

## Introduction to Signals and Systems

EEL 3135

**Class Periods:** TR | Period 3-4 (11:00 AM – 1:45 PM)

**Class Location:** NEB 0101

**Academic Term:** Summer 2019

**Canvas:** <https://ufl.instructure.com/courses/370835>

### Instructor

Name: Tan Wong

Office Location: NEB 461

Office Hours: TR 10–11AM

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### Teaching Assistants

- Barukh Rohde (lead) E-mail: [barukh94-school@yahoo.com](mailto:barukh94-school@yahoo.com) Office Hours: T 1:45–2:45 PM, NEB 467
- Benji Roberts E-mail: [benjiroberts@ufl.edu](mailto:benjiroberts@ufl.edu) Office Hours: TBA
- Cory Arthur E-mail: [coryarthur@ufl.edu](mailto:coryarthur@ufl.edu) Office Hours: TBA
- Nicholas Fata E-mail: [nicholas.fata@ufl.edu](mailto:nicholas.fata@ufl.edu) Office Hours: TBA
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### Course Description

Continuous-time and discrete-time signal analysis including Fourier series and discrete-time and discrete Fourier transforms; sampling; discrete-time linear system analysis with emphasis on FIR and IIR systems: impulse response, frequency response, and system function; MATLAB-based programming for Signals and Systems.

### Course Pre-Requisites / Co-Requisites

Prerequisite: Calculus 2 or equivalent

### Course Objectives

This course aims to provide analytical skills and numerical tools necessary for further study in communications, control, and signal processing. At the conclusion of this course, you should be able to:

- understand basic concepts of discrete-time signals and linear time invariant (LTI) systems
- provide time-domain and frequency-domain descriptions of these signals and systems
- employ Fourier analysis to design and analyze simple LTI systems
- proficiently use MATLAB as a programming and numerical analysis tool
- implement simple discrete-time systems, such as linear filters, in MATLAB
- program MATLAB to numerically perform Fourier analysis of signals and LTI systems.

### Recommended Materials

- Textbook Required
  - DSP First, 2nd edition*
  - Authors: James H. McClellan, Ronald W. Schafer, and Mark A. Yoder
  - Publisher: Pearson
  - ISBN: 0136019250
- Software Required
  - MATLAB, Student Version (\$99 for student edition with toolboxes, \$50 without toolboxes)

## Course Structure

### Class Schedule

Date			Lecture	Text Chapters
Tue	May	14	Introduction, Complex number review	1, App. A
Thu	May	16	Sinusoids, Complex Sinusoids, Sums of Sinusoids 1	2
Tue	May	21	Sums of Sinusoids 2, Fourier Series 1	3
Thu	May	23	Fourier Series 2, Sampling Sinusoids 1	3, 4
Tue	May	28	Sampling Sinusoids 2, Interpolation	3, 4
Thu	May	30	Discrete-Time Systems, FIR Filters	5
Tue	Jun	4	Convolution, LTI Systems 1	5
Thu	Jun	6	LTI Systems 2, Frequency Response 1	5, 6
Tue	Jun	11	Frequency Response 2 & 3	6
Thu	Jun	13	Transient Response	6
Tue	Jun	18	Review	-
Thu	Jun	20	<b>Midterm</b>	-
Tue	Jul	2	Discrete-Time Fourier Transform 1 & 2	7
Thu	Jul	4	Independence Day (no class)	-
Tue	Jul	9	Z-Transform 1 & 2	9
Thu	Jul	11	Poles and Zeros 1 & 2	9
Tue	Jul	16	IIR Filters 1 & 2	10
Thu	Jul	18	IIR Filters 3, Inverse Z-Transform 1	10
Tue	Jul	23	Inverse Z-Transform 2, Analysis in Three Domains	10
Thu	Jul	25	Discrete Fourier Series 1 & 2	8
Tue	Jul	30	Discrete Fourier Transform 1 & 2	8
Thu	Aug	1	Fast Fourier Transform 1, 2 & 2.5	8
Tue	Aug	6	Review	--
Thu	Aug	8	<b>Final Exam</b>	--

### Attendance & Participation:

This class is taught in the flipped classroom format:

1. Lecture videos, readings, and tutorials will be posted on Canvas before classes. It is MANDATORY that you watch them before the designated class period. You WILL be quizzed and tested on this material.
2. In class periods, you are expected to work on classwork and MATLAB lab exercises as well as to participate in other in-class activities. The instructor and TAs will be available to help you individually or in small groups with the classwork and lab exercises. Attendance is MANDATORY and may be graded.

### Slack Page:

We have a Slack page for the course. This is an *optional* resource for students to discuss the course amongst each other and occasionally with the instructor and TAs. This resource is intended to supplement office hours and student interactions. It also serves as an additional communication medium in class. **No official communications / submissions happen over Slack. No assignment submissions will be accepted over Slack.**

### Dr. Wong's Very Rough Class Logistics (Tuesday):

- **Part 1:** Discussion / Conversation (15 minutes)
  - This is not a lecture, but a brief discussion or Q&A session to improve your understanding of the material. Therefore, you should come into this with having watched the lecture videos.
- **Part 2:** Big Quiz on previous week material (20 minutes)
- **Part 3:** Class-collaborative coursework (25 minutes)
  - Classwork problems completed as a class
- **Part 4:** Team-collaborative question (45 minutes)
  - Challenging classwork problems completed in teams

- **Part 5:** Design time! Programming and lab discussion (60 minutes)
  - Solve MATLAB problems in the lab

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  - This is not a lecture, but a brief discussion or Q&A session to improve your understanding of the material. Therefore, you should come into this with having watched the lecture videos.
- **Part 2:** Class-collaborative coursework (30 minutes)
  - Classwork problems completed as a class
- **Part 3:** Team-collaborative coursework (60 minutes)
  - Challenging classwork problems completed in teams
- **Part 4:** Design time! Programming and lab discussion (60 minutes)
  - Solve MATLAB problems in the lab

## **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. **TIP:** Pay attention to the workflow: There will be one weekly big quiz and one weekly little quiz, except the midterm and final weeks. Classwork will be due right after each class period, and lab reports will generally be due every week. **DO NOT FALL BEHIND.**

### **Classwork (20 in total)**

**When:** Assigned every class (see course schedule on website).

**What:** Analytical problems that can be solved by hand.

**Why:** Classwork is intended to guide you through material and present you with questions that will require time to think and complete. Classwork exercises are meant to be done with your peers and with the instructor's or TAs' help.

**Grading:** Classwork is graded on a scale of (1) no completion, (2) partial completion, or (3) full completion.

**Late policy:** Late assignments will not be eligible for any points.

**Submission:** Classwork will be submitted on canvas within 15 mins after each class.

### **Mid-term Exam & Final Exam (1 midterm and 1 final in total)**

**When:** The midterm is half-way thru the course on **Thursday, June 20, 2019**. The final is at the end of the course on **Thursday, August 8, 2019**.

**What:** Analytical problems that can be solved by hand. Similar to the classwork and big quizzes, but may require a deeper understanding of the material.

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

**Grading:** Each exam is graded on a 100-point scale.

**Make-up Exams:** There are no make-up exams, but the final exam may be used in place of the midterm exam.

### **Little Quizzes (10 in total)**

**When:** Occur roughly once every week (except for the midterm and final weeks). The quiz will take roughly 5 minutes.

**What:** The quizzes are low stack questions about lecture videos.

**Why:** These quizzes are to ensure that you watched the lectures for the current week, and to collect feedback from you.

**Grading:** Little quizzes are graded based on completion

**Submission:** Complete directly on Canvas before 11:59pm every Wednesday.

### **Big Quizzes (10 in total)**

**When:** Occur roughly once every Tuesday (except for the midterm and midterm weeks). The quiz will take roughly 20 minutes.

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

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

**Grading:** Big quizzes are graded on a 25-point scale.

**Labs (6-7 in total)**

**When:** There are 6-7 labs over the course of the semester

**What:** Each lab consists of MATLAB design exercises in two parts. You are expected to complete parts 1 and 2 of each lab.

**Why:** In each lab, we apply signals and systems theory to a particular application. This gives you a better understanding about how signals and systems theory is applied in practice using MATLAB.

**Reports:** After each lab, you are required to submit short reports via Canvas. These reports demonstrate your understanding of the material and should be self-sufficient (i.e., the report should be self-explanatory).

**Reports are due 11:59pm every Friday (except for the midterm and midterm weeks).**

**Evaluation of Grades**

Assignment	Percentage of Final Grade
Classwork	10%
Graded Labs	25%
Midterm Exam	20%
Final Exam	20%
Little Quizzes	5%
Big Quizzes	20%
	100%

**Grading:** If the final exam score is greater than the midterm score, then the midterm will be dropped and the final will count for 40% of the grade.

## Grading Policy

Percent	Grade	Grade Points
93.3 - 100.0	A	4.00
90.0 - 93.3	A-	3.67
86.6 - 90.0	B+	3.33
83.3 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.6 - 80.0	C+	2.33
73.3 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.6 - 70.0	D+	1.33
63.3 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
00.0 - 60.0	E	0.00

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

## Accreditation Information

### Relation to Program Outcomes (ABET):

Outcome	Coverage
<b>Outcome 1.</b> An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	Students are assessed using: <ul style="list-style-type: none"><li>- Focused exam questions on<ul style="list-style-type: none"><li>o their ability to solve differential equations</li><li>o using engineering techniques</li><li>o their ability to work with complex numbers and exponentials.</li></ul></li><li>- Exam questions target the use of<ul style="list-style-type: none"><li>o impulse responses, frequency response, DTFT, and z-transform methods.</li></ul></li><li>- Using a MATLAB programming, the students are required to<ul style="list-style-type: none"><li>o apply filtering concepts to design a piano octave detection system to meet specifications.</li></ul></li></ul>
<b>Outcome 6.</b> An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	Students are assessed using: <ul style="list-style-type: none"><li>- A MATLAB assessment where<ul style="list-style-type: none"><li>o Students are provided EKG signals (actual data) of a number of patients from a public database. The students are required to break each EKG signal down into overlapping windows and apply FFT on each window.</li><li>o From the FFT results, the students then generate a time trajectory of the heart rate of a patient.</li><li>o As the EKG signals are noisy and could occasionally be distorted, the students are required to design algorithms that carefully interpret the FFT results to rid out readings that are not physically reasonable.</li></ul></li></ul>

## Course & University Policies

### 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:** Changes to the syllabus may be necessary do to unforeseen situations. The class vote ensures the entire class agrees with the change.

### 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 code, using material taken from another source without proper a citation
- Obtaining solutions to assignments or exams through inappropriate means

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. I am obligated to report on academic misconduct with a letter to the department, college, and/or university leadership. Repeat offences will be treated with significantly greater severity.

### Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

### Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

### University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. You are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions, please consult with the instructors or TAs.

### Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

### Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, [rbielling@eng.ufl.edu](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@ufl.edu](mailto:nishida@ufl.edu)

*Sexual Discrimination, Harassment, Assault, or Violence:* If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the Office of Title IX Compliance, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

### Campus Resources:

#### Health and Wellness

#### **U Matter, We Care:**

If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

#### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

#### Academic Resources

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu).  
<https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.  
<https://teachingcenter.ufl.edu/>.

**Writing Studio**, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.  
<https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

**On-Line Students Complaints:** <http://www.distance.ufl.edu/student-complaint-process>.