ECE2026 Course Syllabus

ECE2026

Introduction to Signal Processing (2-0-3-3)

CMPE Degree
This course is Required for the CMPE degree.

EE Degree
This course is Required for the EE degree.

Lab Hours
3 supervised lab hours and 0 unsupervised lab hours

Course Coordinator
AlRegib,Ghassan

Prerequisites
(MATH 1502/1512 or (MATH 15X2 and MATH 1522))[all min C] and (CS 1371 [min C] or CS 1171*) * Prerequisites indicated with an asterisk may be taken concurrently with ECE2026

Corequisites
None

Catalog Description
Introduction to discrete-time signal processing and linear systems. Sampling theorem. Filtering. Frequency response. Discrete Fourier Transform. Z Transform. Laboratory emphasizes computer-based signal processing.

Textbook(s)
McClellan, Shafer, and Yoder, *Digital Signal Processing First* (2nd edition), Prentice Hall, 2016. ISBN 0136019250, ISBN 9780136019251 (required)

Clicker, Turning Technologies. (required)

Course Outcomes
Upon successful completion of this course, students should be able to:

1. Express signal processing systems in mathematical form.
2. Write Matlab code describing a signal processing system.
3. Analyze signals in terms of their frequency content.
4. Describe system behavior in terms of frequency content.
5. Analyze linear system behavior in terms of Fourier transform and frequency response.
6. Analyze mixed analog-digital systems with sampling operations and digital filters.
7. Utilize the z-transform to analyze discrete-time systems in terms of poles and zeroes.
8. Use complex exponential notation to describe signals and systems.
9. Describe how signal processing is used in applications (e.g., audio and digital image processing).

Student Outcomes

In the parentheses for each Student Outcome:
"P" for primary indicates the outcome is a major focus of the entire course.
“M” for moderate indicates the outcome is the focus of at least one component of the course, but not majority of course material.
“LN” for “little to none” indicates that the course does not contribute significantly to this outcome.

1. (P) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. (LN) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. (LN) An ability to communicate effectively with a range of audiences
4. (LN) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. (LN) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. (M) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. (M) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topical Outline

1. Discrete-Time Signals and Systems
- Sinusoids and Complex Amplitudes
- The Spectrum
2. The Sampling Process
- Shannon?s Sampling Theorem
- Aliasing
3. Digital Filters
- Finite-Impulse-Response (FIR) Filters
- Linearity and Time-Invariance: Convolution
- Frequency Response
- Infinite-Impulse-Response (IIR) Filters
- Relationship between Continuous-Time and Discrete-Time Freq
4. Discrete Fourier Analysis
- DTFT: Discrete-Time Fourier Transform
- DFT: Discrete Fourier Transform
- DFS: Discrete Fourier Series
- Application: Spectrograms for Time-Frequency Analysis
5. The Z-transform
- Zeros and Poles
- Three Domains: Relationship among Time, Frequency, and Z do
6. Lab Topics may include:
- Introduction to MATLAB
- Complex Exponentials and the Spectrum
- Music or Speech Synthesis with Sinusoids
- Image Processing: e.g. Edge Detection, De-blurring
- Bandpass Filtering: Touch-Tone Decoding
- Biomedical Applications: e.g. Hearing, Cochlear Implants, E