San José State University

College of Engineering/Electrical Engineering Department
EE 30: Introduction to Programming Microcontroller for Electrical Engineering, Sections 01 (Lecture), 02 & 03 (Labs), Fall 2021

Updated on 8/17/2021
Refer to Canvas for the current version

Course and Contact Information

Lecture Instructor:	Chao-Li Tarng, Ph.D.
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Office Hours:	Tuesday 3:00 pm – 4:00 pm,
Lab Instructor:	Bhawandeep Singh Harsh
Office Location:	ENG 351
Email:	bhawandeepsingh.harsh@sjsu.edu
Office Hours:	Tuesday, 5:15 pm – 5:45 pm
Class Days/Time:	Tuesday and Thursday, 12:30 pm – 1:20 pm
Lab Days/Time:	Tuesday or Wednesday, 5:45 pm – 8:30 pm
Classroom/Lab:	**Lecture - Online, Lab - ENG 307**
Prerequisites:	Allowed Declared Majors: Electrical Engineering

Course Format

The EE30 is a hybrid class, combining both lectures and laboratory work. Students taking EE30 are required to register for one lecture section and one laboratory section. The lectures (section 01) are offered online using the Zoom meetings. There are no in-person meetings for the lectures. However, the lab sections (section 02/03) are offered as in-person meetings. Computers and microcontroller-based development kit for the lab are provided to students. Students are encouraged to install a suitable C/C++ IDE (integrated development environment) on their own personal machines for practice. Code Composer Studio from Texas Instrument used for the course is also available free from the Texas Instrument website.

The lecture section comprises introduction to algorithm development and programming in C/C++, covering topics like data types, operations, console and file I/O, conditional constructs, loops, arrays, pointers, strings, and bit-wise operations. Embedded concepts of programmer's model, special function registers and GPIO programming are covered.

The laboratory section includes C/C++ programming on Windows PC and embedded platforms covering lecture topics. The lab uses program development tools for PC and microcontroller-based computer systems. Design, development, debugging, testing and documentation, using the C/C++ programming language are covered.

Due to COVID-19 pandemic: Lectures, including quizzes, and exams will be conducted online using Zoom and Canvas. Students are required to have a personal computer and install the necessary software such as the Respondus LockDown Browser in order to take the online quizzes and exams. The personal computer must be equipped with a webcam so that students can be proctored during exam using the webcam.

Due to the online nature of the class, the lectures (i.e., Zoom meetings) will be recorded. The recording will be posted for students to review once available. Students must obtain permission in advance to record any course materials. Such permission allows the recordings to be used for a student's private, study purposes only. Students will not be permitted to share any class recordings with someone who isn't enrolled in the class or without permission. The recordings are protected by instructor's copyright.

Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on the course shell available from the eLearning platform Canvas Learning Management System course login website at http://sjsu.instructure.com. You are responsible for regularly checking with the messaging system through MySJSU on Spartan App Portal http://one.sjsu.edu (or other communication system as indicated by the instructor) to learn of any updates.

Course Goals

Introduction to programming in C for both PC and embedded platforms and the concepts of microprocessor, microcontroller, programmer's model.

Course Learning Outcomes (CLO)

Course Learning Outcomes are based on the following ABET Student Outcomes.

Upon successful completion of the course, students must be able to:

1. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
3. acquire and apply new knowledge as needed, using appropriate learning strategies.

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

1. Develop algorithms for programming problems
2. Program in C/C++ using the different features of C/C++ like loops, pointers, structures etc. as well as different features of software development like breakpoints and watch windows etc. to solve variety of programming problems in Electrical Engineering
3. Understand the difference between microprocessor and microcontroller and between PC and Embedded systems organization and development environments and use them appropriately.
4. Understand the concepts of peripherals, programmer's model and Special Function Registers and employ these concepts to program GPIO modules in ARM Cortex M4.

5. Use industry standard IDEs for both PC and embedded systems programming (using Microsoft Visual Studio for PC and Texas Instruments Code Composer Studio for Embedded Systems).

Required Texts/Readings

There is no single textbook that covers the basics of C/C++ for both PC and embedded targets. Hence, there is no single course textbook. Students may follow any introductory C books of their liking and/or any of the books on embedded programming from the ones mentioned below. Necessary notes will be provided.

Recommended books for C/C++

- Gary Bronson, *C for Engineers and Scientists, An Introduction to Programming with ANSI C*, Thomson Learning (now Cengage), ISBN-10:0314008160, ISBN-13:9780314008169
    - Amazon: https://www.amazon.com/Engineers-Scientists-Introduction-Programming-ANSI/dp/0314008160/ref=sr_1_2?keywords=gary+bronson+c+for+engineers&qid=1579730177&sr=8-2
- [C++] Juan Soulié, *C++ Language Tutorial*, 2007
    - Free Download: http://www.cplusplus.com/files/tutorial.pdf

Recommended books for embedded systems programming with MSP432

- Mazidi, Chen, Naimi, and Salmanzadeh, *TI MSP432 ARM Programming for Embedded Systems*, (Uses Keil IDE)
- Jonathan Valvano, *Real Time Interfacing to the MSP432 Microcontroller*, (Uses TI CCS)

Other Technology Requirements/Equipment/Material

Students will be provided the computers and microcontroller-based development kit for the lab. Students can install any suitable C/C++ IDE (integrated development environment) on their own personal machines for practice. Code Composer Studio from Texas Instrument used for the course is also available free from the Texas Instrument website.

Course Requirements and Assignments

Each week's lab report will be due at the "end" of the following week's lab. Late lab reports will not be accepted.

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

Final Examination and Evaluation

There will be one final exam for the lecture section and one final exam for the laboratory section. There will be two midterms for the lecture and one for the laboratory section, respectively. The class is allowed to choose (one decision for all sections) between having either a midterm + final exam or a term project for the Laboratory section.

Lecture midterm and final exam are individual exams.

Laboratory exams may be in groups. In which case, each member of the group will be expected to be able to explain the work and answer relevant questions individually and independently. Consequently, a portion of marks will be for the output of teamwork; while a portion of marks will be for individual performance.

One letter-size cheat-sheet (both sides) is allowed for both midterms and final exams.

No make-up exams will be given.

Your final grade will be assessed based on the following components:

Homework assignments and quizzes	**Collaboration allowed** for homework*	15%
Labs	**Collaboration allowed***	25%
Lecture midterm exam 1	Individual exam	10%
Lecture midterm exam 2	Individual exam	10%
Comprehensive Lab Assessment 1	Individual exam	10%
Lecture final exam	Individual exam	15%
Comprehensive Lab Assessment 2	Individual exam	15%

*Note: Collaboration means discussions only. Assignments and labs must be worked on and submitted independently. Sharing or copying solutions are not allowed and will be considered plagiarism.

The instructors reserve the right to change the percentages.

There are no options for extra credits.

Grading Information

Grade	*Points*	*Percentage*
A plus	*960 to 1000*	*96 to 100%*
A	*900 to 959*	*90 to 95%*
A minus	*850 to 899*	*85 to 89%*
B plus	*800 to 849*	*80 to 84 %*
B	*750 to 799*	*75 to 79%*
B minus	*700 to 749*	*70 to 74%*
C plus	*650 to 699*	*65 to 69%*
C	*600 to 649*	*60 to 64%*
C minus	*550 to 599*	*55 to 59%*
D plus	*500 to 549*	*50 to 54%*
D	*450 to 499*	*45 to 49%*
D minus	*400 to 449*	*40 to 44%*
F	*000 to 399*	*0% to 39%*

- **No late assignments will be accepted.** An extension will be granted only if a student has serious and compelling reasons that can be proven by an independent authority (e.g. doctor's note if the student has been sick).
- **The exam dates are final.**

Classroom Protocol

- Students are encouraged to ask questions in the class.
- Each student is required to engage in classroom activities, submit assignments and reports on time, *and* take exams and tests on time.
- Web-browsing and online chatting in class are not allowed. Cell phones are to be turned off during lectures, labs, and tests. During exams if you receive a cell phone call or page it will be assumed that you have completed your exam and no further work will be allowed.
- No make-up exams will be held.
- Exams will be close book. **One letter-size cheatsheet will be allowed on each exam**.
- Students are encouraged to use Canvas for communications. While it is preferred to ask technical doubts in class, for all non-technical questions – like syllabus portion, exam format etc. it is good not to ask in person but over Canvas since that allows the instructors to make a Canvas announcement regarding the subject.
- Student causing disruption in the class will be asked to leave the class

Zoom Classroom Etiquette

- **Mute Your Microphone:** To help keep background noise to a minimum, make sure you mute your microphone when you are not speaking.
- **Be Mindful of Background Noise and Distractions:** Find a quiet place to "attend" class, to the greatest extent possible.
    - Avoid video setups where people may be walking behind you, people talking/making noise, etc.
    - Avoid activities that could create additional noise, such as shuffling papers, listening to music in the background, etc.
- **Position Your Camera Properly:** Be sure your webcam is in a stable position and focused at eye level.
- **Limit Your Distractions/Avoid Multitasking:** You can make it easier to focus on the meeting by turning off notifications, closing or minimizing running apps, and putting your smartphone away (unless you are using it to access Zoom).
- **Use Appropriate Virtual Backgrounds:** If using a virtual background, it should be appropriate and professional and should NOT suggest or include content that is objectively offensive or demeaning.

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 at http://www.sjsu.edu/gup/syllabusinfo/". Make sure to visit this page, review and be familiar with these university policies and resources.

Peer Connections

Peer Connections is your online, campus-wide resource for mentoring (time management, note taking, study skills, getting involved, etc.), tutoring (undergraduate writing, lower division Math, Science, History, Humanities, etc.), supplemental instruction (review and study sessions for select courses), and learning assistants in classes across campus. Make appointments to meet with a tutor or mentor by visiting Spartan Connect. (Links to an external site.)For more information on services, online workshops, and a step-by-step guide to making an appointment, please visit the website at https://peerconnections.sjsu.edu/ (Links to an external site.).

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.

EE30, Introduction to Programming Microcontroller for Electrical Engineering, Fall 2021
Course Schedule

The schedule is subject to change with a one-week notice.

Week	Date	Work	Topics	Readings
1	Thurs Aug 19	Lecture	Introduction to EE30. Introduction to C/C++. Programming concepts, Why C for Electrical Engineering, C/C++ syntax	Ch. 1
	Thurs Aug 19	Lab	No labs. Labs begin the following Tuesday	
2	Tues, Thurs Aug 24, 26	Lecture	Number systems in programming, C/C++ user I/O (input/output)	Ch. 1
	Tues, Wed Aug 24, 25	Lab	Lab 1 - Introduction to C and Visual Studio	
3	Tues, Thurs Aug 31, Sep 2	Lecture	Data types, keywords and arithmetic operations	Ch. 2
	Tues, Wed Aug 31, Sep 1	Lab	Lab 2 - Data types, I/O and operators	**Deadline for class decision b/w term project or midterm and final exams for lab section**
4	Tues, Thurs Sep 7, 9	Lecture	Bit Operations - and, or, complement, shift	Ch. 13
	Tues, Wed Sep 7, 8	Lab	Lab 3 - bitwise operators and low level programming	
5	Tues, Thurs Sep 14, 16	Lecture	Selection (conditional) - relational expressions, if-else, switch	Ch. 4
	Tues, Wed Sep 14, 15	Lab	Lab 4 - conditional constructs	**If the project option is selected, then deadline to submit teams. You will also benefit from having decided on a project topic, which you are allowed to change later, if need be.**
6	Tues, Thurs Sep 21, 23	Lecture	Repetition (loops) - while, do-while, for, nesting of loops **Lecture midterm 1 (Sep 23, Thurs)**	Ch. 5
	Tues, Wed Sep 21, 22	Lab	Lab 5 - Looping constructs	

7	Tues, Thurs Sep 28, 30	Lecture	Functions, introduction to the concept of scope, lifetime, visibility, passing by and returning a value or reference	Ch. 7
	Tues, Wed Sep 28, 29	Lab	Lab 6 - Functions and recursion	
8	Tues, Thurs Oct 5, 7	Lecture	Arrays, sorting	Ch. 6
	Tues, Wed Oct 5, 6	Lab	Lab 7 - Arrays, functions and sorting	**If the project option is selected, then the deadline for submission of project topic and project plan. You may change project topic after this and as many times as you need, but you are responsible for choosing a topic that you can start and finish in time, there CAN/WILL be NO extension for final demonstration.**
9	Tues, Thurs Oct 12, 14	Lecture	Data files - create, open, read, write, text and binary files	Ch. 8
	Tues, Wed Oct 12, 13	Lab	Lab repetition and practice	
10	Tues, Thurs Oct 19, 22	Lecture	Struct, union, enum, typedef	Ch. 12, Ch. 14.2
	Tues, Wed Oct 19, 20	Lab	**Lab mid-term**	**Only if class chooses exams, otherwise (if project is chosen) Lab 8 will be done so more portion is covered sooner helping class in doing the project.**
11	Tues, Thurs Oct 26, 28	Lecture	Pointers, memory management **Lecture midterm 2 (Oct 28, Thurs)**	Ch. 10
	Tues, Wed Oct 26, 27	Lab	Lab 8 - File I/O	
12	Tues, Thurs Nov 2, 4	Lecture	Pointers, memory management	Ch. 10
	Tues, Wed Nov 2, 3	Lab	Lab 9 - Character strings and structures	
13	Tues, Thurs Nov 9, 11	Lecture	Character strings	Ch. 11

	Tues, Wed Nov 9, 10	Lab	Introduction to Code Composer Studio - TI Module 1 of RSLK learning course - up to 1.4.6	
14	Tues, Thurs Nov 16, 18	Lecture	Introduction to embedded systems, microcontroller vs microprocessor, platform dependence and concepts of ram size, code size, polling and interrupt, interrupt response latency, execution time.	Notes
	Tues, Wed Nov 16, 17	Lab	MSP432 GPIO programming in C - TI Module 1 of RSLK learning - from 1.4.7 to the end	
15	Tues, Thurs Nov 23, 25	Lecture	*Thanksgiving Holiday - no class*	
	Tues, Wed Nov 23, 24	Lab	*Thanksgiving Holiday - no class*	
16	Tues, Thurs Nov 30, Dec 2	Lecture	Embedded C/C++, why C/C++ for embedded? Superloop architecture, concept of CPU, programmer's model, memory, I/O, interrupts, Cortex M4 features	Notes
	Tues, Wed Nov 30, Dec 1	Lab	**Lab Final Exam**	**If the project option is selected, then project demonstrations.**
17	**Thur Dec 8**	**Final Exam**	**Final Exam: Wednesday 12/8/2021, 12:15pm - 2:30pm**	