ECE 346: Digital Signal Processing – Spring 2012

MTh 8:40–10:00 AM, PH–115

Instructor

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Teaching Assistants

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Location: EE Building (room announcement via email)

Required Text

Alan V. Oppenheim and Ronald W. Schafer, *Discrete-Time Signal Processing*, Prentice Hall (3rd ed.)

Recommended Text

Sophocles J. Orfanidis, *Introduction to Signal Processing* (available freely online).
URL: http://eceweb1.rutgers.edu/~orfanidi/intro2sp/

James H. McClellan, Ronald W. Schafer, and Mark A. Yoder, *Signal Processing First*, Prentice Hall (highly recommended for students with weak understanding of the prerequisites).

Prerequisites

The courses ECE 345 (and ECE 347) *Linear Systems and Signals* (and Lab). In particular, enrolled students should be comfortable with the concepts of complex numbers, Fourier, Laplace, and z transforms, continuous and discrete signals and systems, time-domain and frequency-domain relationships between the input and output of linear, time-invariant (LTI) systems, continuous and discrete convolution, etc. The students will also be expected to turn in some assignments using MATLAB.

Course Policies

The final course grade will be based upon:

1. Weekly homework (10%)
2. Four quizzes (10%)

3. Two in-class exams (45%)
4. Final exam (35%)

Late homework submission policy: Every student gets a grace period of up to 3 days for a maximum of two assignments during the semester. Utilization of the first grace period is without any penalty. Utilization of the second grace period comes with a 30% penalty. No late submissions will be accepted from a student who has utilized both these grace periods.

Quiz and exam policy: Quizzes will typically be announced 3 days in advance and will be closed books and notes. Exams will typically be open required text and class notes *only*. As a general policy, there will be no makeup quizzes and exams. I will allow exceptions for rare emergency situations, but this would require at least 2 days advance approval to skip a quiz and at least 7 days advance approval to skip an exam. Any one not appearing in a quiz and/or an exam without such prior approval will automatically get a 0.

Grading policy: The grades will be assigned on a relative basis. The relative scale though will vary based upon the performance of the overall class. In an ideal setting, students above class average will get B and higher and students below class average will get C+ and lower. If the class performs really well, however, then the B will turn into B+ (or even A!). Similarly, if the class performs really bad then the B will turn into C+ (or even C).

Attendance policy: There will be insights, examples, and notes covered in class that cannot be easily gleaned from the required and recommended texts. It is therefore in the students' best interests that they regularly attend the class. However, there will be no formal roll call in the class.

Mobile and computing devices policy: Use of mobile and computing devices during the class is strictly forbidden. The only exception to this rule is when a student uses a computing device in order to take notes using a stylus.

Tentative Course Outline

- *Week 1:* Introduction, sampling of continuous-time (CT) signals, aliasing, and sampling theorem
- *Week 2:* Sampling theorem, reconstruction & anti-aliasing filters, and discrete-time Fourier transform (DTFT)
- *Week 3:* Properties of the DTFT, and discrete-time (DT) processing of CT signals
- *Week 4:* Finite impulse response (FIR) and infinite impulse response (IIR) DT, LTI systems, convolution in the matrix–vector form, and tapped delay line model of FIR filters
- *Week 5:* Digital processing of analog signals, A/D and D/A conversion, and quantization error
- *Week 6:* **Midterm # 1** (*Tentative: February 23, 2012*) and discrete Fourier transform (DFT)
- *Week 7:* Properties of the DFT, linear convolution using the DFT, and the fast Fourier transform (FFT)
- *Week 8:* Spectral analysis of signals using the DFT and review of the z-transform
- *Week 9:* Analysis of LTI systems using the z-transform and the pole–zero diagram
- *Week 10:* Realizations of filters in direct form I and direct form II
- *Week 11:* **Midterm # 2** (*Tentative: March 29, 2012*) and realizations of filters in cascade and parallel form
- *Week 12:* Design of digital filters and IIR filter design using impulse invariance
- *Week 13:* IIR filter design using the bilinear transformation method
- *Week 14:* FIR filter design using the windowing method

- *Week 15:* Review week for the final exam
- *Advanced Material (if time permits)*: Increasing and decreasing the sampling rate in the discrete domain