Department of Electrical and Computer Engineering  
University of Massachusetts/Amherst  

ECE 565: Digital Signal Processing  
Spring 2011


Objectives: Students completing this course will know:
1. How to use discrete-time systems to implement continuous-time signal processing.
2. Multi-rate signal processing and its applications.
3. How to use z-transforms to characterize discrete-time signal and system properties.
4. How to use the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) for signal analysis and system implementations.
5. How to design and implement finite impulse response (FIR) and infinite impulse response (IIR) discrete-time filters.
6. How to implement filters with adjustable coefficients that adapt to changing conditions.

Prerequisite: ECE 563 (Introduction to Communications and Signal Processing).

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Lectures: T TH, 2:30 – 3:45 PM, Marston 220.

Web Site: All course material (announcements, handouts, assignments and solutions, grade records) will be available through SPARK: https://spark.oit.umass.edu/webct/entryPageIns.dowebct (Note: You must be registered in the course to have SPARK access.)

Laboratory: Lab projects (and some homework problems) will involve the use of MATLAB, which is available on ECS computers. (You might also want to purchase the Student Edition of MATLAB for your own computer.)

Office Hours: Monday, 11:00 AM - noon; Thursday, 4:00 – 5:00 PM.
Textbook: There is no required textbook for this course – all of the course material will be covered in the lectures. The following books are good references for the topics that we will discuss:


(Note: The first two books provide comprehensive and complete coverage of digital signal processing. The third book gives a more concise treatment of the important topics and is very inexpensive.)

Grading policy: Homework: 10%
Labs: 10%
Exam 1 (Tuesday, March 1, 6 – 8 PM): 25%
Exam 2 (Thursday, April 7, 6 – 8 PM): 25%
Final Exam (Date TBD): 30%

Topics covered:

1. Introduction and overview: Quick review of DSP topics covered in ECE 563.
2. Discrete-time implementations of continuous-time systems: sampling and reconstruction; relation of discrete-time and equivalent continuous-time frequency responses.
4. z-transforms: poles and zeros; region of convergence (ROC); z-transform properties; inverse transforms.
5. Transform analysis of discrete-time signals and systems: stability; LTI systems with rational system functions; all-pass, minimum-phase and generalized linear phase systems.
6. Design and implementation techniques for FIR filters: design by windowing; generalized linear phase FIR filters; network structures for implementation; implementation with DFTs, block convolution.
7. Fast Fourier Transform (FFT) algorithms for computing DFTs: exploiting symmetry for fast computation; decimation-in-time algorithms; practical considerations.
8. Design and implementation techniques for IIR filters: analog filter design methods; conversion of analog designs to discrete-time filters: impulse invariance, bilinear transformation; signal flow graphs and network structures for IIR systems.