

**Department of Electrical and Computer Engineering
University of Massachusetts/Amherst**

ECE 565: Digital Signal Processing, Spring 2008

(Draft, 20080128)

Catalog Data:

(4 credits, with lab) IIR and FIR digital filter design. Applications of DFT and FFT. Transform domain analysis of discrete-time (DT) linear time-invariant systems: minimum phase, allpass, linear phase systems. Implementation of DT systems. Finite wordlength effects. Multirate digital systems processing. Power spectrum estimation. Prerequisite: ECE 563.

Objectives:

Students completing this course will know:

1. How to use z-transforms to characterize discrete-time signal and system properties.
2. How to use the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) for signal analysis and system implementations.
3. How to design and implement FIR and IIR discrete-time filters.
4. Effects of quantization and finite wordlength on the performance of digital signal processors.
5. How to use digital signal processing to estimate the power spectral densities of random signals.

Prerequisite:

ECE 563 (Introduction to Communications and Signal Processing)

Instructor:

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Teaching Assistants:

Nupur Murlidharan, email nmurlidh@engin.umass.edu
Ashik Waheed, email aabdulwa@ecs.umass.edu

Lectures:

T Th, 2:30 – 3:45 PM, Marston 211.

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 personal computer.)

Office Hours:

AM: TBD.
NP, TBD
AW, TBD

Textbook:

Oppenheim, Schafer and Buck, Discrete-Time Signal Processing, 2nd ed., Prentice Hall, 1999.

Grading policy:

Labs: 25%

Homework: 15%

In-class quizzes: 15%

Midterm Exam: 20%

Final Exam: 25%

Topics covered:

1. **Introduction and Overview**
2. **z-transforms:** poles and zeros; region of convergence (ROC); z-transform properties; inverse transforms. (Textbook, Sec. 3.0 – 3.4).
3. **Transform Analysis of Discrete-Time Signals and Systems:** stability; LTI systems with rational system functions; all-pass, minimum-phase and generalized linear phase systems.
4. **Design and Implementation Techniques for FIR Filters:** design by windowing; generalized linear phase FIR filters; network structures for implementation; implementation with DFT's, block convolution (Sec. 7.2 – 7.3, 6.5, 8.7)
5. **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. (Appendix B; Sec. 7.1, 6.2 – 6.4).
6. **Effects of Finite Precision in System Implementations:** coefficient quantization; round-off noise; limit cycles. (Sec. 6.6 – 6.9)
7. **Power Spectrum Estimation for Discrete-Time Random Processes:** periodograms; windowed periodograms; autocorrelation estimates. (Appendix A; Sec. 10.6 – 10.7)