**San José State University**

**Charles W. Davidson College of Engineering**

**DEPARTMENT OF ELECTRICAL ENGINEERING**

# EE 210 - 01 - Linear Systems Theory (Fall 2020)

## Course and Contact Information

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| Instructor: | John (JeongHee) Kim |
| Office Location: | Engineering Building, Room 259 |
| Telephone: | (408) 924-3950 |
| Email: | jeonghee.kim@sjsu.edu or jeonghee\_kim@yahoo.com |
| Office Hours: | Monday: 2:50-3:30 & Tuesday, 16:30 – 17:15, or by email for zoom meeting appointment. |
| Class Days/Time: | Tuesday & Thursday, 18:00 – 19:15, California time |
| Classroom: | Live lecture online @  https://sjsu.zoom.us/j/98401815961?pwd=bzdaNXFHSHIzR1V5QXh5dmZvcjRZQT09 |
| Prerequisites: | Graduate student standing |

## Course Description

Comprehensive overview of signals and linear systems with discrete-time emphasis. System attributes. Fourier transforms families and properties. Convolution and correlation. The 2-sided z-transform. FIR and IIR filters analysis and realizations. Sampling, filtering, and other applications. Computer simulations.

## Course Format

## This is an online course. Lectures will be delivered live online at the dates/time specified above.

## Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on [Canvas Learning Management System course login website](http://sjsu.instructure.com/) at http://sjsu.instructure.com.

**Course Learning Outcomes (CLO)**

LO1: Distinguish how to analytically and numerically calculate spectra of continuous-time and discrete-time signals from various Fourier transform definitions and transform properties.

LO2: Classify how to infer from signals and their spectra basic attributes including energy, power, moments, among others.

LO3: Analyze analytically and numerically perform basic signal operations such as convolutions, and correlations in either the time or frequency domain and to relate such operations to real-life applications.

LO4: Use various system attributes such as linearity, shift invariance, causality, and stability, and to understand their relationship to the system function.

LO5: Analyze the time and frequency responses of linear shift invariant systems to aperiodic and periodic temporal or spatial input signals both in the real frequency and complex-frequency domains.

LO6: Analyze the developed analysis methodologies to real-life applications such as filtering, sampling, imaging, control, communications, bio, signal processing, among others.

## Required Texts/Readings

### Textbook

Discrete-Time Signal Processing, 3rd Ed., by Oppenheim and Schafer, Pearson/Prentice-Hall 2010

ISBN-13: 978-0131988422

ISBN-10: 0131988425

### Other Readings

Joyce Van de Vegte, “Fundamentals of Digital Signal Processing”, Prentice-Hall, 2002

ISBN: 0-13-016077-6

### Other technology requirements / equipment / material

## The Student Version of Matlab (or Python or Octave (free and similar to Matlab)) is recommended for supporting numerical computations when needed. It’s available from the Mathworks Inc. (http://www.mathworks.com/academia/student\_version/). Matlab and many of its “toolboxes” are available on the EE Department PC’s in room ENG387 (an open lab; open times are posted on the door). Matlab may be used to demonstrate some topics in the class.

## Course Requirements and Assignments

**Lectures**

Lectures will be delivered **LIVE** online at the class days/time specified above. Lectures will be recorded (Attendance is mandatory at the class times). The course will follow the selected subjects as listed on the course description. Additional theory and examples will be given and discussed in class as much as time permits.

 Please note that lecture materials are NOT solely based on the required text and so students are responsible for following up the lecture, in order to prepare themselves for the exams

 Students are responsible for the reading the text, handouts, lecture presentations, etc.

 Students are responsible for following up and keeping track of the in-class lecture materials.

 Students are responsible for finding and reading additional books, papers, examples, etc., in order to gain more understanding of the materials discussed in the lectures.

 Students are responsible for self-learning and tools for assigned homework problems, projects, and lecture discussions.

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practice. Other course structures will have equivalent workload expectations as described in the syllabus.

## Midterm and Final Exams

There will **be homework assignments, two midterm exams, projects, quizzes & one comprehensive final exam**. The Final exam date is posted by the university. Since make-up exams will NOT be given, please make sure that you are able to attend all exams at the indicated scheduled dates and times (from the beginning of the semester) in order to register for the course.

 **All exams & Quizzes will be proctored through Respondus LockDown Browser + Webcam.**

 All exams are closed-book exams.

• One sheet (double-side 8.5x11) of hand-written notes is allowed for each midterm exam and two sheets of hand-written notes are allowed for the final exam.

• Only basic calculators may be allowed (It will be notified before each exam).

 There will be no make-up exams nor quizzes (as mentioned above)

## Homework Assignments

 Homework assignments with due dates will be given through Canvas. Homework must be submitted through Canvas and solutions will be available after the due dates.

 Do NOT submit HW via email.

 Late submission will NOT be accepted (absolutely!).

 There is no make-up homework.

##  To get credit for your homework assignments, submissions must be neat, clean, and must be done professionally and seriously. Your official name (not nickname), course #, and homework # must be visibly shown on each assignment.

 If unreasonable or out of common sense behavior or disturbance happen in the class, one will be asked to leave from the class and will be given “F” grade. And I will drop you from the class if the class is disturbed unreasonably with my right.

 **There is no make-up homework, projects, quizzes, Exams (again)**

## Grading Information

The overall course grades (letter-grades) will be assigned based on a defined grading standard as shown below. The weights of the whole course work assignments are:

1. Homework assignments, Projects & Quizzes 20%

2. Two midterm exams 50% (25% each)

3. One final exam 30%

And the overall course grade (letter-grade) will be assigned based on the distribution below:

Grading criteria (Example: 74% results in a grade of C plus):

|  |  |
| --- | --- |
| **Grade** | **Percentage** |
| A plus | 95% and above |
| A | 90 to 94% |
| A minus | 87 to 89% |
| B plus | 84 to 86% |
| B | 80 to 83% |
| C plus | 77 to 79% |
| C | 74 to 76% |
| C minus | 70 to 73% |
| D plus | 67 to 69% |
| D | 60 to 63% |
| D minus | 57 to 59% |
| F | 0 to 56% |

## Zoom Classroom Protocol

EE210 students understand that professional attitude is necessary to maintain a comfortable academic environment in the Zoom classroom. For examples:

 Students may turn on their webcam (optional) to participate in class, unmute their microphone to speak and mute it when not speaking.

 Students will put their cell phones in quiet/vibration mode during the lecture.

 Students understand that drinking water, juices, etc. during the lecture is acceptable but NOT eating.

 Students will not skip the lecture and then ask the instructor to summarize the lecture later on.

 Office hours are for students to have questions, not for the instructor to summarize the lecture for any specific student.

 Students will attend the lectures on time and leave the class at the end of the lecture (attendance is mandatory for each class even if each class is recorded).

 Students will consult the course syllabus for class policies and requirements before requesting the instructor for any special considerations and/or exceptions

To minimize possible tension during the exams, students are requested to follow the exam rules closely.

 Students understand that long-term learning is their responsibility and will always keep it up.

## University Policies

Per University Policy S16-9, *(http://www.sjsu.edu/senate/docs/S16-9.pdf)*, relevant information to all courses, such as academic integrity, accommodations, dropping and adding, consent for recording of class, etc. is available on Office of Graduate and Undergraduate Programs’ [Syllabus Information web page](http://www.sjsu.edu/gup/syllabusinfo/) at http://www.sjsu.edu/gup/syllabusinfo/”.

**EE Department Honor Code**

*The Electrical Engineering Department will enforce the following Honor Code that must be read and accepted by all students.*

*“I have read the Honor Code and agree with its provisions. My continued enrollment in this course constitutes full acceptance of this code. I will NOT:*

* *Take an exam in place of someone else, or have someone take an exam in my place*
* *Give information or receive information from another person during an exam*
* *Use more reference material during an exam than is allowed by the instructor*
* *Obtain a copy of an exam prior to the time it is given*
* *Alter an exam after it has been graded and then return it to the instructor for re-grading*
* *Leave the exam room without returning the exam to the instructor.”*

***Measures Dealing with Occurrences of Cheating***

* *Department policy mandates that the student or students involved in cheating will receive an “F” on that evaluation instrument (paper, exam, project, homework, etc.) and will be reported to the Department and the University.*
* *A student’s second offense in any course will result in a Department recommendation of suspension from the University.*

## No Incomplete grade will be given

# EE210-01, Linear Systems Theory, Fall, 2020

| Week | Topics |
| --- | --- |
| 1 | Introduction  Signals and Systems |
| 2 | Continuous Time (CT) Signals & Fourier Transform (FT)  CT Fourier transform & properties 1 |
| 3 | CT Fourier transform properties & Fourier Series  CT Convolution |
| 4 | Properties of time domain vs. Frequency domain relationships  Sampling process of CT signals |
| 5 | DT LTI (discrete time linear time invariant) Systems and properties  DT Fourier transform (DTFT) |
| 6 | DT Fourier transform (DTFT): properties |
| 7 | The z-transform & its inverse: definitions, example pairs  **Midterm Exam I** |
| 8 | The z-transform: properties, system function  Z transform and filtering relationships |
| 9 | Laplace transform (may be represented closer to end of semester) |
| 10 | The discrete Fourier transform (DFT)  The DFT: circular and linear convolutions |
| 11 | Discrete Fourier Series (DFS)  DFT vs. FFT (Fast Fourier Transform) |
| 12 | FFT: DIT (decimation in time) & DIF (decimation in frequency) |
| 13 | **Midterm Exam II** |
| 14 | Finite Impulse Response filter (FIR) filter design |
| 15 | Infinite Impulse Response filter (IIR) filter design |
| 16 | Review |
| Final | **Thursday, December 10 1715-1930** |