ECE 241 - Signals
ECE Department, University of Rochester

Please read this carefully and all other course related instructions, particularly those pertaining to the Academic Honesty Policy!

Course Mechanics:

Pre-requisites: Either ECE 113 (Circuits and Signals) or ECE 210 (Circuits), and MATLAB™ familiarity (or instructor permission). Note that the course will draw upon material from MTH 165 which is a pre/co-requisite for ECE 113 and ECE 210.

Credit Hours: 4

Lectures: Tue, Thu 12:30-1:45 PM, B&L 106

Labs: Two Sections (choose one). Tue, Thu 7:40-10:00 PM, Gavett 244

Recitation: Thu 6:15-7:30 PM, CSB 209 (Attendance required, recitation sessions will be exchanged with lectures as required for making up lecture slots lost due to travel)

The pre-requisites are absolutely necessary. If you are (or become) concerned that your background may not have prepared you adequately for this class, please let me know ASAP.

Course Description:

We live in a world full of signals: music, speech, video, and images are all common examples, as are measurements of temperature, humidity, location, orientation, etc. This course provides the mathematical foundations for the representation, processing, analysis, and reproduction of signals and of the systems and algorithms used to process these. The course is intended for junior/senior undergraduate level students in Electrical and Computer Engineering.

Course Objectives:

The goals of this course are to: a) introduce students to signals and systems as powerful abstractions that can be used to represent a wide variety of physical measurements, circuits, devices, and algorithms, b) develop an underlying mathematical theory that facilitates analysis and design, c) equip students with widely-applicable mathematical tools and techniques in this field, particularly, common signal transforms, and d) relate theory to practice through computer-based laboratory experiments and specific application case studies.

Upon completion of this course, students should be able to:

• Classify signals and systems as discrete or continuous domain and appropriately choose between these representations for specific application settings
• Classify discrete or continuous domain signals and systems into their different types
• Provide mathematical definitions of common signals and list their key properties
• Characterize LTI systems and analyze their basic properties in terms of the system impulse response
• Recognize and write the mathematical equations representing discrete and continuous time convolution. Use properties of the convolution operation to infer attributes of inter-connected systems
• Develop block diagram representations of causal LTI systems from linear constant coefficient differential and difference equations
• Write out expressions for Fourier series, Fourier transforms, Laplace transforms and infer these series and transforms for simple commonly encountered signals
• Use common properties to infer Fourier series, transforms, and other properties for related signals
• Evaluate system transfer functions for simple LTI systems. Analyze the behavior of LTI systems on simple signals using Fourier/Laplace transforms and/or convolution operations
• State the relations between the different transforms
• Apply sampling theory to determine required rates for sampling of band-limited signals without loss of information and to explain the phenomenon of aliasing
• Write programs in MATLAB™ to generate signals from simple difference equations or mathematical specifications and appropriately plot the signals
• Using MATLAB™, evaluate Fourier series for discrete time periodic signals, relate the direct computations to matrix-vector calculations studied in linear algebra, and explain, in light of theoretical concepts studied, the observed characteristics of Fourier series coefficients for some simple signals
• Using MATLAB™, numerically evaluate and plot system transfer function magnitudes for causal CT systems specified by linear constant coefficient differential equations. For a simple filter and a suitably defined input signal, relate the observed frequency response to expected output characteristics in the Fourier domain
• Using MATLAB™ simulations, empirically examine the effect of sampling, aliasing, and simple frequency domain low-pass filtering on linearly mixed sinusoidal signals and explain the observed characteristics in light of sampling theory
• Recognize the relation and relevance of topics covered in this course to the prerequisites and to follow on advanced courses

Course Outline:
1. Introduction and Motivation
2. Continuous Time (CT) and Discrete Time (DT) Signals and Systems
3. Linear Time Invariant (LTI) Systems
4. Convolution Integral and Sum
5. CT and DT Fourier Series
6. CT and DT Fourier Transforms and Relation to Fourier Series
7. Sampling of CT Signals
8. DT Processing of CT Signals
9. Laplace transforms

Text (required):
Grading:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Homework</td>
<td>20%</td>
</tr>
<tr>
<td>Labs</td>
<td>15%</td>
</tr>
<tr>
<td>Recitation attendance</td>
<td>5%</td>
</tr>
<tr>
<td>Midterm</td>
<td>30%</td>
</tr>
<tr>
<td>Final</td>
<td>30%</td>
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Late homework assignments are not accepted. To allow for handling of exceptional circumstances, homework assignments have a 20% grace policy, i.e., any grade over 80% of the total homework points will assure you the full 20% credit toward the final course grade.

Important: Assignment of final grades will use a combination of establishing an acceptable level of performance and grading on a curve. In particular, you cannot and should not set expectations for the grade you will receive in the course purely based on reported mean and standard deviation statistics. Means are typically skewed downward by unsatisfactory scores (for instance, from students who do not show up for an exam and therefore receive a 0).

Tentative Exam Schedule:

- **Pre-requisite Math Proficiency Assessment:** Closes on Friday, September 13, 2019 (WeBWorK)
- **Midterm Exam I:** Thursday, October 10, in class (subject to change, check course announcements)
- **Midterm Exam II:** Tuesday, November 19, in class (subject to change, check course announcements)
- **Final Exam:** Tuesday, December 17, 7:15pm (Room TBD)

Instructor:

**Prof. Cristiano Tapparello**

Office hours: 3:00-4:00PM, Tuesday (confirm by email)

Office: Computer Studies Bldg. 511

Email: [cristiano.tapparello@rochester.edu](mailto:cristiano.tapparello@rochester.edu)

Homepage: [http://www.ece.rochester.edu/~ctappare](http://www.ece.rochester.edu/~ctappare)

Teaching Assistant:

**Utku Demir**

Office hours: 10:00-11:00AM, Wednesday

Office: Computer Studies Bldg. 505

Email: [udemir@ur.rochester.edu](mailto:udemir@ur.rochester.edu)

**Nadir Adam**

Office hours: 10:00-11:00AM, Monday

Office: Computer Studies Bldg. 505

Email: [nadam@ur.rochester.edu](mailto:nadam@ur.rochester.edu)
**Wuxieucheng Wang**
Office hours: 4:30-5:30PM, Monday  
Office: Computer Studies Bldg. 506  
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**Yaqing Liu**
Office hours: 4:00-5:00PM, Thursday  
Office: Computer Studies Bldg. 505  
Email: yaqing.liu@rochester.edu

**Sheng Xu**
Office hours: 2:00-3:00PM, Friday  
Office: Computer Studies Bldg. 505  
Email: shengxu@rochester.edu

**Notes:**
- TAs may decide to use their other research offices for office hours if the number of students is small. The posted version of this sheet will be updated accordingly and they will post a notice on their labs if they move their office hours to other rooms due to the number of students.
- If you cannot make the above times, please email the TAs to individually arrange office hours.
- Check the updated course information sheet on BlackBoard for updated TA office hours and locations.
- Utku is the head TA and is responsible for coordination of tasks among the TAs.

**Course Web Sites:**
Homework assignments, handouts and general announcements relating to the class will be posted on the Blackboard course web-site accessible from:  
http://learn.rochester.edu/

You will need your UR NETID to access the Blackboard course content.

The course sheet and general information on the class is also available at the ECE course website:  
http://www.ece.rochester.edu/courses/ECE241

Course calendar on Google Calendars:  
https://tinyurl.com/y3v34vf2

**Note:** Information on the calendar is updated as changes occur. For important events, such as exams, please check the online calendar instead of simply copying over the appointments to your own calendars.
Academic Honesty Policy:

The University of Rochester academic honesty policy applies to all assignments and exams for this class. The full-text of the academic honesty policy can be found at: http://www.rochester.edu/College/CCAS/AdviserHandbook/AcadHonesty.html

In addition to the general guidelines mentioned in the above policy, for this course I require that:

• In examinations, you must work individually with no communication with others and use only materials/tools that have been explicitly allowed.

• For homework, you may discuss problems with your colleagues but final solutions need to be worked out, written and submitted individually.

• **Any external material used should be clearly cited.** This applies to all work you submit for the class. It is inappropriate to use any resources that you would not be willing to publicly acknowledge or those that your are explicitly forbidden from using.

• In your own writings (for example, lab reports, homework solutions etc), no more than one or two sentences may be used verbatim from any source (even with citation and clear demarcation as quotations).

• Online tutoring and homework help sites such as chegg.com should be clearly acknowledged if these are used for any work. Problems, lab assignments, quizzes, etc that are assigned in the class should not be posted on such sites (to seek solutions or tutoring help).

**READ THESE INSTRUCTIONS CAREFULLY!** If any aspect of the academic honesty policy and guidelines for this course are unclear, please ask me for clarifications. Lack of awareness or understanding of this policy will not be an acceptable excuse or defense against disciplinary action.

Scheduling Issues:

1. Announcements and updates will be posted on the course website on Blackboard (learn.rochester.edu). **Important:** You are responsible for checking announcements and for setting notifications on Blackboard.

2. Homework assignments are due on the day indicated and should be handed in at the **start of class.** No assignments will be accepted more that 5 minutes into the lecture session. If you need to travel, you may choose to typeset or scan in your homework and email it to the class TA before the time it is due.

3. The schedule for the course final exam is set by the registrar and announced with the course timetables. Please note the exam times and make your vacation, travel, and other extra-curricular plans for the end of the semester taking this schedule into account. No changes are possible in this schedule under normal circumstances.

4. The tentative schedule for the mid-term exam is also listed on the course sheet. Individual adjustments to the mid-term schedule will not be allowed under ordinary circumstances.

5. If you cannot attend a class lecture, please contact a classmate or a TA that is attending the lectures to borrow notes and find out what was covered in the lecture. Depending on questions and discussion, the topics we cover can and will vary.