Fall 2023

ECE 512 -Digital Signal Processing

Class Hours: 2:00-3:15 pm Tuesdays and Thursdays

Place: Weber 202

Prerequisites: ECE 312 or an equivalent course on Signals and Systems.

Textbook: J.G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Prentice-Hall, 5th Edition 2021.

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Office Hours: 4:00pm-5:00 pm Tuesdays

Objective:

The purpose of this course is to introduce the fundamental concepts and ideas in the Digital Signal Processing (DSP) area and provide an understanding for the range and scope of its applications in a wide variety of disciplines. This course is intended for all senior-level and graduate students in the Electrical and Computer Engineering as well as for those individuals in industry establishing, refocusing, or expanding their professional horizons. At the completion of the course, the students will be familiar with the analysis, design, and implementation methods for both recursive and non-recursive digital filters and different useful transforms for frequency domain signal processing and their applications in various areas. The specific topics that will be covered include: review of discrete-time systems, z-transform and properties, transfer function and system representation in the time and frequency domains, discrete Fourier representation and FFT, digital filtering techniques, recursive and non-recursive filters, digital filter design and implementation, review of random signal processing and quantization effects in digital systems, multi-rate systems, filter banks and applications in several areas including speech processing, radar, sonar, and communication systems.

Course Outline:

1. Review of discrete-time signals and system representation, z-transform and properties, transfer function and realizations, recursive and non-recursive digital filters, stability analysis of recursive filters
2. Sampling theorem and band-limited signals, discrete-time Fourier series and transform, discrete Fourier transform (DFT) and FFT algorithms.
3. Implementation of recursive and non-recursive filters using sectioning and block processing schemes.
4. Design of non-recursive digital filters, windowing and frequency sampling methods, optimal Filter design schemes and Remez Exchange method.
5. Design of recursive digital filters, stability considerations, impulse invariant technique, bilinear z-transformation, and linear programming methods for optimal filter design.
6. Quantization effects in digital systems, limit cycle oscillations, round-off error and filter realization.
7. Multi-rate DSP, decimation and interpolation, sampling rate conversation techniques.
8. Applications in various areas including speech, radar, sonar and communication systems.
9.

Grading Criteria:

Homework	20%
Computer Assignments*	25%
Midterm Exam	25%
Final Exam/Project	30%

*There will be several computer projects using MATLAB DSP toolboxes. Students are free to use any other available toolboxes e.g., using Python.