ECE 346: Digital Signal Processing – Spring 2019

Lectures (All Sections) — TF 8:40–10:00 AM, RWH 105

Instructor

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Teaching Assistants

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Modes of Communication

Piazza: http://piazza.com/rutgers/spring2019/ece346/home (all course-related discussions)
YouTube Channel: http://youtube.com/c/SigProcessing (only for questions related to the videos)
Emails to the TAs and/or the Instructor: Only for questions of personal nature

Office Hours

Instructor: Tuesdays 10:15–11:15 am, but only after an appointment has been made by Monday 10 pm at the latest.
Teaching Assistants: By appointment only (setup the appointment using email)

TA-led Recitations *(starting Jan. 28)*

Section 1: Mondays, 5–6:20 PM in SEC-210
Section 2: Tuesdays, 5–6:20 PM in SEC-207
Section 3: Thursdays, 5–6:20 PM in SEC-207

Course Calendar

A detailed calendar for the 28 lectures and 13 recitations is available through the course's page on Sakai. You can also subscribe to the course calendar using the following link: https://sakai.rutgers.edu/access/calendar/ical/ece346-sp19.ics

Textbook

The textbook traditionally used for this course seems to be out of print. We will instead be providing scanned passages from parts of the book under the "fair use" doctrine for reading purposes.

Prerequisites

The courses ECE 345 (and ECE 347) Linear Systems and Signals (and Lab). In particular, enrolled students should be comfortable with the concepts of complex numbers, Fourier, Laplace, and z transforms, continuous and discrete signals and systems, time-domain and frequency-domain relationships between the input and output of linear, time-invariant (LTI) systems, continuous and discrete convolutions, etc. The students are also expected to be comfortable with the use of MATLAB for some activities.

Course Policies

Division of Grades. The final course grade of 100% will be divided into the following categories:

1. ***Active Learning Assessments: 22.5%***
    - In-class activities: 10%
    - Recitation activities: 5%
    - Home activities: 7.5%
2. ***Formal Assessments: 77.5%***
    - Recitation quizzes: 5%
    - In-class exam #1: 15%
    - In-class exam #2: 20%
    - Final exam: 37.5%

Given that this is going to be a "flipped class," you might not be familiar with the meanings of in-class, recitation, and home activities. In each class, we will carry out a number of activities using polling, solution sheets, and Matlab. These won't be quizzes; rather, several learning assistants (LAs) and I will be there to help you. Plus, you will be working in groups. These in-class activities will carry 10% of the total course grade. There will be some activities in recitations also (though on a smaller scale); hence, the name of recitation activities. Finally, the activities that you carry out outside class or recitations are termed home activities.

Bonus Points. Students can earn up to a total of five bonus points through their helping out of other students and their engagement on Piazza.

- ***Kudos points; capped at 2.5 points:*** A student can receive kudos from other students for their helpfulness in explaining course material to them, with each kudos worth 0.25 bonus points. Any single student can give a maximum to five kudos to other students in the class.
- ***Piazza points; capped at 2.5 points:*** Any answer by a student to a non-trivial question that is endorsed by the instructor (termed "Endorsed Answer" in Piazza-speak) will earn 0.5 bonus points. Students can only earn these bonus points if they answer using their real names.

Will Attendance be Taken? There won't be any attendance taken in class. Before you jump with joy on reading this, however, keep this in mind. There won't be any make up for in-class or recitation activities. Further, 10% to 25% of each activity's grade will be given for just submitting the activity (e.g., taking a poll might give you 25% of the grade of the question, even if you got the answer wrong). So, if you skip a class or recitation, you essentially loose out on valuable activity points. Can you afford to do that? Only you can answer that question.

The Implicit Attendance Policy Sounds so Cruel ... X-(How can I expect any one to attend every single class and recitation, especially when the class starts at 8:40am? Well, the simple answer is I don't! And that is why I have another policy to accommodate missed classes, recitations, home activities, and quizzes due to genuine emergencies. Students will have their lowest grades dropped in the three categories of the activities and recitation quizzes according to the following formula:

- In-class activities: Drop lowest 15% of points
- Recitation activities: Drop lowest 20% of points
- Home activities: Drop lowest 5% of points
- Recitation quizzes: Drop lowest 20% of points

This policy is your buffer for either a bad patch in academic performance or a few missed classes (similarly, recitations and in-home activities). I strongly encourage you to use this buffer wisely and try not to miss classes and recitations. As I wrote earlier, *there would not be any make-up of activities under any circumstances*.

Relative or Absolute Grading? Grades will be assigned on a relative basis. The relative scale though will vary based upon the performance of the overall class. In an ideal setting, students above class average will get B and higher and students at and below class average will get C+ and lower, respectively. If the class performs really well, however, then the B will turn into B+ (or even A!). Similarly, if the class performs really bad then the B will turn into C+ (or even C). In short, I have no hesitation giving the entire class A's, if the class deserves them (or vice versa for F's).

Exam Policy. Exams will be closed book and closed notes. Students can bring in one, two-sided letter-sized handwritten page for midterm exams and three, two-sided letter-sized handwritten pages for the final exam. As a general policy, there will be no makeup exams. I will allow exceptions for rare emergency situations, but this would require at least 7 days advance approval to skip an exam. Any one not appearing in an exam without such prior approval will automatically get a 0.

Academic misconduct and plagiarism warning

It is important that the students familiarize themselves with the Rutgers Academic Integrity Policy, available at `http://academicintegrity.rutgers.edu/academic-integrity-at-rutgers`, and the definition of plagiarism (see `http://www.plagiarism.org/plagiarism-101/what-is-plagiarism/`). All cases of academic misconduct, whether minor or major, will not only be reported to the School of Engineering, but will, in most cases, also result in loss of one or more letter grade.

Some tips for making learning the class material easier

Let's admit it, digital signal processing is a hard class. But we can work together in a team to make it a fun and enjoyable class. I will work hard to achieve this goal, but all of you have to work equally hard to make this a reality. ***In particular, in order to facilitate learning, this year's offering of ECE 346 will be a "flipped class."*** I will be assisted in this offering through not only two TAs but also several learning assistants (LAs). These LAs are ECE students who took my class in previous years and are interested in helping you out this year. As you will realize during the course of the semester, a flipped classroom means a lot of work for the instructor and his/her helpers. At the same time, it will also be a lot of work for you, ranging from coming to the class prepared (see below) to actively engaging during class and recitation times with the instructor/LAs and the TAs (no more snoozing, unfortunately). But I am confident that we can work together as a team during this semester and successfully achieve our learning goals.

Here are in particular some tips that I hope you will remember to ensure you have a good learning experience throughout the semester.

- Keep up with the assigned videos, Sakai quizzes, and reading assignments to benefit from the flipped structure of the class.
- Get to know your assigned group members and learn to work with them both within and outside the classroom.
- If you feel lost at any time during the semester, please do not hesitate to reach out to the instructor team (myself, TAs, and/or LAs).
- Pay attention to the flow of information via email, Sakai, and Piazza. Stay engaged, both within and outside the class. Make good use of Piazza for clarifying any doubts and also helping your fellow students.
- Because of the mathematically intensive nature of the course, one cannot learn it by forgetting about it till it is time for an exam. It is therefore important that you try to keep up with the class material on a regular basis, especially if you either late to the class/recitation and/or end up missing a class or recitation.

- While the idea of a flipped classroom is that most of the learning takes place during the class time, this alone would not be enough for you to retain all the information. You have to ensure that you revisit the exercises done during class and recitation times for full retention.

That's all from my side on this topic folks. Happy learning!

Tentative Course Outline

- Revisiting key LSS concepts that overlap with digital signal processing
  - Class 1: Introduction to signal processing
  - Class 2: Review of signals, systems, and convolution
  - Classes 3, 4: Review of continuous-time and discrete-time Fourier transforms (CTFT and DTFT)
- Sampling theory for bandlimited signals
  - Classes 5, 6: Basic sampling theory
  - Class 7: Aliasing in sampling theory
  - Classes 8, 9: Discrete-time processing of continuous-time signals
  - Classes 10, 11: Practical issues associated with A/D and D/A conversion
  - Class 12: Capping off the material learned so far
- The discrete Fourier transform (DFT)
  - Class 13: Introduction to the DFT
  - Class 14: Relationship between the DFT and the DTFT
  - Classes 15, 16: Properties of the DFT
  - Class 17: The fast Fourier transform (FFT)
  - Class 18: Capping off the material learned so far
- Spectral analysis
  - Class 19: Spectral analysis using the DFT
  - Class 20: Spectral analysis using the short-time Fourier transform (STFT)
  - Class 21: Capping off the material learned so far
- Design of digital filters
  - Class 22: Digital filters and the z-transform
  - Class 23: Understanding the response of filters in terms of the pole-zero placements
  - Classes 24, 25: Design techniques for FIR filters
  - Class 26: Design techniques for IIR filters

While there are a total of 28 classes in a semester, the remaining two classes will be used for midterm exams. Please note that this is a "tentative" course outline and we will go faster or slower depending upon how the semester unfolds.