ECE 3500: Fundamentals of Signals and Systems

Spring 2020

- **Instructor:** Yi Zhou [i: zhou]
- **Email:** yi.zhou@utah.edu
- **Course website:** Canvas (required by department)
- **Office:** MEB 3102
- **Class meetings:** Tue, Thu 12:25pm - 1:45 pm
- **Office hours:** Tue 1:00pm - 3:00pm or by appointment

**Course description:** Electrical engineering aims to develop principled mathematical and engineering tools to analyze how data and information (signals) are affected by processes, devices, and mediums (systems). In circuit design, we analyze how electronic devices and circuit configurations (system) change current and voltage measurements (signal). In radio and communications systems, we analyze how the air, buildings, and land (system) distort radio waves (signal). In biomedical applications, we study how x-rays, ultrasound, MRI, and other medical imaging modalities (signal) respond to materials in the human body (system). In this course, we explore the fundamental mathematical concepts used to analyze these relationships.

We begin introducing definitions and properties of signals and systems in order to establish a professional language used by both academics and industry. We then focus on the simplest and important type of system—linear time-invariant (LTI) system. We analyze how LTI systems process and manipulate signals by leveraging the Fourier transform, the Laplace transform and other related mathematical operations. These topics are illustrated first with continuous-time signals (e.g., AC voltages and currents) and then discrete-time signals (e.g., data found in a computer). Throughout our discussions, we demonstrate how this fundamental framework is applied to more advanced topics in signal/image processing, communications, and controls.

**Course Objectives:** By taking this course and working hard, you should be able to:

- Understand the language of signals and systems
- Apply convolution to continuous-time and discrete-time systems
- Analyze a system’s input-output relationship using Fourier transform
- Design and implement simple systems for practical applications in MATLAB
- Discuss the use of signals and systems for advanced applications
- Communicate signals and systems concepts through a technical report

**Prerequisites:** ECE 2240, Math 2210 and 2250, or equivalent.

**Grading:**

- Regular: Homework 20%, Midterms(I,II,III) 20% \times 3, Labs 20%
- Bonus: Lecture note 5%, Quizzes 5%
- Grades: A: 93.3, A-: 90-93.3, B+: 86.6-90, B: 83.3-86.6, B-: 80-83.3, C+: 76.6-80, C: 73.3-76.6, C-: 70-73.3, D+: 66.6-70, D: 63.3-66.6, D-: 60-63.3, E: 60

**Teaching Assistants (TAs):** To be determined.

**Course Materials:**

- Lecture notes: written by yourself by following my white-board presentation.
Lab Assignments (five in total):

- When: There are three regular labs and two mini-labs (no reports required). Each lab corresponds to one part of the course. Lab reports are due before the next lab starts.
- Lab hours: Wed, Fri 7:30am-10:30am. In the starting week of each lab, you do experiments with the help of teaching assistants. In the following weeks before the next lab, lab hours are used to continue, finish, or retry experiments. Lab hours may also be used to ask the teaching assistants for help on writing your lab reports.
- What: In each lab, we apply signals and systems theory to a particular application. Lab assignments will be completed individually or in a group depending on the availability of equipment. Each student will submit an individual lab report about the methods and results applied and explored during the lab session.
- Why: Lab assignments and lab reports allow you to apply concepts learned from class to particular applications, and allow you to practice communicating engineering work to a technical audience.
- Lab reports: For each full lab, you will be asked to write a partial or complete report of your work. Long, confusing reports will not be eligible for as many points as well-written reports. See the “Lab Report Guidelines” for each lab. (Highly recommend using Overleaf to write professional reports)
- Grading: Lab reports are graded on a 100-point percentage scale. See “Lab Report Guidelines” for the complete grading rubric.
- Late Policy: If you receive A points for an assignment and submit the assignment B days late, the final grade will be $A - 2 \times B$.

Cheating and plagiarism: While collaboration is encouraged, you are expected to submit your own work. Submitting work completed by another student is considered plagiarism and will be dealt with according to the university policy. Examples of plagiarism or cheating include:

- Copying (or allowing someone to copy), even partially, an assignment solution or program from the course.
- Submitting material, particularly a program, using material taken from another source without proper a citation.
- Obtaining solutions to assignments or exams through inappropriate means.

Additional information can be found in Section I.B of the Code of Student Rights and Responsibilities found here: http://regulations.utah.edu/academics/6-400.php. Note that I may elect to use a plagiarism detection service in this course, in which case you will be required to submit your work to such a service as part of your assignment. Consequences: If you are suspected of dishonest academic activity, I will ask you to discuss it further in private. Academic dishonesty will likely result in a grade reduction, with severity depending on the nature of the dishonest activity, and a letter to the department, college, and/or university leadership. Repeat offenses will be treated with significantly greater severity. Additional information can be found in Section V of the Code of Student Rights and Responsibilities found here: http://regulations.utah.edu/academics/6-400.php.

Disabilities Act Support: Equal access services: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations.” (www.hr.utah.edu/oee/ada/guide/faculty/)