ECE 161A - Introduction to Digital Signal Processing

Fall 2024 - Syllabus

Digital signal processing is key subject in electrical enginieer with applications in wireless communication, medical analytics, ocean sciences, seismology, and related areas. In this introductory course, we will discuss the z-transform, fast Fourier transform (FFT), design of finite impulse response (FIR) and infinite impulse response (IIR) digital filters and their implementations as well as finite precision effects.

Students graduating from ECE 161A will be able to:

- Use the z-transform to solve difference equations and to determine the response of discrete-time linear shift-invariant systems to known inputs
- Design and implement digital filters and apply them to real-world problems
- Visualize, analyze, and process digital signals in time and frequency domain using Matlab

Time and place: Lectures are on Tuesdays and Thursday 3:30PM – 4:50PM in FAH 1450. A discussion session will be held on Wednesdays 2:00 PM – 2:50 PM in CENTR 113.

Instructor:

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Teaching Assistant (TA):

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Course Website: Handouts and homework assignments will be posted on the Canvas website.

Bibliography: This course is based on lecture notes developed by Prof. Bhaskar Rao. Our main textbook will be

> *Discrete-Time Signal Processing*, Alan V. Oppenheim and Ronald W. Schafer, Prentice Hall, 2009.

In particular, the course will cover the following sections in the main textbook

- Chapter 3: 3.1 – 3.5 (Z-transforms)
- Chapter 5: 5.1, 5.5, 5.7 (Group delay, All-Pass Filters, linear phase filters)
- Chapter 6: 6.1 – 6.5, 6.7, 6.8 (Filter implementation and finite precision effects)

- Chapter 7: 7.1 – 7.7 (Filter design: IIR and FIR)
- Chapter 8: 8.1 – 8.7 (DFT and linear convolutions using DFT)
- Chapter 9: 9.2, 9.3 (FFT)

This textbook will be on reserve at the UCSD library. Additional references are the following textbooks

- *Digital Signal Processing*, John Proakis and Dimitris Manolakis, Pearson, 2007
- *Digital Signal Processing using Matlab*, Vinay Ingle and John Proakis, Cengage Learning, 2016.

Prerequisites: A required prerequisite for this course is ECE 101A. In particular, you must be familiar with discrete-time systems, the Fourier transform of discrete signals, and the sampling theorem. These concepts are covered by the following sections in the textbook.

- Chapter 2: 2.1 – 2.9 (LTI systems, Fourier transform of discrete-time signals)
- Chapter 4: 4.1 – 4.5 (Sampling theorem)
- Chapter 5: 5.2 – 5.3 (Difference equations, transfer functions, poles and zeros)

Grades: Grades will be assigned based on the weekly homework problems and the mid-term/final projects. The homework assignments count 25%, the mid-term exam count 25%, and the final exam counts 50%.

Homework: Theoretical problems and problems to be solved in Matlab will be posted every week on the course website and will be due one week later.

Office Hours: Office hours are every Friday at 2 PM via Zoom.

Collaboration Policy: The goal of homework is to give you practice in mastering the course material. Consequently, you are encouraged to form study groups to discuss the course material and problem sets. However, the developed solutions you hand in should reflect your understanding of the course material. It is not acceptable to copy a solution that somebody else has written. You must develop each problem solution by yourself without assistance. Cheating will result in penalties.