ECE 113: Digital Signal Processing (Winter 2023)

Course Abstract: This course discusses the foundations of signals and systems in the discrete-time domain. These types of signals are reflective of the digital world we live in. For example, data logged by financial markets, weather stations, healthcare records, and self-driving cars are sampled and stored in digital form. The course will enable students to analyze signals and systems in three key domains: the time domain, the transform domain, and the frequency domain.

Prerequisites: (1) **Programming**. Problem sets will often include some light programming questions to apply the concepts. Please be willing to pick up basic programming in a high-level language. The instructors will use Python, but students can use MATLAB or Octave if chosen. (2) **Mathematics.** Familiarity with complex numbers, calculus, and trigonometry is needed. (3) **EE102.** This is a prerequisite. If taken an equivalent at another school, please be prepared to review independently if a topic was not covered.

Instructor: Prof. Achuta Kadambi <achuta@ucla.edu>

Professor OH: Wednesdays 10-11 am in Engineering IV, Maxwell room. No prof. OH in the week of March 8th, except by appointment.

Lecture Zoom: Most lectures will be recorded and available on bruinlearn.

TA (first half): Shijie Zhou <shijiezhou@ucla.edu>
Office hour: Friday 1-1:50 pm, Boelter Hall 5420

TA (second half): Alexander "Sasha" Vilesov <vilesov@g.ucla.edu>
Office hour: Friday 1-1:50 pm, Boelter Hall 5420. Except for the week of Feb. 24th, OH will be held online on Zoom.

Grader: Connor Nasseraddin <connornasser37@ucla.edu>
Brandon Le <ble86@g.ucla.edu>

Lecture Times and Location: MW 8:05am-9:50am. HAINES A2.

Piazza Link: This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. Find our class signup link at:
https://piazza.com/ucla/winter2023/ece113

Grade Structure: Letter grades assigned based on a mix of continuous assessment and exams. A key grading philosophy is to minimize randomness.

Exam 1 ("Midterm Exam")	20%
Exam 2 ("Final Exam")	25%
Lecture Quizzes (top K=10 scores)	25%
Problem Sets	25%
Participation	5%

Grading thresholds are used as:

A+	at discretion	A	93-max	A-	90-93
B+	87-90	B	83-87	B-	80-83
C+	77-79	C	73-76	C-	70-72

The instructor reserves the right to adjust up grades but never down.

Exams: Exams will be in person. You are allowed 1 page of notes (a page is considered single sided). Each exam will have an alternate date, which is to be used if one has COVID/flu/family emergency/etc.

Lecture Quizzes: At the end of each lecture, we will have an 8 minute lecture quiz that is closed book. This lecture quiz is graded and forms a continuous assessment of your abilities in the course. There will be no less than 15 lecture quizzes, from which we will take the top K=10 scores for each student to use as part of the grade.

Problem Sets: Problem sets will be more difficult than the lectures. For example, while we can certainly spend the whole course on the richness of the Fourier transform, we have to balance lecture coverage of other topics as well to move through the pace.

Participation: ~~Based on the PhD DSP research paragraph. In a nutshell, PhD students in our Dept. will present < 10' overviews of their research, and 113 students will pick one of the PhD presentations and write a short summary of which DSP techniques are used as well as extensions. The PhD presentations will occur in the 3/1, 3/6, 3/8, and 3/13 lectures and paragraphs are due by 3/23.~~ Due to time considerations, we have made participation 100% for everyone.

Schedule of Problem Sets: The problem sets are due on Fridays at 11:59pm PT, and released the preceding Friday no later than 11:59pm PT. There are no problem sets due in weeks where there is an exam. The schedule is as follows.

Pset 1: OUT: Friday 1/20	DUE: Friday, 1/27	
Pset 2: OUT: Friday 1/27	DUE: Friday, 2/3	SOLN OUT: 2/8
Pset 3: OUT: Friday 2/3	DUE: Friday, 2/10	SOLN OUT: 2/13
Unscored Pset 3.5* OUT: 2/8	DUE: Monday, 2/13	SOLN OUT: 2/13
Exam 1 on 2/15		
Pset 4: OUT: Friday 2/24	DUE: Friday, 3/3	SOLN OUT: 3/6
Pset 5: OUT: Friday 3/3	DUE: Friday, 3/10	SOLN OUT: 3/13
Pset 6: OUT: Friday 3/10	DUE: Friday, 3/17	SOLN OUT: 3/20
Exam 2 on 3/23		

Unscored pset can be turned in for a grade just to get feedback, but the grade will not count.

Extension and Regrades: Three late days are allotted to be used for any reason (illness, job interview, etc). Extensions beyond this will be granted only in cases of extreme hardship. For regrades please email the reader directly (email above), and please escalate to TA or professor only if it cannot be resolved w/ the grader.

Late Work Policy: 10% of the assignment grade will be taken off per day, if an assignment is submitted past the deadline and the number of late days allotted has been exceeded.

(Optional) Additional Textbook and Videos: Please refer to *Signals and Systems: A MATLAB Integrated Approach* by Alkin, Oktay. Handouts will be added to the online learning management system in advance.

Tentative Topics

Magenta Text: On Midterm #1.

Date	Lecture Topic
1/9	Class Overview and Discrete Signals
1/11	Signal Properties
1/16	**No Lecture - MLK Day**
1/18	Signal Properties Cont'd and Systems Overview
1/23	System Properties I
1/25	System Properties II

URL to this document:

1/30	Convolution
2/1	Discrete Time Fourier Series (DTFS) I
2/6	Discrete Time Fourier Series (DTFS) and Discrete Time Fourier Transform (DTFT)
2/8	DTFT and Inverse Discrete Time Fourier Transform (IDTFT)
2/13	DFT and Midterm Review
2/15	**Exam 1**
2/20	**No Lecture - President's Day**
2/22	DFT and Properties
2/27	Optimization and Change of Basis Lecture
3/1	Circular Convolution, Computational Complexity, FFT
3/6	Z-transform I
3/8	Z-transform II
3/13	Z Transform III (inversion)
3/15	FIR, IIR, and Z-transform IV
3/23	**Final Exam 11:30AM - 2:30PM**

Extra Credit Overview

Bonuses that have been earned, and will be added to scoresheet.

- ☐ 1 Bonus Point on Quiz (3/8 lecture)
- ☐ 1 Bonus Point on Quiz (3/6 lecture)
- ☐ 80% response rate on Midterm Evaluations (complete)
- ☐ 80% response rate on Official Evaluations (complete)

Bonuses that have not yet been earned

- ☐ 1 Bonus Point on Final for Veritaserum Video (Question on Final will be chosen so that everyone who has watched the video should likely get it correct)
- ☐ Extra HW7 (Sasha to announce, worth 20 points as per his email)