San José State University, College of Engineering,  
Electrical Engineering Department,  
EE153, Real-Time Digital Signal Processing, Fall 2016

Instructor: JeongHee (John) Kim
Office Location: ENG263
Telephone: (408) 623-8412
Email: jeonghee.kim@sjtu.edu
Office Hours: T & TR 3:00 to 3:45 pm & after class & by appointment
Class Days/Time: T.TH 1:30 to 2:45 pm
Classroom: ENG345
Prerequisites: EE110, EE112, EE120, C, C++, and Basic Programming, Matlab, Assembly lang., Calculus

EE153 Website
Course materials such as the syllabus, major assignment, handouts, etc. may be found on my web page at [https://groups.yahoo.com/groups/SJSU_EE153/]. You are responsible for regular checking of the web site.

Course Description
In this class students will see applications of electrical engineering techniques to the real-time processing of signals in the digital domain, provide a basis for career employment or graduate school. This course introduces an understanding of real-time DSP through software design for real-time applications, understanding of digital signal processor architecture and programming model. And it also presents processor addressing modes, instruction set, parallel operations, algorithm and code development, debugging, and code verification techniques

We will use Texas Instruments floating point DSP platform (TMS320C6713) and Code Composer Studio to implement real-time dsp.

1. Introduction to real-time DSP, Texas Instrument and Motorola DSP and digital signal processing

2. Introduction to Architecture and programming modes, Addressing Modes, Parallel Moves and Instruction Set

3. Understanding and implementation of adaptive noise canceller, LMS and NLMS.
4. Introduction to sound field simulation in TI Dsp.

5. Simulation and programing of BPSK modem to the dsp board.

6. Implementation and development of FFT

**Student Learning Outcomes**

1. The ability to represent discrete signals graphically and mathematically using difference equations.

2. Ability to understand digital signal processing theories and implementation.

3. The ability to use MATLAB’s DSP Toolbox to analyze discrete signals and filters in both time and frequency domain. The ability to use MATLAB to design and evaluate digital filters.

4. Ability to understanding real-time signal processing with Texas Instrument dsp board

5. Ability to understand and implement adaptive noise cancellation programming, LMS and NLMS, to the TI dsp.

6. Ability to simulate and programming of Binary phase shift keying to TI dsp.

7. Ability to use assembly language and C programming

8. Ability to do debugging of codes.

9. The ability to analyze an audio signal and determine the filters needed to improve its quality, design the required filters, apply these to the signal and evaluate performance. (a)

**Required & Recommended Texts/Software**

**Textbook & Software**


6. The Student Version of Matlab (Release 2007a or later includes the Signal Processing Toolbox among other Toolboxes; the current release is 2011a). Matlab is published by the Mathworks Inc. It’s the computational tool for this course; please see software section below.

7. Code Composer Studio (CCS)

**Laboratory References**


**Other References**

**Software: Matlab & the Signal Processing Toolbox**

Matlab is used as the computational platform for class examples and homework problems. 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 times posted on the lab door. You may also consider purchasing the Student Version of Matlab ($100) for private use at school and home. This is perhaps the most time flexible way to do the computational assignments and Project. The Student Version Release R2007a and later includes the Signal Processing Toolbox. Check the web site [http://www.mathworks.com/academia/](http://www.mathworks.com/academia/) for more information. You may order the Matlab Student Version on the web or may purchase it directly from the Spartan Bookstore, Textbooks Department.

If you are not familiar with Matlab, an introduction can be found at [http://www.mathworks.com/access/helpdesk/help/techdoc/matlab.html](http://www.mathworks.com/access/helpdesk/help/techdoc/matlab.html) and a DSP introduction at [http://www.mathworks.com/access/helpdesk/help/toolbox/signal/](http://www.mathworks.com/access/helpdesk/help/toolbox/signal/). See also the Student Version Manual. Several good Matlab tutorials are also available on various websites (some links will be posted on the class website). Google ‘Matlab tutorial’. Electronic versions (html and pdf) of Matlab and all Toolboxes manuals can be accessed at the Mathworks website above. Matlab has very good ‘help’ facility that you should invoke to learn more about specific commands and functions.

*You will need to learn and use Matlab to get the most out of this course.*

**Dropping and Adding**

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Reference to the current semester’s [Catalog Policies](http://info.sjsu.edu/static/catalog/policies.html) section at [http://info.sjsu.edu/static/catalog/policies.html](http://info.sjsu.edu/static/catalog/policies.html). Add/drop deadlines can be found on the [current academic calendar](http://www.sjsu.edu/academic_programs/calendars/academic_calendar/) web page located at [http://www.sjsu.edu/academic_programs/calendars/academic_calendar/](http://www.sjsu.edu/academic_programs/calendars/academic_calendar/). The [Late Drop Policy](http://www.sjsu.edu/aars/policies/late_drops/policy/) is available at [http://www.sjsu.edu/aars/policies/late_drops/policy/](http://www.sjsu.edu/aars/policies/late_drops/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/](http://www.sjsu.edu/advising/).
Assignments and Grading Policy

Grading:  
Homework & Quiz: 15%  
Midterm Exam 2 out 3: 30%  
Project: 30%  
Final Exam (Friday, December 16 12:15-14:30) 25%

Assignments and Grading Policy

1. No late homework will be accepted. Solutions to the homework assignments and all other info will be posted in group site. Everyone must join in this site to get necessary info.

2. If more than 75% of combined assignments, quizzes, and projects are not done by end of semester, you will get F grade automatically. Maximum of 10% credits will be given for late submission of assignments (if any special occasions happen. Otherwise late works will not be accepted).

3. HW has to have cover page given in the group site otherwise you will not get any credits for that HW. Final solutions on the HW and exam solutions must be boxed. Otherwise you will not get credits. Only one side of page must be used in the HWs. (No HW sending through an email will be accepted.)

4. All exams are closed book and note. Only one 8.5 x 11 cheat sheet (both pages) is allowed for each exam (2 midterm exams). You can bring all two cheat sheets in the final exam (2 cheat sheet for the final exam).

5. No makeup exams will be given.

6. No in-complete grading will be given.

7. If unreasonable or out of common sense behavior happens in the class, one will be asked to leave from the class and will be given “F” grade.

8. Attendance will be checked randomly and will be counted as one Qz.

9. No food is allowed (Water is ok)

10. If there are any cheatings, all will be reported to the department.

Exams & Optional Term Project:
All exams are in-class. Two 8.5x11 front & back summary sheets in your own handwriting are allowed. No other photocopied problem solutions or any other course material is allowed. A term project that deals with an in depth study of a relevant application, including computer simulations or DSP board implementation, is optional. The optional project grade could replace the worst of the two midterms. More details regarding the term project will be talked in class later.

Homework:
Homework is crucial for the understanding of the course material. Homework will be assigned regularly. Part will be fully graded and the rest will be checked for completeness. Solutions for only the analytical part of the problems will be provided. Part of the homework will require using Matlab. Please try to solve the homework problems on your own. This is critical if you are to understand the course material and to do well in the exams. Please note that the 5% for the homework can move your grade across grade boundaries (from B to B+ or A- to A, … etc).

Numerical Grade to Letter Grade Conversion:
95% and above A+,  
90-94% A
86-89% A-
82-85% B+
78-81% B
74-77% B-
70-73% C+
66-69% C
62-65% C-
58-61% D+
54-57% D
50-53% D-
below 50% F

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 and the following items to be included:

- “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.”
  - It is suggested that the greensheet include the instructor’s process for granting permission, whether in writing or orally and whether for the whole semester or on a class by class basis.
  - In classes where active participation of students or guests may be on the recording, permission of those students or guests should be obtained as well.
- “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’s Academic Integrity policy, located at http://www.sjsu.edu/senate/S07-2.htm, 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.sa.sjsu.edu/judicial_affairs/index.html. Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person’s ideas without giving proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified. If you would like to include your assignment or any material you have submitted, or plan to submit for another class, please note that SJSU’s Academic Policy S07-2 requires approval of instructors.

**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.

**Accommodation to Students' Religious Holidays**

San José State University shall provide accommodation on any graded class work or activities for students wishing to observe religious holidays when such observances require students to be absent from class. It is the responsibility of the student to inform the instructor, in writing, about such holidays before the add deadline at the start of each semester. If such holidays occur before the add deadline, the student must notify the instructor, in writing, at least three days before the date that he/she will be absent. It is the responsibility of the instructor to make every reasonable effort to honor the student request without penalty, and of the student to make up the work missed. See University Policy S14-7 at http://www.sjsu.edu/senate/docs/S14-7.pdf.

**Student Technology Resources**

Computer labs for student use are available in the Academic Success Center at http://www.sjsu.edu/at/asc/ located on the 1st floor of Clark Hall and in the Associated Students Lab on the 2nd floor of the Student Union. Additional computer labs may be available in your department/college. Computers are also available in the Martin Luther King Library. A wide variety of audio-visual equipment is available for student checkout from Media Services located in IRC 112. These items include DV and HD digital camcorders; digital still cameras; video, slide and overhead projectors; DVD, CD, and audiotape players; sound systems, wireless microphones, projection screens and monitors.

**SJSU Peer Connections**

Peer Connections, a campus-wide resource for mentoring and tutoring, strives to inspire students to develop their potential as independent learners while they learn to successfully navigate through their university experience. You are encouraged to take advantage of their services which include course-content based tutoring, enhanced study and time management skills, more effective critical thinking strategies, decision making and problem-solving abilities, and campus resource referrals.
In addition to offering small group, individual, and drop-in tutoring for a number of undergraduate courses, consultation with mentors is available on a drop-in or by appointment basis. Workshops are offered on a wide variety of topics including preparing for the Writing Skills Test (WST), improving your learning and memory, alleviating procrastination, surviving your first semester at SJSU, and other related topics. A computer lab and study space are also available for student use in Room 600 of Student Services Center (SSC).

Peer Connections is located in three locations: SSC, Room 600 (10th Street Garage on the corner of 10th and San Fernando Street), at the 1st floor entrance of Clark Hall, and in the Living Learning Center (LLC) in Campus Village Housing Building B. Visit Peer Connections website at http://peerconnections.sjsu.edu for more information.

**SJSU Writing Center**

The SJSU Writing Center is located in Clark Hall, Suite 126. All Writing Specialists have gone through a rigorous hiring process, and they are well trained to assist all students at all levels within all disciplines to become better writers. In addition to one-on-one tutoring services, the Writing Center also offers workshops every semester on a variety of writing topics. To make an appointment or to refer to the numerous online resources offered through the Writing Center, visit the Writing Center website at http://www.sjsu.edu/writingcenter. For additional resources and updated information, follow the Writing Center on Twitter and become a fan of the SJSU Writing Center on Facebook. (Note: You need to have a QR Reader to scan this code.)

**SJSU Counseling Services**

The SJSU Counseling Services is located on the corner of 7th Street and San Fernando Street, in Room 201, Administration Building. Professional psychologists, social workers, and counselors are available to provide consultations on issues of student mental health, campus climate or psychological and academic issues on an individual, couple, or group basis. To schedule an appointment or learn more information, visit Counseling Services website at http://www.sjsu.edu/counseling.

**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.
# Tentative Class/Lab Schedule

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to real-time DSP</td>
<td>Introduction to the Texas Instrument DSP family</td>
</tr>
<tr>
<td>2.</td>
<td>Sampling and reconstruction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Choosing sampling rate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Starting winDSK</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Talk-Thru Applications</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Matlab demonstration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Implementation in C</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>FIR filter design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Comparison FIR vs. IIR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calculating output of the filter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>winDSK demo</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Matlab demo and C implementation</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>IIR filter design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Filter design and analysis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSK Implementation in C</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Periodic signal generation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Signal generation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSK implementation in C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Table lookup techniques</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Frame based dsp</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Matlab implementation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>winDSK implementation in C</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Final Exam (Friday, December 16 12:15-14:30)</td>
<td></td>
</tr>
</tbody>
</table>