ECE 437 (436) - Digital Signal Processing I (with Laboratory)

Credits: 3, **Contact Hours:** Two 75 minute lecture sessions per week.

Credits: 4, **Contact Hours:** Two 75 minute lecture sessions per week, one 150 minute laboratory session per week.

Coordinator: J. Brankov, Associate Professor of ECE

Textbook: J.G. Proakis, *Introduction to Digital Signal Processing*, Pearson Education, 3rd Edition, 1996.

2019 Catalog Data: ECE 436: Digital Signal Processing I with Laboratory. Credits 4.
Discrete-time system analysis, discrete convolution and correlation, Z-transforms. Realization and frequency response of discretetime systems, properties of analog filters, IIR filter design, FIR filter design. Discrete Fourier Transforms. Applications of digital signal processing. Credit will be given for either ECE 436 or ECE 437, but not for both. Lecture: 3 Lab: 3 Credits: 4 Satisfies: ECE Professional Elective (P)

ECE 437: Digital Signal Processing I. Credits 3.
Discrete-time system analysis, discrete convolution and correlation, Z-transforms. Realization and frequency response of discretetime systems, properties of analog filters, IIR filter design, FIR filter design. Discrete Fourier Transforms. Applications of digital signal processing. Credit will be given for either ECE 436 or ECE 437, but not for both. Lecture: 3 Lab: 0 Credits: 3 Satisfies: ECE Professional Elective (P)

Prerequisites or co-requisites by topic: ECE 308 or BME 330

1. Engineering mathematics
2. Fourier and Laplace transforms
3. Linear system analysis, including time and frequency domain representation of signals and systems

Enrollment: Required course for CPE and EE majors

Specific outcomes of instruction:
After completing this course, the student should be able to do the following:

1. Conduct fundamental time analyses of discrete-time signals and systems.
2. Analyze linear, time-invariant discrete-time system behavior using the Z-transform.
3. Conduct frequency analyses of discrete-time signals and systems using the discrete-time Fourier transform.
4. Apply the DFT (Discrete Fourier Transform) in the analysis of discrete-time signals.
5. Implement DFTs efficiently via FFT (Fast Fourier Transform) algorithms.
6. Design structures for the implementation of discrete-time systems.
7. Design basic digital filters.
8. Use computer-based analysis and design tools (such as MATLAB software) in the analysis and design of discrete time systems.

Additional goals for ECE 436 only

9. Complete an engineering design that incorporates engineering standards and/or realistic constraints.
10. Prepare an informative and organized design project report.

Relationship of ECE 437 and 436 specific outcomes of instruction to student outcomes:

	Student Outcomes	ECE 437 Goals	ECE 436 Goals
1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	1, 2, 3, 4, 5, 6, 7, 8, 9	1, 2, 3, 4, 5, 6, 7,8
2	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	6,7,8,9	6,7,8
3	An ability to communicate effectively with a range of audiences	10	
4	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	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		9,10
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	8,9	8
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies		

Topics:

- Discrete-Time Signals and systems, Applications, Convolution and correlation (1 week)
- Fourier Analysis and Sampled Data Signals (2 weeks)
- Z Transform, Frequency Response and Realization (2 weeks)
- Design and Properties of Analog Filters (2 weeks)
- IIR Filter Design (2 weeks)
- FIR Filter Design (2 weeks)
- Discrete Fourier Transform and Properties (2 weeks)
- Fast Fourier Transform, FFT Convolution and Correlation (1 week)
- Exams (1 week)

Laboratory topics:

- Introduction to the DSP LAB System and MATLAB signal processing software
- MATLAB Functions (Matrix Operations, FFT, Convolution, Windows, Random Number Generators)
- Sampling, Quantization and Aliasing Effects
- System Realization, convolution, Correlation, Difference Equations
- Transform, Inverse Z-transform, Frequency Response
- Design and Evaluation of Low pass, High pass and Bandpass IIR filters
- Design and Evaluation of FIR filters and Windows
- Discrete Fourier Transform and Properties, 2D DFT algorithm
- Fast Fourier Transform and Spectral Analysis

Prepared by: I. Brown **Date:** February 26, 2020