EE 483: Introduction to Digital Signal Processing
Units: 4
Fall 2019

Lecture: 9:00am-10:50am Tue/Thu
Lecture Location: OHE 136

Discussion: 1:00pm-1:50pm Fri
Discussion Location: OHE 132

Instructor: Prof. Justin Haldar
Office: EEB 442
Office Hours: Mon 2pm-3:30pm
              Tue 2pm-3:30pm

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Teaching Assistants: Tae Hyung Kim (taehyung@usc.edu) and Rodrigo Lobos (rlobos@usc.edu)
Office: PHE 320
Office Hours:
  Tae:               Wed 1pm-2:30pm and Thu 1pm-2:30pm
  Rodrigo:          Tue 5pm-6:30pm and Wed 9am-10:30am

Schedule:
First Class:       Tue, August 27th
Midterm:           Tue, October 22nd
                   9:00am-10:50am (in class)
Last Class:        Thu, December 5th
Final Exam:        Thu, December 12th
                   11:00am-1:00pm

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

Required Textbooks and Supplementary Materials
All books are available from the USC bookstore, online textbook vendors, or from course reserves at the USC library

Required:
  - A comprehensive modern textbook on digital signal processing.
  - A nice complement to the text by Mitra, this book contains overviews of important DSP concepts and hundreds of solved example problems.
Other references:

  - The classic textbook on DSP.
  - Another popular text.

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

**Prerequisite:** EE 301

Familiarity with MATLAB

**Grading and Course Policies:**

25% Homework
35% Midterm
40% Final

Homeworks must be submitted electronically through the USC DEN website by 5pm PST 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.

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 programming.

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

**Websites:** All course materials will be distributed through the USC DEN website ([https://www.uscden.net/](https://www.uscden.net/)). 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.

The website will also provide access to streaming videos of each lecture. However, please note that live attendance of each lecture is required, either on campus or at a remote DEN location. Archived lecture videos should only be used for reviewing course material, or in case you had to miss a lecture because of illness or work-related travel.

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 Piazza page for the course can be found at: [https://piazza.com/usc/fall2019/ee483](https://piazza.com/usc/fall2019/ee483)
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 (8/27, 8/29)**
- Introduction and overview
  - Discrete-time signals and systems

**Week 2 (9/3, 9/5)**
- Linear Time-Invariant (LTI) systems
  - Causality, stability, impulse response
  - Linear difference equations (LDEs)

**Week 3 (9/10, 9/12)**
- Discrete-Time Fourier Transform (DTFT)
  - Frequency response of LTI systems

**Week 4 (9/17, 9/19)**
- Phase and group delay
  - Discrete Fourier Transform (DFT)

**Week 5 (9/24, 9/26)**
- Fast Fourier Transform (FFT)
  - Unitary Transforms: Discrete Cosine Transform and Wavelet Transforms

**Week 6 (10/1, 10/3)**
- Sampling of continuous-time signals
  - Aliasing, the sampling theorem, signal reconstruction
  - A/D and D/A conversion
  - Multi-rate systems

**Week 7 (10/8, 10/10)**
- Relationships between the Fourier transform, DFT, and DTFT
  - Windows and nonparametric spectral analysis

**Week 8 (10/15)**
- Review

**Week 9 (10/22, 10/24)**
- Midterm
  - z-Transform

**Week 10 (10/29, 10/31)**
- Transfer functions of LTI systems
  - FIR and IIR digital filters

**Week 11 (11/5, 11/7)**
- Design of FIR filters
Week 12 (11/12, 11/14)  
Design of IIR filters

Week 13 (11/19, 11/21)  
Digital filter structures  
Quantization

Week 14 (11/26)  
Introduction to multidimensional sampling theory  
Digital cameras and color filter arrays

Week 15 (12/3, 12/5)  
Introduction to adaptive filtering  
Introduction to tomographic imaging  
Life after EE 483  
Review

Final Exam (12/12)
Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

**Student Health Counseling Services** - (213) 740-7711 – 24/7 on call engemannshc.usc.edu/counseling
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

**National Suicide Prevention Lifeline** - 1 (800) 273-8255 – 24/7 on call suicidepreventionlifeline.org
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

**Relationship and Sexual Violence Prevention Services (RSVP)** - (213) 740-4900 – 24/7 on call engemannshc.usc.edu/rsvp
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

**Office of Equity and Diversity (OED) | Title IX** - (213) 740-5086 equity.usc.edu, titleix.usc.edu
Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

**Bias Assessment Response and Support** - (213) 740-2421 studentaffairs.usc.edu/bias-assessment-response-support
Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

**The Office of Disability Services and Programs** - (213) 740-0776 dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

**USC Support and Advocacy** - (213) 821-4710 studentaffairs.usc.edu/ssa
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.
Diversity at USC - (213) 740-2101
diversity.usc.edu
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
dps.usc.edu, emergency.usc.edu
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) 442-120 – 24/7 on call
dps.usc.edu
Non-emergency assistance or information.