ECE 3500: Fundamentals of Signals and Systems (Fall 2017)

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Office : MEB 3104
Office hours : T,H 2:00 PM – 3:30 PM or by appointment
Class meetings : T,H 12:25 PM – 1:45 PM in WEB L102
Credit hours : 4.0 units

Course Description: In one form or another, all engineering disciplines analyze how data, waveforms, and information (signals) are affected by processes, devices, and mediums (systems). In circuit design, we analyze how electronic devices and circuit configurations (our systems) change current and voltage measurements (our signals). In radio and communications systems, we analyze how the air, buildings, and land (our systems) distort radio waves (our signals). In biomedical applications, we study how x-rays, ultrasound, MRI, and other medical imaging modalities (our signals) respond to materials in the human body (our system). In this course, we explore the fundamental concepts used to analyze these relationships.

We begin the course by discussing the definitions and properties of signals and systems to establish a common language used by both academics and professionals in industry. We then focus on one common type of system, the linear time-invariant system. We discuss and analyze how linear time-invariant systems process and manipulate signals through the use of Fourier analysis, 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.

Learning Objectives:

At the completion of this course, you should be able to:

1. Understand the language of signals and systems
2. Apply convolution to continuous-time and discrete-time systems
3. Analyze a system's input-output relationship using Fourier theory
4. Design and implement simple systems for practical applications in MATLAB
5. Discuss the use of signals and systems for advanced applications
6. Communicate signals and systems concepts through a technical report

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

Grade Distribution:

Labs	20%
Midterm Exam I (or Final Part 1)	(16+2/3)%
Midterm Exam II (or Final Part 2)	(16+2/3)%
Midterm Exam III (or Final Part 3)	(16+2/3)%
Quizzes (best 5 out of 7)	15%
Homework (best 10 out of 11)	15%

Course Logistics:

The following section discusses the setup of this course. You should look here first for answers to any general, course-related inquiries.

Teaching Assistants (TAs):

Farhan Nasrullah Grading Teaching Assistant
Office Hours: TBD

Benozir Ahmed Grading / Lab Teaching Assistant
Office Hours: TBD
Lab Hours: Tuesday, 7:30 AM - 10:30 AM in MEB 2265

Saeed Boroomand Lab Teaching Assistant
Lab Hours: Wednesday, 11:50 AM - 2:50 PM in MEB 2265
Lab Hours: Friday, 11:50 AM - 2:50 AM in MEB 2265

Hossein Mehrpourbernety Lab Teaching Assistant
Lab Hours: Monday, 2:00 PM - 5:00 PM in MEB 2265
Lab Hours: Thursday, 2:00 PM - 5:00 AM in MEB 2265

TA Policy: Your teaching assistants are a brilliant group of graduate students that are here to help you learn the material and get your through assignments and exams. Feel free to ask them questions. However, please respect their time constraints. They may not always be available to answer questions the night before homework is due.

Textbook and Materials:

Primary (Physical) Text: *Signal Processing and Linear Systems*, First Edition, by B. P. Lathi.

Secondary Open (Online) Text: *Signals and Systems* by Richard Baraniuk

Textbook Necessity: Lathi's textbook is good. It is easy to read (relative to similar texts) and addresses parts of signals and systems that can be confusing to novices. Baraniuk's textbook is good alternative and is freely available. My online lecture notes will have links to relevant sections of Baraniuk's textbook at the bottom of each notes page under "Additional Resources."

Online Notes: Lecture notes will be posted online for students. A small, select number of links to supplementary material will also be posted.

Final Grades:

Guaranteed Grades:

>93.3%: A	90–93.3%: A-	
86.6–90%: B+	83.3–86.6%: B	80–83.3%: B-
76.6–80%: C+	73.3–76.6%: C	70–73.3%: C-
66.6–70%: D+	63.3–66.6%: D	60–63.3%: D-
<60%: E		

Curves: If necessary, the grading criteria may be curved to strictly improve (not worsen) the class's *overall* scores. Unless there are extreme circumstances, individual assignment / exam / lab grades will not be curved.

Attendance and Participation:

Attendance: While attendance is not graded, lectures will include regular homework help, graded quizzes, and in-class discussions and demonstrations of the subject material.

Participation: While participation is not graded, it is an integral part of each class that can help you learn the material.

Evaluation Methods and Criteria:

The following section discusses the policies for each of the graded assessments in this course. You should look here first for answers to any general, course-related inquiries.

Homework (11 in total):

When: Assigned roughly once a week (see course schedule on website).

What: Analytical problems that can be solved by hand.

Why: Homework is intended to guide you through course material and present you with questions that will require time to think about and complete (unlike quiz or exam questions). Homework assignments are not meant to be completed in a single day.

Grading: Homework is graded on a scale from 0 to 3. The meaning of each grade is:

- 3.0: $>$ 75% correct
- 2.5: 65% – 75% correct
- 2.0: 55% – 65% correct
- 1.5: 45% – 55% correct
- 1.0: 35% – 45% correct
- 0.5: 25% – 35% correct
- 0.0: 00% – 25% correct

Late policy: Late assignments will not be eligible for $(0.5)x$ points, where x is the number of weekdays late, for up to 2 weekdays. For example, if you receive a 2.5 for an assignment and submit the assignment 2 days late (assignment due on Thursday, you submit on Monday), the final grade will be a $2.5 - 1 = 1.5$. After 2 weekdays, the homework is assigned a 0.

Submission: Homework is due in the course locker *before* 5:00 PM on the due date **or** on canvas before midnight (11:59 PM) on the due date. Please ensure that your submission is readable.

Quizzes (7 in total):

When: Occur roughly once every two weeks (see course schedule at the end of the syllabus).

What: Three or four short analytical problems similar to examples on the course website.

Why: These quizzes are intended (1) to help you, the teaching assistants, and me assess your current understanding of course material and (2) to broaden the course's grading scheme and lower the stakes of each exam.

Grading: Quizzes are graded on a 20-point scale. Of the 7 quizzes, only the highest scoring 5 will count toward the final grade.

Makeup quizzes: There are no makeup quizzes.

Exams (3 in total):

When: There are three non-cumulative exams covering each part of the course and one cumulative final exam (see course schedule at the end of the syllabus).

What: Similar to quizzes except longer and slightly more challenging.

Why: Exams are an opportunity to show what you know about signals and systems.

Cheat sheets: Exam 1 & 2 & 3: **one** double-sided 8.5 by 11 inches (or smaller) cheat sheet allowed. Final exam: **three** double-sided 8.5 by 11 inches (or smaller) cheat sheets allowed.

Grading: Exams are graded on a 100-percentage scale.

Makeup exams: Each part of the final exam acts as a re-take or make-up exam. If you perform poorly on an exam, you will have the opportunity to take one or more final exam parts to replace your grade(s). You will receive the highest grade from each midterm/final part pair (i.e., midterm 1/final part 1, midterm 2/final part 2, midterm 3/final part 3).

Lab Assignments (5 in total):

When: There will be three labs assignments and two mini-lab assignments (no lab reports required) during the course. Each lab will correspond to one part of the course. Lab reports are due *before* the next lab starts. See the schedule on the course website for details.

Lab hours: Labs are open and supervised *every week* during the designated day and time in your schedule. In the first week of each new lab, you begin your experiments with the help of your teaching assistant. In the remaining weeks, lab hours may be 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. Labs assignment 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.

Why: Lab assignments and lab reports allow you to apply concepts from class to particular applications, and allows 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.

Grading: Lab reports are graded on a 100-point percentage scale. See "Lab Report Guidelines"for each lab for the complete grading rubric.

Late Policy: Late reports / deliverables will not be eligible for $(5)x$ points, where x is the number of weekdays late, for up to 10 weekdays. For example, if you receive a 90 for an assignment and submit the assignment 2 days late, the final grade will be a $90 - 10 = 80$. After 10 weekdays, the grade becomes a 0.

Teaching and Learning Methods / Course Policies:

The following section discusses the course's non-graded activities and policies towards collaboration and cheating. You should look here first for answers to any general, course-related inquiries.

Course Structure:

Part I: The language of signals and systems

Part II: Continuous-time signals and systems analysis

Part III: Discrete-time signals and systems analysis

Class Structure: (Based on your feedback, this structure may change as the course progresses)

Part 1, Biweekly Quiz: Once every other week, we apply our knowledge on a short set of problems. These problems are in the form of graded quiz problems.

Part 2, Practice/Review: Quick review of prior material so everyone starts lecture on the same page. During this time, we may also solve a few practice problems.

Part 3, Discussion: We discuss questions and topics that link our prior knowledge to what will learn each day. This part of class is intended highlight signals and systems on a conceptual level.

Part 4, Lecture: We learn the new material through a traditional lecture format.

Part 5, Survey: You are occasionally given an anonymous survey to provide feedback about the progress of the course. This survey is intended to show me what topics you may not understand and help me improve upon each throughout during the semester.

Surveys:

When: At the end of class (frequent at the start of the semester and less frequency later).

What: A few short questions about the course progress.

Why: The surveys are intended to let you shape the course by letting me know what you like and what could be improved. Note that while I may not be able to follow-through with every suggestion in a single semester, they will still help me to improve the course in subsequent years.

Modifying Syllabus by Class Vote:

When: If you and/or other students believe the course would be improved by a change in the syllabus and I agree that it would be a reasonable change.

What: The proposed change will be put to an anonymous vote with the entire class. If the majority of the class agrees to this change, it becomes part of the syllabus.

Why: In previous years, changes to the syllabus have been necessary do to unforeseen consequences of certain policies. The class vote ensures the entire class agrees with the change.

Faculty and Student Responsibilities:

Student responsibilities: You are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion (course details described in following section), as well as fraud, theft, etc. You should read the Code carefully and know they are responsible for the content.

Faculty responsibilities: According to Faculty Rules and Regulations, it is my responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. You have the right to appeal such action to the Student Behavior Committee.

Collaboration:

Healthy collaboration: To solve homework assignments, healthy discussion and collaboration amongst classmates is encouraged. Healthy collaboration includes:

- Discussing and explaining general course material
- Discussing assignments for better understanding
- Providing assistance for general programming and debugging issues

If another student contributes substantially to your understanding of a problem, you should *cite* this student to let myself and the teaching assistants be aware of your similar interpretations of a problem. You will not be judged negatively for citing another student.

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 university policy. In general, if you do not fully understand your solution, the work is not your own. 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 invite 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 offences 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.

Americans with 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/oeo/ada/guide/faculty/)

Legal Note:

Note: The syllabus is not a binding legal contract. It may be modified by the instructor when the student is given reasonable notice of the modification. See "Modifying Syllabus by Class Vote" for additional information.