Course Syllabus

Edit

Important University Information

EE 648: Digital Signal Processing

Professor: **Dr. W. David Pan** **(http://www.ece.uah.edu/~dwpan/intro.htm)**

Contact Information

Email Address: **pand@uah.edu (mailto:pand@uah.edu)**

Phone Number: 256-824-6642 (Office)

Note: Office hours are conducted online via Zoom:

Office Hours: Tuesday and Thursday, 5:00 pm – 6:00 pm via Zoom.

Join URL: **https://uah-uasystem.zoom.us/j/83180200076 (https://uah-uasystem.zoom.us/j/83180200076)**

Course Information

Course Name: Digital Signal Processing

Credit Hours: 3

Semester/Year: Summer / 2024

Meeting day, time, and location:

Asynchronous online -- course material provided on Canvas

Prerequisites: Students should have prerequisite knowledge of signals and systems as covered in EE 383.

Course Description

Theory and applications of signal processing by digital techniques. Difference equations, Z Transform theory, digital-filter design, fast Fourier transform, quantization effects, and discrete estimation. Applications of digital signal processing.

Course Objectives

Upon completion of this course, the student is expected to be able to:

- Represent linear time-invariant systems in time-domain and frequency-domains.
- Analyze multirate signal processing systems based on upsampling and downsampling of discrete-time signals.
- Analyze and design linear time-invariant systems using Fourier and Z-transforms.

Required:

- Discrete-Time Signal Processing, by Alan V. Oppenheim and Ronald W. Schafer, Third Edition, Pearson. ISBN: 978-0131988422.
- Matlab
  Matlab download and installation, see:
  https://chargerware.uah.edu/all-software/matlab (https://chargerware.uah.edu/all-software/matlab)

Organization of Course/Instructional Methods

The course structure is online -- all lectures and materials will be delivered online with asynchronous components.

You MUST have a computer or laptop, webcam, and reliable access to an internet source.
If you will NOT have appropriate technology resources, you should NOT take this course.

The course is organized in modules, which contain lecture videos. Homework assignments and submission are also handled on Canvas. The Quiz, Midterm and Final Exams are conducted using the Lockdown Browser and webcam.

Corresponding lecture notes will be posted on:
http://www.ece.uah.edu/~dwpan/course/ee648/notes/ (http://www.ece.uah.edu/~dwpan/course/ee648/notes/)

Course Communication

The official mode of communication is through Canvas. All communication should be respectful and professional. Each student is responsible for course information communicated via Canvas. Students can expect responses from the instructor and grader to Canvas messages and emails within a 24-48 hour time frame.

Attendance Policy

This course is accessible online and active participation will greatly improve your success in this course. You are expected to watch lecture videos, complete and submit homework assignments on time, and take quiz and tests on time, and to regularly check updates related to the course.

Homework submission

Homework assignments will be posted on Canvas. Homework must be electronically submitted to Canvas in PDF format.

It is recommended that all homework should be typeset using a word processor.

If your homework is in handwriting, you must scan in the pages and convert the images to **black-and-white images (black texts on white background)**, and then save the black-and-white images as **a single PDF file** for submission to Canvas. It is your responsibility to control and enhance the image quality to ensure the texts and graphs are clear and sharp enough to receive a fair and accurate grading. Points will be deducted for poor image quality that make grading difficult.

Late Turn-in of Assignments/Make-Ups/Extra Credit

The midterm and final exam are very important for the course. There will be NO late exams arranged. **If you cannot commit to taking the exams on the specified dates, you should NOT take this course.**

Timely submission of homework is also very important. After homework solutions are posted, NO late homework will be accepted.

If the solutions have not been discussed or posted, late homework submissions can be accepted with penalty **within 24 hours after the due date/time**.

The penalty is 20% for late submission with less than 24 hours past the due date/time.

Any work submitted after 24 hours past the due date/time, or submitted after the solutions have been discussed or posted, will **NOT** be accepted. The work will get a permanent zero.

There will be **NO** extra credit being offered.

Evaluation and Grading

The following grading scale will apply when assigning the overall grade for the course:

A = 90%–100%
B = 80%–89%
C = 70%–79%
D = 60%–69%
F = 0%–59%

Evaluation and grading will be based on:

Assignment Groups	Number of Assignments	Weight in %
Quiz	1	2%
Homework	4	38%
Midterm Exam	1	25%
Final Exam	1	35%
TOTAL		100%

Assignment Descriptions

Assignment	Description
HW1 – HW4	Homework problems are associated with the lecture modules.
Quiz (Due: June 14, 2024)	A timed and graded quiz to familiarize you with the format of the midterm and final exam: First take a timed quiz using the Lockdown browser and webcam, and then exit the quiz. Next. within 15 minutes, scan the written answer and upload the PDF file to a separate submission link on Canvas.
Midterm Exam (June 25, 2024) Duration: 120 minutes. You can choose the starting time; however, be mindful of the submission due time.	The test will be comprehensive of all the material covered in roughly the first one half of the course. The test is closed-book and closed-notes. However, you are allowed to use a formula sheet (letter-sized, two sided), and a calculator. The test has to be taken on the specified date, using lockdown browser with a webcam. The test (quiz) will be open as early as 7:00 am on the test date. Once you start the test, you are allowed up to 120 minutes to finish the test (quiz). After you "submit" the quiz, you are

	allowed up to 15 minutes to scan your written answers to a single PDF file and upload the PDF file to a separate link on Canvas.
Final Exam (July 31, 2024) Duration: 150 minutes. You can choose the starting time; however, be mindful of the submission due time.	The Final Exam will be a comprehensive exam covering the entire semester. The test is closed-book and closed-notes. However, you are allowed to use two formula sheets (letter-sized, two sided), and a calculator. Similar to the midterm exam, you need to use the lockdown browser with a webcam to take the final exam. You are allowed up to 150 minutes to finish the text. You are then allowed up to 15 minutes to submit your scanned written answers to a separate link on Canvas.

Academic Honesty

Your written assignments and examinations must be your own work. Collaborations with other people is not permitted. Academic misconduct will not be tolerated. To insure that you are aware of what is considered academic misconduct, you should review carefully the definition and examples provided in the Student Handbook, p. 139. If you have questions in this regard, please contact me without delay.

Use of Prior Work

You may not submit in fulfillment of requirements in this course any work submitted, presented, or used by you in any other course.

Copyright

This course may also contain copyright protected materials such as audio or video clips, images, text materials, etc. These items are being used with regard to the Fair Use doctrine in order to enhance the learning environment. Please do not copy, duplicate, download or distribute these items. The use of these materials is strictly reserved for this course and your use only. All copyright materials are credited to the copyright holder.

Technology Statement

This course will use UAH's learning management system, Canvas, as well as other technology tools. Students will be expected to have access to a computer with internet capabilities in order to fully participate in this course. Students are encouraged to reference accessibility information regarding specific technologies.

If you encounter technical difficulties with Canvas, report the behavior to Canvas Support. Canvas Support is available 24/7 for all faculty and students. In order to get immediate help:

1. Call the Canvas Support at 844-219-5802
2. Click on the "Help" icon on the left panel navigation in Canvas and select "Chat with Canvas Support"

When submitting a support ticket include your name, your class, the element/assignment being affected, and a detailed description of the issue. Providing a screenshot is often very helpful in diagnosing an issue.

Only under extraordinary circumstances would technical difficulties be considered as a mitigating factor in late or missed assignments (e.g., Canvas is down for two days, which is a highly unlikely event). In other words, if technology fails when a student waits until the last hour or two to complete an assignment, that situation does not qualify as an extraordinary circumstance.

In the event that deadline extensions are indeed allowed, you must show documentation that you have first followed the above procedures. Canvas support will email you a ticket number. You can forward the email to the instructor as documentation.

This class requires a computer or laptop that meets the College of Engineering laptop requirements to run MATLAB, and MS Office. A webcam is also required (to support active online lecture participation and online testing in Canvas).

You can find the COE Laptop requirements document in the follow link:

https://www.uah.edu/images/Engineering/CUEE/coelaptoprequirements_2022.pdf (https://www.uah.edu/images/Engineering/CUEE/coelaptoprequirements_2022.pdf)

If you do not have a computer or laptop that meets these requirements, and reliable access to internet source, you should NOT take this course.

It is recommended that all homework should be typeset using a word processor and convert the document to a single PDF file for Canvas submission.

If your homework is in handwriting, you must scan in the pages and convert the black-and-white images to a single PDF file for submission to Canvas. For this purpose, you need to have access to a scanner, or you can consider using some smart phone or tablet apps (e.g., **https://www.camscanner.com/ (https://www.camscanner.com/)**).

Elasticity Statement

The instructor will make every effort to follow the guidelines of this syllabus as listed; however, the instructor reserves the right to amend this document as the need arises. In such instances, the instructor will notify students via email and will endeavor to provide reasonable time for students to adjust to any changes.

While this is an online course, we are required to include the following statement:

Continuity Statement

Course requirements, due dates, grading policy, and office hours are subject to change when necessitated by revised course delivery, semester calendar, or other instances. Information about changes in this course can be obtained from the Announcements section on the Canvas course webpage, or by contacting the instructor via email. If you did not hear from the instructor within 48 hours, please contact the ECE Department via email: **ece@uah.edu (mailto:ece@uah.edu)** .

Students should regularly log into Canvas and read any course announcements. In the event of unexpected course interruption, students are encouraged to continue the readings and other assignments as outlined on the course syllabus until otherwise advised. Any student who does not could fall behind in the course.

Tentative Course Schedule (subject to change)

Module	Topic	Reading	Assignment Due
Module 1 (Lecture 1)	Introduction, Discrete-time signals	Chapter 1, Section 2.1	
Module 1 (Lecture 2)	Discrete-time systems, LTI systems	Sections 2.2 -- 2.3	

Module 1 (Lecture 3)	Properties of LTI systems, Linear constant-coefficient difference equations, frequency-domain representations, Fourier transform and symmetry properties	Sections 2.4 -- 2.9	
Module 1 (Lecture 4)	Fourier transform theorems, Discrete-time random signals	Sections 2.9 – 2.10	
Module 1 (Lecture 5)	Autocorrelation functions, Power density spectrum, White noise	Section 2.10	HW1 due at 5:00 pm on June 12 (Wednesday)
Module 2 (Lecture 6)	Z-transforms, properties of the ROC for z-transforms	Sections 3.0 – 3.2	Quiz submission Due at 5:00 pm on June 14 (Friday)
Module 2 (Lecture 7)	Inverse z-transforms, z-transform of finite-length truncated sequence, z-transform properties, z-transform and LTI systems	Sections 3.3 - 3.5	HW2 due at 5:00 pm on June 20 (Thursday)
Midterm Exam			Midterm Exam on June 25 (Tuesday)
Module 2 (Lecture 8)	Fourier transforms and Fourier Series, periodic sampling	Sections 4.0 – 4.2	
Module 3 (Lecture 9)	Frequency-domain representation of sampling	Sections 4.0 – 4.2	

Module 3 (Lecture 10)	Reconstruction of bandlimited signal, discrete-time processing of continuous-time signals	Section 4.3 – 4.4	
Module 3 (Lecture 11)	Changing the sampling rate using discrete-time processing	Section 4.6	
Module 3 (Lecture 12)	Downsampling, Upsampling, Multirate signal processing	Section 4.7	
Module 3 (Lecture 13)	Interchange of filtering and compressor, Polyphase decomposition	Section 4.7	HW3 due at 5:00 pm on July 17 (Wednesday)
Module 4 (Lecture 14)	Frequency response phase and group delay of LTI systems, system characterization by linear constant-coefficient difference equations	Section 5.0 – 5.2	
Module 4 (Lecture 15)	Inverse systems, All-pass systems	Section 5.2 -- 5.4	
Module 4 (Lecture 16)	Minimum-phase systems, frequency-response compensation of non-minimum-phase systems	Section 5.5 – 5.6	
Module 4 (Lecture 17)	Selected topic, homework and lecture review		HW 4 due at 5:00 pm on July 26 (Friday)
Final Exam			Final Exam on July

31 (Wednesday)