Examination Review:** Integration of continuous and discrete transform methods, sampling, filter design, and review of core problem architectures for the final examination. *Reading: Review Oppenheim & Willsky Ch. 1–5, 7, 9, 10*	*Wed Dec 9: Last day of classes. Thu Dec 10: Reading Day.*
Finals	Dec 17	**Comprehensive Final Examination:** Thursday, December 17, 2026, 1:00–3:00 p.m., Rowan Engineering Center 110.	Comprehensive.

Course Policies

Attendance Policy

Class attendance at every lecture is required. The conceptual frameworks of Fourier, Laplace, and z-transforms build sequentially each week, and in-class mathematical derivations provide vital insights not easily replicated from textbooks alone. If an illness or university-approved absence arises, inform Dr. Kaya promptly. Students who miss the first two class meetings without notifying the instructor may be dropped. Students may miss class for religious observance without penalty if they notify the instructor in writing within the first two weeks of the semester (by Wednesday, September 9, 2026). Absences for university-sponsored activities (athletics, performances, conferences) are excused with a letter from the sponsoring office at least one week in advance.

Late Work Policy

Homework problem sets submitted after the Wednesday 11:59 p.m. deadline will incur a 15% deduction per 24 hours up to 48 hours late, after which no credit can be awarded. The lowest homework set grade and lowest quiz grade are dropped to accommodate personal illness or family emergencies.

Final Exam Policy

The final examination (Thursday, December 17, 2026, 1:00–3:00 p.m.) is scheduled by the University Registrar and can't be moved without the Dean's written approval (Faculty Handbook §5.5). A student with three or more final exams on the same calendar day may reschedule one of them. Requests go to the instructor of the middle exam by the last day of classes. For this term, send the request by Wednesday, December 9, 2026 (Student Handbook §6.4).

Academic Integrity

Alkimi University is an academic community devoted to rigorous scholarship, open intellectual inquiry, and uncompromising ethical conduct. All students are subject to the regulations of the Alkimi University Academic Integrity Policy. Academic dishonesty—including plagiarism, cheating on examinations, unauthorized collaboration, fabrication of empirical data, and unauthorized submission of academic work generated by artificial intelligence—undermines the integrity of the university and carries severe disciplinary sanctions. Sanctions range from a failing grade on an assignment or exam to an administrative course failure recorded as an 'XF' on the official transcript, academic suspension, or expulsion. Suspected violations are formally investigated and resolved through the Office of Academic Integrity in accordance with Faculty Handbook §6. For detailed information, consult the Office of Academic Integrity, Lovell Hall 315, (555) 555-0163, integrity@university.alkimi.ai.

Accessibility Services

Alkimi University is committed to providing equitable educational access and reasonable accommodations for all students with documented disabilities, including physical, sensory, psychological, learning, and chronic health conditions. Students requesting academic accommodations must formally register with the Office of Accessibility Services, Harlan Hall 204, (555) 555-0155, access@university.alkimi.ai. Once approved, students will receive an official Faculty Accommodation Letter detailing approved accommodations. Students should present this letter to the instructor as early in the semester as possible, and at least one week prior to any exam or assignment requiring accommodation. Accommodations cannot be applied retroactively.

Student Wellness and Mental Health

Your physical health, psychological well-being, and mental health are essential to your academic success. If you experience heightened stress, anxiety, depressive symptoms, personal trauma, or academic burnout, free, confidential counseling and medical care are available through the Hollis Health & Counseling Center, located in the Hollis Center. Routine appointments are available Monday–Friday 8:00 a.m.–6:00 p.m. and Saturday 10:00 a.m.–2:00 p.m. during the semester by calling (555) 555-0190 or emailing health@university.alkimi.ai. Urgent, 24/7 crisis psychological counseling is accessible immediately at (555) 555-0199.

Campus Student Support Services

- **Academic Advising Center:** Lovell Hall 101 | (555) 555-0158 | advising@university.alkimi.ai
- **Writing Center:** Whitcombe Library 3rd Floor | Free consultations on papers, reports, and research projects at any stage.
- **Whitcombe Library:** Whitcombe Library, Main Floor | (555) 555-0170 | askalibrarian@university.alkimi.ai
- **Hollis Health & Counseling Center:** Hollis Center | (555) 555-0190 | 24/7 Counseling Line: (555) 555-0199 | health@university.alkimi.ai
- **Signals & Systems Peer Help:** Rowan Engineering Center 140 | Drop-in mathematics and MATLAB signals tutoring available Tuesday and Thursday 4:30–7:00 p.m.