Coordinates and Resources

- My office is in Room 1002, Building 305.
- My email address is mhh3@gatech.edu.
- Course notes, homework assignments, solutions to problems, handouts, and other useful resources are available on the Digital Signal Processing Web Page,
  
  http://cau.ac.kr/~mhhgtx/courses/dsp/

  This page is accessible from my CAU web page
  
  http://cau.ac.kr/~mhhgtx/

  where you may find information about my research, recent papers, seminars, and other courses.

Announcements

- There will be no class on Wednesday. The next class will be on September 10.
- Start reading Chapter 2 in your textbook.
- Print and read and start working on the first problem set that is posted on the web.

Structure of the Course

- Lectures
  - **Goal**: To introduce concepts in digital signal processing and filtering, and illustrate these concepts through interesting problems and applications.
  - **Note**: I cannot cover everything in 2.5 hours a week. It is up to you to supplement lectures with reading and outside classwork.
- Assignments
  - **Purpose**: To give you a chance to exercise your mind, and to solidify the concepts introduced to you in class.
  - **Structure**: Some simple “drill problems,” some more challenging “thought problems.”
  - **Importance**: Extremely important (but only if you want to succeed in this course, learn something, and get a good grade).
- Exams (Midterm plus a final)
  - **Reason**: I need to give you a grade for the course.
  - **Benefits**: It will give you the chance to perform an “assessment” of your understanding of the course. These exams will not be “plug in an equation and solve” problems.
- A weekly 10 minute in-class quiz.
Lecture Notes

- Before each class (hopefully two days before, but I cannot guarantee this), I will post the lecture slides for the next lecture.
  - It is highly recommended that you review/read the lecture slides before class so that you are better prepared.
  - Personally, I do not believe in lecturing using well-choreographed PowerPoint slides, but ...
- Sometimes the slides that are presented will differ from those that have been posted for two reasons:
  - We may not have finished some of the slides from the previous class,
  - Some ideas for some other material may come to mind after I have posted the slides.
- I will not repost the lecture slides, it is up to you to take the appropriate notes.
- Sometimes, I will leave parts of the slide blank and fill it in during class, and many times I will create a new slide, in real-time, during lecture to answer a question or add some additional explanations. Again, it will be your responsibility to take notes.

Grading and Class Attendance

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<tbody>
<tr>
<td>Midterm</td>
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<tr>
<td>Final</td>
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<tr>
<td>Assignments</td>
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<td>Weekly Quizzes</td>
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<td>Class Participation</td>
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Elements that will enter into your Class Participation Grade

- Your participation in class in asking/answering questions,
- Your performance on the 10 minute quizzes, and
- Your out-of-class discussions with me, after class or during office hours.

Some notes on the Assignments

- These are for you and for your benefit.
- If I believed that you would work hard and put in the time to complete these assignments, I would not collect them for grading.
- Discussing the problems with each other is encouraged,
- Copying each others assignments or submitting solutions/answers on the web is strictly prohibited (I am very good at determining when this has been done).

Phones, Texting, and Newspapers

- There are a few very simple rules in this course, and they are based on the following premise, which I hope is true:
  - You are coming to class to learn
  - and to participate in classroom discussions
- So,
  - Turn your phones off and put them away! I never want to hear a phone ring during class, and I never want to see anyone playing with their phone.
  - No Texting: If you feel the urge to text someone are read a text message form someone else, leave the room and don’t come back.
  - Nothing in your Ears. I do not want to see anything plugged in your ears. If I do, I will assume that whatever is in your ear is intended as a gift for me and I will come to your desk and gladly accept it.
Goals

- I have four goals for this course
  - To teach you something this term.
  - To have you appreciate the importance of DSP in today’s digital world.
  - To help you break an unfortunate pattern in today’s world of “looking for the answer on the internet.” You have a brain, and I want to give you the confidence to use it.
  - To have some fun.
- By the end of the term I hope that you can say "I really enjoyed this course."
- What are your goals (besides getting a passing grade or an "A")?
  - This is a very important question to think about, because there is a lot more to learning then "getting the grade you want," and it is not a very good recipe for success.

Objectives of the Course

- 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.
- To understand the processes of A-D and D-A conversion.
- To acquire some familiarity with digital filters in terms design and implementation and to become familiar with how various types of filters affect signal characteristics.
- To understand the discrete Fourier transform and discrete spectral analysis. To become familiar with some applications of digital processing. Topics may include speech processing, image processing, multidimensional digital signal processing, adaptive filtering, spectrum estimation, and adaptive filtering.

Course Prerequisites

There are NO prerequisites for this course except:
- A willingness to work hard and to think independently.
- A commitment to put a time, outside of class, reading and working problems.
- A desire to learn and to not be afraid to ask questions.

Some Important Things to Understand About This Course

- DSP is Applied Mathematics, and Math is Not a Spectator Sport
  
  You cannot learn DSP by just going to class and watching the instructor lecture and work problems.
  
  You need to get involved in the learning process. If you aren’t willing to be actively involved in the process of learning, both inside and outside of the class room, then you will have trouble passing any class.
Some Important Things to Understand About This Course

- Work to Understand the Principles

You can pass a history class by simply memorizing a set of dates, names, and events. You will find, however, that in order to pass this class, you will need to do more than just memorize a set of formulas.

You need to understand how to USE the formulas and that is often far different from just memorizing them.

You also need to understand WHAT formula to use and WHEN.

You may have to modify the formula to fit the problem.

DSP an Applied Mathematics is Cumulative

This course, as well as most other courses in engineering, is cumulative.

Most everything that you learn will depend on subjects that you’ve previously learned.

How Do I Study/Learn DSP?

There are many things that are important for you to do in order to succeed. A few of the more important things, and ones that are most often not done are:

1. Do the homework in a manner that is conducive to learning.
2. Use the Internet as a resource for learning, but never as a place to look for answers to problems.
3. Do not wait until the last minute to do your homework, read the book, study your notes, or get ready for an exam.
4. Ask questions, seek help from your professor (it is his job and responsibility to help you learn - that is what (s)he is paid to do), discuss the course with classmates.

Objectives of the Course

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 A-D and D-A conversion.
3. To acquire some familiarity with digital filters in terms design and implementation and to become familiar with how various types of filters affect signal characteristics.
4. To understand what is meant by a discrete-time random process, to understand the effect of digital filters on random signals, and the importance of noise in digital systems.
5. To understand the discrete Fourier transform and discrete spectral analysis.
6. To become familiar with some applications of digital processing, and to implement signal processing functions in Matlab and Simulink. Applications include: speech processing, image processing, multidimensional digital signal processing, and spectrum estimation.
Prerequisites for the Course

- A willingness to work hard and to think independently.
- A commitment to put a significant amount of time, outside of class, reading and working problem.
- A desire to learn and to not be afraid to ask questions.

Course Topics

- **Discrete-time signals and systems**
  - Basic signal manipulations.
  - System analysis and description:
    - Linearity and shift-invariance.
    - Difference equations.
    - Stability and causality.
    - Convolution

- **Frequency analysis of signals and systems.**
  - The Discrete-Time Fourier transform – definition and properties.
  - The use and application of Fourier transforms.
  - Frequency response of systems.

Course Topics (cont.)

- **Sampling – A/D and D/A conversion**
- **The z-transform.**
  - Definition and properties.
  - Poles and zeros.
  - The system function.
- **The Discrete Fourier Transform (DFT)**
  - Fourier series and Periodic convolution
  - Circular convolution and the DFT
  - Introduction to the FFT

Course Topics (cont.)

- **Filter Structures and Flowgraphs**
  - Direct Form, Cascade and Parallel forms
  - Transposed structures
  - The Lattice filter
  - FIR Structures
- **Filter Design**
  - FIR filter design
  - IIR filter design
  - Least squares inverse design
**Course Topics (cont.)**

- **Discrete-Time Random Signals**
  - Mean, correlation, and wide-sense stationarity
  - Noise
  - Random signals through discrete-time LSI systems
  - Minimum mean-square error estimation
  - Power spectrum