THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Introduction to Digital Signal Processing

ECE 5200

Credit Hours:
3.00

Course Levels:
Undergraduate (1000-5000 level)
Graduate (5000-8000 level)

Course Components:
Lecture

Course Description:
Sampling and reconstruction; discrete-time rate conversion; processing of discrete-time signals; design of discrete-time filters, selected topics in adaptive filtering, time-frequency analysis, and wavelets.

Prerequisites and Co-requisites:
Prereq: 3050, and Stat 3470 or Math 4530; or Grad standing.

Course Goals / Objectives:

- Master undergrad-level signals & systems concepts (e.g., linearity, time-invariance, causality, stability, impulse response, convolution, Fourier series, CTFT, DTFT, Laplace transform, Z-transform), applying these concepts to new problems
- Master the fundamentals of sampling and reconstruction, i.e., conversion between the continuous-time and discrete-time domains, as well as discrete-time rate conversion (e.g., upsampling, downsampling, interpolation, decimation)
- Master filter design based on magnitude response and phase response; FIR filter design methods like window-based, weighted least-squares, & equiripple designs; IIR filter design methods based on bilinear transform & least-squares
- Be competent with the fundamental concepts in the processing of finite-duration discrete-time signals, including windowing, DFT, circular convolution, spectral analysis, FFT, fast convolution, and overlap/save processing
- Be familiar with one or more selected topics in multidimensional, multirate, multiresolution, or adaptive signal processing, possibly including time-frequency analysis, filterbanks, or wavelets
- Be competent with programming discrete-time signal processing and analysis tasks in Matlab, Python, or similar high-level languages

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Course Topics:

- Signals and systems review: system properties (e.g., linearity, time invariance, causality, stability), impulse response, convolution, Fourier series, CTFT, Laplace transform, DTFT, Z-transform
- Sampling and conversion: sampling, aliasing, Nyquist rate, sinc reconstruction, ZOH reconstruction, upsampling, downsampling, interpolation, decimation, rate conversion
- Processing of finite-length discrete-time signals: DFT, circular convolution, windowing, spectral analysis, matrix/vector formulations, FFT, fast convolution, overlap-save
- Design of discrete-time filters: ideal magnitude responses, group delay, linear phase, FIR designs (e.g., window-based, frequency-sampled, weighted least-squares, equiripple), IIR designs (e.g., bilinear transform, Prony's method, Shank's method).
- Selected topics in multidimensional, multirate, multiresolution, or adaptive signal processing, possibly including time-frequency analysis, filterbanks, or wavelets

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Designation:
Elective