E483: Introduction to Digital Signal Processing
Units: 4
Fall 2023

Lecture: 10:00am-11:50am Tue/Thu
Discussion: 1:00pm-1:50pm Fri
Location: OHE 136

Instructor: Prof. Justin Haldar
Office: Zoom (see DEN website and Lecture 01 slides) & EEB 442
Office Hours: Mon 10am-11:30am and Tue 12pm-1:30pm
e-mail: jhaldar@usc.edu

Teaching Assistants: Chin-Cheng Chan (chinchen@usc.edu) and Kevin Lee (kylee@usc.edu)
Office: Zoom (see DEN website and Lecture 01 slides) & PHE 320
Office Hours:
Kevin: Mon 3pm-4pm and Wed 2:30pm-4:30pm
Chin-Cheng: Wed 7pm-8pm (Zoom only) and Thu 1pm-3pm

Schedule:

First Lecture: Tue, August 22nd

Midterm: Tue, October 17th
10:00am-11:50am (during lecture time)

Last Lecture: Thu, November 30th

Final Exam: Tue, December 12th
8:00am-10:00am

Catalog Description:

Fundamentals of digital signal processing covering: discrete time linear systems, quantization, sampling, Z-transforms, Fourier transforms, FFTs and filter design.

Prerequisites: EE 301
Familiarity with MATLAB

Websites: All course materials will be distributed through the USC DEN website. It is your responsibility to check the website regularly for updates (notes, assignments, due dates, etc.) If you have any problems with the website, please contact USC DEN directly. https://courses.uscden.net/

We will be using the Piazza website for class discussion. The system is aimed at getting students help from classmates and instructors quickly and efficiently. Rather than emailing questions to the instructors, students are encouraged to post questions on Piazza so that everyone in the course can see the conversation and benefit from the discussion. The course Piazza page can be found at: https://piazza.com/usc/fall2023/ee483

Required Textbooks and Supplementary Materials

All books are available from the bookstore, online textbook vendors, or from course reserves at the library

Required:

- S. K. Mitra. *Digital Signal Processing: A Computer-Based Approach*, 4th ed, McGraw Hill 2010.
  - A comprehensive modern textbook on digital signal processing. Out of print, so may be hard to find (it's okay if you can't get the book, as long as you get a similar book).
- M. H. Hayes. *Schaum's Outlines: Digital Signal Processing,* 2nd ed, McGraw Hill 2011.
  - A nice complement to the text by Mitra, this book contains overviews of important DSP concepts and hundreds of solved example problems.

Other references:

- A. V. Oppenheim and R. W. Schafer. *Discrete-Time Signal Processing*, 3rd ed, Prentice-Hall 2010.
    - The classic textbook on DSP.
- J. G. Proakis and D. K. Manolakis. *Digital Signal Processing*, 4th ed, Prentice-Hall 2006.
    - Another popular text.

There are also a large number of other DSP books and online DSP resources – take a look at what the USC library and the internet have to offer

Grading and Course Policies:

25% Homework
35% Midterm
40% Final

Homeworks must be submitted electronically through the USC DEN website by 9pm PT on the due date. Late homeworks will receive a score of zero. The final homework grade will be based on the average score after discarding the lowest.

Students are allowed (and encouraged!) to discuss homework assignments with fellow classmates, but are expected to complete homework assignments individually. USC's recommended sanction for plagiarism, unauthorized collaboration, and/or cheating on any coursework is an F for the course, with a possibility for further disciplinary action.

Accessing EE483 course materials from previous semesters or giving others access to EE483 materials will be viewed as academic misconduct.

Several of the homeworks will require MATLAB programming. It is your responsibility to make sure that you know how to access the software and read/write/debug MATLAB code. If students prefer, they may complete their programming assignments using Python or C instead of MATLAB. This may require some self-study of C or Python.

All exams are cumulative and closed book, with no calculators (subject to change). Please check now for any conflicts with the scheduled exam times.

Suggestions:

My goal is to teach you and your fellow students as much as possible about DSP, while simultaneously inspiring your interest, excitement, and curiosity about the material. This will be easier if you:

- Come to class on time and pay attention.
- Ask questions and participate in classroom discussion.
- Do all of the assignments.
- Make use of office hours.
- If you're struggling with the material, don't wait until the last minute to talk to us about it.
- Don't violate USC's academic integrity standards – you won't enjoy the consequences

Course Timeline (subject to change):

Week 1 (8/22, 8/24)	Introduction and overview Discrete-time signals and systems
Week 2 (8/29, 8/31)	Linear Time-Invariant (LTI) systems Causality, stability, impulse response Linear difference equations (LDEs)
Week 3 (9/5, 9/7)	Discrete-Time Fourier Transform (DTFT) Frequency response of LTI systems
Week 4 (9/12, 9/14)	Phase and group delay Discrete Fourier Transform (DFT)
Week 5 (9/19, 9/21)	Fast Fourier Transform (FFT) Unitary Transforms: Discrete Cosine Transform and Wavelet Transforms
Week 6 (9/26, 9/28)	Sampling of continuous-time signals Aliasing, the sampling theorem, signal reconstruction A/D and D/A conversion
Week 7 (10/3, 10/5)	Multi-rate systems Relationships between the Fourier transform, DFT, and DTFT Windows and nonparametric spectral analysis
Week 8 (10/10)	Review
Week 9 (10/17, 10/19)	**Midterm** z-Transform
Week 10 (10/24, 10/26)	Rational transfer functions and Regions of Convergence (ROCs) Inverse z-Transform
Week 11 (10/31, 11/2)	Transfer functions of LTI systems Design of FIR filters
Week 12 (11/7, 11/9)	Design of FIR filters (continued) Design of IIR filters
Week 13 (11/14, 11/16)	Design of IIR filters (continued) Quantization
Week 14 (11/21)	Digital filter structures
Week 15 (11/28, 11/30)	Advanced Applications Life after EE 483 Review
Final Exam (12/12)	

Academic Integrity

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the USC Student Handbook. All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct.

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 740-0411
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call
Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-2850 or otfp@med.usc.edu
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.