

AUBURN UNIVERSITY
Department of Electrical and Computer Engineering

ELEC 5410/6410
Digital Signal Processing
Fall 2019

Course Information

Professor: Stanley J. Reeves
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Class Hours: MWF 8:00 - 8:50 a.m.

Office Hours: T 2:45-3:45, W 2:30-3:30. I also encourage email contact at any time and posted questions in the class forum on Canvas.

Text: *Schaum's Outline of Digital Signal Processing*, 2nd ed., M. Hayes, McGraw-Hill, 2012.

Other References and Recommended Supplements:

Discrete-Time Signal Processing, 3rd ed., A. V. Oppenheim and R. W. Schaffer, Prentice-Hall, 2010.

(standard text — good for alternative presentations of material)

S. J. Mitra *Digital Signal Processing: A Computer-Based Approach*, 4th ed., McGraw-Hill, 2011. (standard text — good for alternative presentations of material)

Schaum's Outline of Signals and Systems, 2nd Ed., H. Hsu, McGraw-Hill, 2010. (good for review of prerequisite material)

Web Site: Canvas will be used for several things:

- class forum
- electronic presentation of computer assignments
- syllabus
- miscellaneous related info

Reference for computer exercises:

Beginning MATLAB for Engineers, S. J. Reeves. (available as an e-Book)
Online help is available through the class web site.

Prerequisites by Topic:

1. impulse response and convolution
2. frequency response of linear systems
3. Laplace and Fourier transforms
4. probability and random processes

A brief lecture reviewing prerequisite material is posted on the web site.

Course Objectives:

This course covers the fundamental theory and important applications of digital signal processing. Upon completion of the course, the student should have a solid foundation in basic digital signal processing. The objectives of the course will be:

1. To develop methods for processing discrete-time signals. These signals include waveforms that originate as discrete-time signals as well as those that originate from sampling continuous-time signals.
2. To understand the processes of analog-to-digital and digital-to-analog conversion.
3. To understand the discrete Fourier transform and fast Fourier transform.
4. To learn the basic techniques of digital filter implementation and design.
5. To become aware of some applications of digital signal processing.

Teaching Philosophy:

A statement of my teaching philosophy can be found at <http://www.eng.auburn.edu/~reevesj>

Grading Policy:

Test 1 (September 25):	15%
Test 2 (November 6):	15%
Quizzes:	15%
Computer projects:	25%
Final exam (December 9):	25%
Professionalism:	5%

Note: Grade calculations done automatically on Canvas are not authoritative and may or may not be accurate.

5410 and 6410 students will at times be given different or extra problems on the quizzes, computer assignments, supplemental assignments, and tests to differentiate from the parallel course.

Homework: Homework will be assigned regularly but not graded. Solutions will be made available when not covered in the book.

Weekly Quizzes:

Ten-minute quizzes will ordinarily be given at the end of class on Wednesdays. These quizzes will be based closely on homework problems assigned prior to the quiz. Quizzes will be graded on a 10-point scale. **Grade appeals on quizzes will only be allowed within one week of the class following the quiz, so please check the web regularly to make sure your grades are posted accurately.**

Occasionally, the professor may post an online lecture instead of a class meeting. In that case, a simple assessment quiz may be given to make sure students have watched the online lecture. These quizzes will be averaged with the regular quizzes ordinarily as a 6-point quiz.

Computer Projects:

Computer projects will be a major part of the learning process for this class. These assignments will consist of projects to illustrate and explore various signal processing concepts. All out-of-class work is to be done **independently**. Sharing of programming tips and discussing general concepts is ok. Collaborating on experiments or code-writing is not. **Any** such collaboration on these assignments will be considered an act of dishonesty and will be treated accordingly.

Final Exam:

The final will be cumulative with about 40% weight on the material after the second test.

Professionalism:

Students are professionals in training and should make every effort to take a professional approach to learning and classroom behavior. The following are specific areas of concern:

1. **Attendance:** Attendance is important and expected but not required. However, it is unprofessional behavior for a student to miss class without a valid excuse and then expect individual help or consideration from the instructor.
2. **Punctuality:** Professionals show respect to others in a meeting by being on time. Walking in late distracts the instructor and other students. Tardiness should be a rare event.
3. **Retrieving graded assignments:** Be sure to get your graded assignments when they are returned. If you miss a class in which assignments were returned, please see the instructor as soon as possible to pick yours up, either after class or in his office.
4. **Restroom:** The restroom is for use before and after class and for medical emergencies. Plan ahead!
5. **Talking in class:** Avoid obscene and profane speech. Exchanges with classmates during class should be quiet and related to the lecture. Stop talking when the instructor begins the class.
6. **End of class:** Do not rustle papers, slam books shut, snap three-ring binders, or shuffle around near the end of class. The instructor will work hard to end class on time, but the last few statements may be the most important of the entire class period. Do not distract yourself or others from hearing these.
7. **Laptops:** Laptops are to be used only for class purposes. Do not display anything that will distract others. Laptops are to be closed during quizzes and tests.
8. **Cell phones:** Cell phones should be in silent or vibrate mode and not answered during class apart from an emergency. Headsets should be removed. Do not use your phone in any way that distracts others (including the instructor) in class.
9. **Personal audio devices:** These should be turned off and earphones removed during class.
10. **Other electronic gizmos:** No Wiis, Xboxes, Playstations, handheld games, Pong, Van de Graaff generators, or other electronic gizmos should be visible in class.
11. **Spitballs:** Do not throw spitballs or put tacks in the instructor's chair. This is generally considered unprofessional behavior, except in Elbonia.

Academic Honesty Policy

All portions of the Auburn University student academic honesty code (Title XII) found in the Tiger Cub will apply to this class. At the discretion of the instructor, academic honesty violations or alleged violations of the SGA Code of Laws will be reported to the Office of the Provost, which will then refer the case to the Academic Honesty Committee.

Students with Disabilities:

Students who need special accommodations are encouraged to see me after class or in my office as soon as possible so we can discuss your situation confidentially. You can contact me by phone or email if my office hours conflict with your schedule. Please bring your memo from The Program for Students with Disabilities (PSD) to me as soon as possible; we can discuss it during your appointment. **Exam accommodations must be arranged at least one week in advance.** If at any time during the quarter you feel that the accommodations we have put in place are not working, please consult with me and/or the professional staff in the PSD office. If you do not have a memo from the PSD office that tells me about your accommodations, please make an appointment to see them in 1232 Haley Center (844-2096).

Contingency:

If normal class activities or computer lab availability are disrupted due to many students or the instructor experiencing illness or an emergency or crisis situation, the syllabus and other course plans and assignments may be modified to allow completion of the course. If this occurs, an addendum to your syllabus and/or course assignments will replace the original materials.

Topical Outline

1. Introduction
 - (a) Overview of digital signal processing
 - (b) Linear, time-invariant systems
 - (c) Properties of discrete-time systems
 - (d) Sampling theorem
2. Discrete Fourier Transforms and Fast Fourier Transforms
 - (a) Discrete Fourier series
 - (b) Discrete Fourier transform and properties
 - (c) circular convolution
 - (d) Fast Fourier transform
3. Z-transform
 - (a) Properties of the z-transform
 - (b) System functions
 - (c) Poles and zeros
4. Digital filter design
 - (a) FIR filters
 - (b) IIR filters
 - (c) Filter structures and roundoff error analysis
5. Applications