

Cleveland State University
Department of Electrical Engineering and Computer Science

EEC 430: Digital Signal Processing

- Catalog Description:** EEC 430 Digital Signal Processing. (3-0-3)
Pre-requisites: EEC 315 or 316, EEC 383
Modeling of DSP operations using discrete-time signals and systems: difference equations, Z-transforms, Fourier methods; signal sampling (A/D) and reconstruction (D/A); digital filters; sample rate converters and oversampling; DFT, and fast convolution; delta-sigma converters; selected applications. Out-of-class projects done using Matlab.
- Textbook:** Mitra, Sanjit K., *Digital Signal Processing*, 4thEd., McGraw-Hill, 2011.
- References:** Proakis, John G. and Dimitris G. Manolakis, *Digital Signal Processing*, Third Edition, Prentice Hall, 1996.
- Coordinator:** Dr. Murad Hizlan,
Associate Professor of Electrical Engineering and Computer Science
- Course Objectives:** This course is designed to provide students with a basic knowledge of methods of signal sampling and reconstruction, and to introduce them to the mathematical methods used to characterize DSP operations. Other goals include introducing students to specific DSP operations such as filtering and sample rate conversion and providing them with open-ended analysis and design problems in the form of computer projects.
- Expected Outcomes:** Upon completion of this course students should be able to:
1. Understand the various methods (time, transform, and frequency domain) of describing discrete-time signals and systems.
 2. Understand the basic structure of a DSP system, including antialiasing filters, sampling, A/D and D/A converters, DSP processing, and anti-imaging filters.
 3. Understand the principles of operation of digital filters, adaptive filters, spectrum estimators, multirate systems, fast convolution, and delta-sigma converters.
 4. Design digital filters.
 5. Specify requirements for an overall DSP system including sampling rates, A/D and D/A converters, antialiasing and anti-imaging filters, and the need for oversampling, upsampling and the use of decimators and interpolators.
 6. Design decimators and interpolators.
 7. Design spectrum estimators.

Fulfills the Following Electrical Engineering Program Objectives and Outcomes:

Objectives:

1. Practice Electrical Engineering in one or more of the following areas: communications, computers, controls, power electronics, and power systems.
2. Define and diagnose problems, and provide and implement electrical engineering solutions in an industrial environment.

Outcomes:

- a. An ability to apply knowledge of mathematics, science, and engineering to general electrical engineering and, in particular, to one or more of the following areas: communications, computers, controls, power electronics, and power systems.
- c. An ability to design a system, component, or process to meet desired needs.
- e. An ability to identify, formulate, and solve electrical engineering problems.
- k. An ability to use the techniques, skills, and modern engineering tools necessary for electrical engineering practice.

Prerequisites by Topics:

1. Fourier methods for analysis of continuous-time signals and systems.
2. Laplace-transform methods for analysis of continuous-time signals and systems.
3. Spectrum of a continuous-time signal.
4. A knowledge of basic digital systems including the digital representation of data, gates, counters, comparators, etc.

Topics:

1. Introduction; review of Fourier Methods for continuous-time signals.	2
2. Discrete-time signals: time domain; Fourier Methods; DTFT; spectra.	6
3. Sampling; bandlimited and repeated spectra; Nyquist Theorem; aliasing.	6
4. A/D conversion; antialiasing filters.	6
5. Discrete-time systems: difference equations; impulse response and convolution; FIR and IIR systems.	4
6. Z-transform of a signal; Z-transfer function of a system.	2
7. Frequency domain description of systems—frequency response.	3
8. FIR filter design.	4
9. IIR filter design.	3
10. Signal reconstruction; D/A conversion; anti-imaging filters.	3
11. Decimation and interpolation.	2
Exams; holidays.	4
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Class/Laboratory Schedule:

The class meets two sessions per week, two hours each session. There is no laboratory associated with the course.

Outside of Class Projects:

Students are required to complete projects using Matlab software. Projects include topics in signal generation, sampling and aliasing, sampling and quantization noise effects, oversampling and antialiasing filter design, and design of analog and digital filters.

Prepared by: Dr. Murad Hizlan.

Date: September 2013