San José State University
Charles W. Davidson College of Engineering
Department of Electrical Engineering

EE112 – Introduction to Signal Processing (Spring 2016)

Course and Contact Information

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Office Hours: Monday & Wednesday, 4:30pm – 6:00pm

Class Days/Time: Monday & Wednesday, 3:00pm – 4:15pm

Classroom: Engineering Building, Room 331

Prerequisites: EE98 and MATH133A with grade of C or better, and EE101

Course Information and Materials

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on the Canvas learning management system course website. Students are responsible for regularly checking with the messaging system through Canvas and email to learn of any updates.

Course Description

Introduction to discrete-time signal processing. Sampling and aliasing. Frequency response, transfer function, poles/zeros. Z-transform. FIR and IIR filtering. The four Fourier transforms. Computing spectra and spectrograms. Bio-systems, speech, music, image processing applications with MATLAB.

Course Learning Outcomes

Upon successful completion of this course, students will be able to:

1. CLO 1 – Mathematically characterize LTI signal processing systems
2. CLO 2 – Analyze the function performed by simple discrete-time filters
3. CLO 3 – Utilize the Z-transform to analyze discrete-time filters in terms of poles and zeros and their relation to the impulse response and frequency response
4. CLO 4 – Utilize the appropriate Fourier transform to analyze periodic and aperiodic signals in terms of their frequency content and of filters in terms of their frequency response

5. CLO 5 – Implement signal processing functions using MATLAB

Required Texts/Readings

Required Textbook/Readings

- Signal Processing First, by J. McClellan, R. Schafer, and M. Yoder, Pearson/Prentice-Hall, 2003. **(Required)**
- Student Version of MATLAB, The Mathworks, Inc., http://www.mathworks.com/academia. **(Recommended)** MATLAB and many of its toolboxes are available on the PCs in room ENG 387. The lab operates on an open door policy. Check availability time posted on the lab door.

Other Readings

- *Signal and Systems* by Haykin and Van Veen, 2nd Edition, Wiley, 2005.
- *Signals, Systems, and Transforms* by Phillips, Parr and Riskin, Pearson/Prentice Hall, 2003.
- *Discrete-Time Signal Processing* by A. Oppenheim and R. Schafer, 2nd Edition, Prentice Hall, 2010.

Lectures

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.

Important Note: Attendance is expected. Whether you come to class or not, you are responsible for keeping up with what happens in class. If you miss a class (other than for illness or an emergency), it is not reasonable for you to expect me to repeat the material that was covered in the class that you missed just for you. This applies both to the content of the class as well as to announcements about class policies, events, deadlines, etc. Please note that lecture materials are NOT solely based on the required text and so students are responsible for knowing the contents of lectures in order to prepare themselves for the exams. Students can expect a lower letter grade if they miss too many lectures.

Homework Assignments

Seven homework assignments will be given with due dates as shown on the syllabus. Homework must be submitted in class and solutions will be available after the due date.

- Do NOT submit HW via email. Submit HWs in class as hard-copies (paper) only
- Late submission will NOT be accepted (absolutely!)
- There are no make-up homework assignments

To get credit for your homework, submissions must be neat, clean, and must be done professionally. Your official name, course #, and homework # must be visibly shown on each assignment. You are expected to prepare homework assignments individually. You may discuss the problem and general concepts with other students, but there should be no sharing of answers. A good rule to follow is that you should be working alone when preparing the document you will be submitting.

Exams and Final Project

There will be two midterm exams, a comprehensive final exam, and a final project with report. The exam and project due dates are listed on the course schedule section of this syllabus. Since make-up exams will NOT be allowed, 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 are closed-book exams.

- One sheet (double-side) of hand-written notes is allowed for the midterm exams and two sheets of hand-written notes are allowed for the final exam.
- Exam questions will NOT be interpreted during the exam.
- There will be no make-up exams (in very special circumstances, written excuse and official proofs are required for making-up exams).
- Exam solutions will be discussed in class after the exam dates. Written solutions will NOT be distributed.

Grading Policy

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

- Homework assignments: 10%
- Closed-book midterm exam 1: 25%
- Closed-book midterm exam 2: 25%
- A closed-book comprehensive final exam: 30%
- Final project and project report: 10%

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

Percentage Grade	Letter Grade
94 or above	A
90 – 93	A-
87 – 90	B+
84 – 86	B
80 – 83	B-
77 – 79	C+
74 – 76	C
70 – 73	C-
67 – 69	D+
64 – 66	D
60 – 63	D-
Below 60	F

Classroom Protocol

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on.

EE289 students understand that professional attitude is necessary to maintain a comfortable academic environment in the classroom. Some examples include:

- Students will put their cell phones in quiet/vibration mode during the lecture
- Office hours are strictly for questions and clarification, not for the instructor to summarize lecture for students that have missed class
- Students should come to the class on time and leave the class at the end of lecture to minimize distractions
- 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

- Email correspondence should be conducted in a professional manner

University Policies

General Expectations, Rights and Responsibilities of the Student

As members of the academic community, students accept both the rights and responsibilities incumbent upon all members of the institution. Students are encouraged to familiarize themselves with SJSU's policies and practices pertaining to the procedures to follow if and when questions or concerns about a class arises. See University Policy S90–5 at http://www.sjsu.edu/senate/docs/S90-5.pdf. More detailed information on a variety of related topics is available in the SJSU catalog, at http://info.sjsu.edu/web-dbgen/narr/catalog/rec-12234.12506.html. In general, it is recommended that students begin by seeking clarification or discussing concerns with their instructor. If such conversation is not possible, or if it does not serve to address the issue, it is recommended that the student contact the Department Chair as a next step.

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's Catalog Policies section at http://info.sjsu.edu/static/catalog/policies.html. Add/drop deadlines can be found on the current academic year calendars document on the Academic Calendars webpage at http://www.sjsu.edu/provost/services/academic_calendars/. The Late Drop Policy is available at http://www.sjsu.edu/aars/policies/latedrops/policy/. Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the Advising Hub at http://www.sjsu.edu/advising/.

Consent for Recording of Class and Public Sharing of Instructor Material

University Policy S12-7, http://www.sjsu.edu/senate/docs/S12-7.pdf, requires students to obtain instructor's permission to record the course:

- Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material.
- Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent.

Academic integrity

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The University Academic Integrity Policy S07-2 at http://www.sjsu.edu/senate/docs/S07-2.pdf requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The Student Conduct and Ethical Development website is available at http://www.sjsu.edu/studentconduct/.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or

see me during office hours. Presidential Directive 97-03 at http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf requires that students with disabilities requesting accommodations must register with the Accessible Education Center (AEC) at http://www.sjsu.edu/aec to establish a record of their disability.

EE Honor Code – Honesty and Respect for Others and Public Property

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*
- *Copy project information from others*
- *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.

EE112 – Course Schedule

Schedule is subject to change with fair notice by class announcement and update to schedule on Canvas

Course Schedule

Week	Date	Topics, Readings, Assignments, Deadlines
1	02/01/2016	Course syllabus, information, and overview. Review of sinusoidal signals
1	02/03/2016	Phasors and complex number review. Spectrum representation.
2	02/08/2016	Spectrum Representation: Periodic signals, harmonics, time-varying signals Last day to drop (02/09/2016)
2	02/10/2016	Time-varying signals.
3	02/15/2016	Fourier coefficients Last day to add and register late (02/16/2016)
3	02/17/2016	Fourier series and spectrum HW #1 Due
4	02/22/2016	Sampling and aliasing
4	02/24/2016	D-to-A conversion
5	02/29/2016	FIR filtering
5	03/02/2016	FIR Filters: Linearity, time-invariance, convolution HW #2 Due
6	03/07/2016	FIR Filters: Frequency response
6	03/09/2016	FIR Filters: Smoothing filters, digital filtering of CT signals
7	03/14/2016	z-Transform: Introduction and properties HW #3 Due
7	03/16/2016	Midterm Exam #1
8	03/21/2016	z-Transform: Convolution properties, H(w) and zeros of H(z)
8	03/23/2016	z-Transform: FIR Filter examples, linear phase filters
9	03/28/2016	Spring Break
9	03/30/2016	Spring Break
10	04/04/2016	IIR Filters: Feedback and H(z)
10	04/06/2016	IIR Filters: H(w) and poles/zeros of H(z) HW #4 Due
11	04/11/2016	IIR Filters: Inverse transform, transient and steady-state responses
11	04/13/2016	IIR Filters: Second-order filters (bandpass, notch, etc.) HW #5 Due
12	04/18/2016	Midterm Exam #2
12	04/20/2016	Discrete-time Fourier Transform (DTFT)

Week	Date	Topics, Readings, Assignments, Deadlines
13	04/25/2016	Continuous-time Fourier Transform (CTFT), properties
13	04/27/2016	Overview of CT Signals and Systems HW #6 Due
14	05/02/2016	Fourier view of sampling and reconstruction
14	05/04/2016	Spectra of finite signals, windows, resolutions, leakage
15	05/09/2016	Discrete Fourier Transform (DFT), the 4-FT family
15	05/11/2016	Computing spectra with the DFT. FFT algorithm HW #7 Due
16	05/16/2016	Final EXAM Review Final Project Due
Final Exam	05/20/2016	Final EXAM (Friday, May 20, 2016, 1215 - 1430)