

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

**ECE 565: Digital Signal Processing  
Spring 2018**

- Catalog Data:** 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. Multi-rate digital signal processing. Power spectrum estimation. Prerequisite: ECE 563.
- 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 the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) for signal analysis and system implementations.
  4. How to use z-transforms to characterize discrete-time signal and system properties.
  5. How to design and implement finite impulse response (FIR) and infinite impulse response (IIR) discrete-time filters.
  6. Applications of digital signal processing methods including signal estimation, adaptive filtering, and speech analysis.
- Prerequisite:** ECE 563 (Introduction to Communications and Signal Processing).
- Instructor:** Patrick A. Kelly  
215B Marcus Hall  
phone: (413)545-3637; email: kelly@ecs.umass.edu
- Lectures:** T TH, 1:00 – 2:15 PM, ELAB 306.
- Web Site:** All course material (announcements, handouts, assignments and solutions, grade records) will be available on Moodle: [moodle.umass.edu](http://moodle.umass.edu)  
(Note: You must be registered in the course to have Moodle access.)
- MATLAB:** Some assignments will involve the use of MATLAB, which is available on ECS computers. You might also want to obtain the Student Edition of MATLAB for your own computer.
- Office Hours:** Monday, 3 – 4 PM; Thursday, 11 AM – noon.

**Textbook:**

There is no required textbook for this course – all of the course material will be covered in the lectures, and lecture notes covering most material will be posted on Moodle. The following books are good references for the topics that we will discuss:

1. Oppenheim and Schaffer, *Discrete-Time Signal Processing*, 3<sup>rd</sup> ed., Prentice Hall, 2009.
2. Proakis and Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, 4<sup>th</sup> ed., Prentice Hall, 2007.
3. Hayes, *Schaum's Outline of Digital Signal Processing*, 2<sup>nd</sup> ed., McGraw-Hill, 2012.

(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: 15%

Midterm Exam 1 (Tuesday, February 27): 25%

Midterm Exam 2 (Tuesday, April 3): 25%

Final Exam (Tuesday, May 8, 10:30 AM - 12:30 PM): 35%

(Note: The two midterm exams will be given during class periods)

**Course Grade Scale:**

<b>If your overall course grade is in the range:</b>	<b>You will receive a course letter grade of at least:</b>
85-100	A
81-84	A-
77-80	B+
73-76	B
69-72	B-
65-68	C+
61-64	C
55-60	D (undergraduate)

**Topics covered:****I. Time and Frequency Domain System Design**

1. Discrete-time Fourier Transform (DTFT)
2. Sampling, quantization and reconstruction

3. DT implementation of CT systems
4. FIR filter design
5. DFT/FFT and FIR filtering
6. Multi-rate DSP

## **II. Transform Domain System Design**

1. z-transform
2. Relation of pole and zero locations to magnitude and phase responses
3. All-pass and minimum phase systems
4. IIR filter designs
5. System implementations

## **III. Applications of Digital Signal Processing**

1. Linear minimum mean-square error (LMMSE) filtering
2. Adaptive filtering and the LMS algorithm
3. Speech Analysis (time permitting)

### **Accommodation Policy**

The University of Massachusetts Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological or learning disability on file with Disability Services (DS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify me within the first two weeks of the semester so that we may make appropriate arrangements.

### **Academic Honesty**

Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst. Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent (<https://www.umass.edu/honesty/>).

**Inclusivity and Diversity**

The diversity of the participants in this course is a valuable source of ideas, problem solving strategies, and engineering creativity. If you feel that your contribution is not being valued for any reason, please speak with the instructor privately. If you wish to communicate anonymously, you may do so in writing or speak with Dr. Paula Rees, Director of Engineering Diversity Programs ([rees@umass.edu](mailto:rees@umass.edu), 413-545-6324, Marston 128). We are all members of an academic community where it is our shared responsibility to cultivate a climate where all students/individuals are valued and where both they and their ideas are treated with respect.