

San José State University
School of Engineering, Electrical Engineering Department
EE138, Embedded Control System Design, Fall 2018

Course and Contact Information

Instructor:	Christopher Pham
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Office Hours:	Tuesday & Thursday before class/lab hours or upon arrangement
Class Days/Time:	Tuesday & Thursday, 6:00-7:15PM
Classroom:	Clark Building 234
Lab:	ENG 244
Prerequisites:	EE 112, EE 120

MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on Canvas Learning Management System course login website at <http://sjsu.instructure.com>. You are responsible for regularly checking with the messaging system through MySJSU at <http://my.sjsu.edu> to learn of any updates. Students are responsible for updating your email address with SJSU system in order to receive my messages timely.

Course Description

Embedded system design challenge and metrics. Processor and IC technologies. Software and hardware architectures for embedded system design. Design flow and tools. The design of standard peripherals, microcontrollers, single-purpose and general-purpose processors. Basic concepts of interfacing and communication protocols in embedded systems

Course Learning Outcomes (CLO)

Upon successful completion of this course, students should be able to design a microcontroller system to meet the requirements, specifically,

- CLO 1. Understand the basic concept of processor and peripherals such as general purpose IO, ADC, DAC, timers, interrupt controller, serial interface controller
- CLO 2. Develop the overall software structure of the system using state machine
- CLO 3. Implement simple digital filters and PID controllers for a motion control system
- CLO 4: Design simple analog interface circuits
- CLO 5. Implement serial communication.
- CLO 6. Real-time operating system.

Required Texts/Readings

Textbook: Data sheets and Application Notes (to be provided in lecture notes), Software Tools, Atmel Studio 7 or latest

Other Readings: Lecture and lab handouts

Course Requirements and Assignments

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. Other course structures will have equivalent workload expectations as described in the syllabus.

Examinations, Final Examination and Lab Evaluation

There will be two midterms and one final exam. The midterm dates will be announced at least 1 week before the exam. The final exam will be given at the official university final exam time for this course. Seven laboratory projects will be assigned. The projects will be performed by teams of two students. The report grades will be based on a written report and a lab demonstration.

Each group is expected to do their individual work for this course. Students who turn in identical report, and/or source code will be considered to have copied. **Two hundred percent** (-200%) of the maximum possible grade will be deducted for each instance of cheating on laboratory assignments. Copying of material from the Web for laboratory reports and source code will be considered to be cheating. Illegal copying or cheating on an exam or on the laboratory assignments will result in a zero for that exam or for the project. All the provisions of the code of student conduct apply to this course as appropriate.

Grading Information

Lab projects	42%
In-class quizzes (subject to change)	3%
Midterm exam 1, and 2	15% each
Final exam	25%

See section about **Determination of Grades** for more information.

University Policies

Determination of Grades

Letter grade will be assigned based on the distribution curves for final raw score.

97% and above	A+
94% - 96%	A
90% - 93%	A-
87% - 89%	B+
83% - 86%	B
80% - 82%	B-
77% - 79%	C+
73% - 76%	C

70% - 72%	C-
67% - 69%	D+
63% - 66%	D
60% - 62%	D-
Below 59%	F

- No late or missed work will be accepted.

Classroom Protocol

As a graduating elective course, this class resembles the enterprise level working environment. Ethics and professionalism in the workplace will be enforced.

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be 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/>"

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](http://www.sjsu.edu/senate/docs/S90-5.pdf) 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](http://info.sjsu.edu/home/catalog.html), at <http://info.sjsu.edu/home/catalog.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 calendar web page located at <http://www.sjsu.edu/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), <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 in the syllabus:

- “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.”
 - 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/policies/pol_plagarism_acad_integrity/index.html, 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/>

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.

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.

EE138, Embedded Control System Design, Fall 2018, Course Schedule

EE138 is an introductory course on microcontroller based control system design. Atmel SAM D20 ARM will be introduced and used in the course projects throughout this course. The course will be based on supporting the following lab projects.

Course Schedule (tentative)

Schedule is subject to change with fair notice by email and class announcement

Week	Date	Topics, Readings, Assignments, Deadlines
1-3		<p>(1) General Purpose Input/output (week 1~3) <u>Concepts:</u> SAM D20 overview, port definition and configuration, electrical characteristics of the I/O pins, LED driver circuit consideration, Input voltage level consideration, software de-bouncing state machine, BCD/binary conversion, 7-segment decoding. <u>Project:</u> Design a simple calculator (integer only, floating point optional) using the 7-segment display and the keypad.</p>
4-5		<p>(2) Analog interface (week 4~5) <u>Concepts:</u> Generic clock configuration, analog peripheral definition and configuration, conversion time, polling, analog input voltage scaling using operational amplifiers, unit-polar and bi-polar input consideration. <u>Project:</u> Design a voltage-meter using the 7-segment display routine developed in (1). Use DAC to produce a sinusoidal waveform and some musical notes.</p>
6-7		<p>(3) Timers and Pulse-Width-Modulation (week 6-7) <u>Concepts:</u> Timer configuration. PWM based DAC. Motor drive circuit and H-bridge. <u>Project:</u> An open-loop motor speed controller using the POT and the keyboard as speed command input.</p>
7-8		EXAM 1
8		<p>(4) Interrupts and Digital Filter (week 8) <u>Concepts:</u> Interrupt concept, NVIC, EIC, timer based interrupt, digital filter, sampling, aliasing effect, anti-aliasing filter <u>Project:</u> Implement and evaluate two digital filters</p>
9-11		<p>(5) Motor speed and position control (week 9-11) <u>Concepts:</u> state-machine, interrupt based real-time control system. PID controller. <u>Project:</u> Develop a motor control system. The position or speed of the motor can be entered via the keypad or the POT and their real-time values should be displayed on the 7-segment display. Motor position is sensed by an optical encoder. A PID controller is used for controlling the speed and position.</p>
11-12		EXAM 2

Week	Date	Topics, Readings, Assignments, Deadlines
12-13		<p>(6) Serial communications (week 12-13)</p> <p><u>Concepts</u>: Serial interface protocols: RS-232 (tentative), SPI, I2C.</p> <p><u>Projects</u>: Interface with a EEPROM using SPI, interface with an DAC using I2C, and design a RS232 terminal emulation program using the keyboard and 7-segment display (tentative).</p>
14		<p>(7) Real-time Operating System (week 14)</p> <p><u>Concepts</u>: Real-time OS</p> <p><u>Projects</u>: Interface and program the SAMD20 in an RTOS environment.</p>
15		Review
Final Exam	Thursday, December 13, 2018	<p>Venue: Clark Building 234</p> <p>Date: Thursday, December 13, 2018</p> <p>Time: 1715-1930</p>