

San Francisco State University
School of Engineering

ENGR 498: Advanced Design with Microcontrollers

Bulletin Description:

ENGR 498: Advanced Design with Microcontrollers (Classwork, 3 units; Laboratory, 1 unit)

- Advanced microcontroller architecture
- C language programming
- System bus and interfacing with memory and I/O devices
- Advanced serial interfaces
- Direct memory access
- Pulse width modulation
- Memory and power management
- Introduction to real-time operating systems

Prerequisites:

ENGR 478 with a grade of C- or better

Specific Learning Outcomes:

Students completing the course successfully will demonstrate

- an in-depth knowledge of the ARM Cortex M4 microcontroller
- an ability to interface microcontroller with other devices through a variety of serial and parallel interfaces
- an ability to use direct memory access and pulse width modulation modules
- an understanding of concepts of real-time operating systems
- an ability to apply memory and power management strategies to embedded system design
- an ability to design microcontroller-based real-time embedded systems using embedded C language
- an ability to use development and measurement tools and equipment
- an ability to work collaboratively in a group

Instructor:

Instructor: Xiaorong Zhang, Ph.D.

Office: SCI 213D

Office Hours: TBD

E-mail: xrzhang@sfsu.edu

Course Website: <https://ilearn.sfsu.edu>

(All lecture slides, supplementary materials, and assignments will be posted on iLearn.)

Required Course Material

Each student needs to buy a

Tiva C Series TM4C123G LaunchPad Evaluation Kit (EK-TM4C123GXL) (\$12.99)

<http://www.ti.com/ww/en/launchpad/launchpads-connected-ek-tm4c123gxl.html#tabs>

The launchpads can be purchased from:

TI eStore, element14, Digi-Key, Mouser, Newark, Arrow

Reference Materials:

1. Tiva TM4C123GH6PM Microcontroller Data Sheet.
2. Getting Started with the Tiva TM4C123G LaunchPad Workshop Student Guide and Lab Manual
3. TivaWare Peripheral Driver Library User's Guide
4. Tiva C Series TM4C123G LaunchPad Evaluation Board User's Guide.
5. Cortex-M4 Technical Reference Manual.
6. Cortex-M4 Devices Generic User Guide.
7. Cortex-M3/M4F Instruction Set Technical User's Manual.
8. Jonathan W. Valvano, "Introduction to ARM Cortex-M Microcontrollers (fifth edition)," 2014. ISBN: 978-1477508992.
9. Jonathan W. Valvano, "Real-Time Interfacing to ARM Cortex-M Microcontrollers (fifth edition)," 2016. ISBN: 978-1463590154.
10. Jonathan W. Valvano, "Real-Time Operating Systems for ARM Cortex-M Microcontrollers (fifth edition)," 2017. ISBN: 978-1466468863.

(Other readings will be posted on the course website)

Topics

- ARM Cortex-M4 architecture
- Serial interfaces such as UART, SSI, I²C, CAN, and USB
- Direct memory access
- Pulse width modulation
- Memory and power management
- Microcontroller-based real-time embedded systems design
- Introduction to real-time operating systems

Grading Policy:

Grades will be based on total points earned through the following activities:

Midterm Exam	15%
Final Exam	30%
Labs	20%
Project	25%
Homework	10%
Attendance	5%
Total	105%

Grade assignment:

A from 100 to 94	A- from 93 to 89		
B+ from 88 to 84	B from 83 to 80	B- from 79 to 75	
C+ from 74 to 70	C from 69 to 65	C- from 64 to 60	
D+ from 59 to 55	D from 54 to 50	D- from 49 to 45	F below 45

Notes on grading:

- Generally, there will be **no make-up exam and no incomplete** grades given. If you miss an exam, you must notify the instructor before the exam or, if physically impossible, soon after. If you have an acceptable, documented excuse, you may be given a make-up exam. If you do not have an acceptable reason for missing the exam, you will receive zero points for the exam.
- The due date of homework assignments/lab reports will be specified in the homework/lab handouts. ZERO point will be given to late submission without justified excuses. Though you can collaborate during homework assignments and labs, **direct copying of solutions, in part or in whole, is not permitted.**
- The labs and the project are to be done in student groups of no more than 3. You will be evaluated as a group as well as individually.
- **Attendance is mandatory.** Students missing six lectures or more need to withdraw from the class. You must come to class if you plan to pass the course. The information covered in class is essential for you to complete homework assignments and labs, as well as prepare for exams and quizzes. Students late for over 10 minutes will be considered “absent” from that class.

Group Work

The students are required to form groups to complete all the labs and the term project.

- Group size: 2 or 3
- Group members must share work equally and each member must know all work done by the group.
- You may not be able to complete all the work during lab time so choose partners who you can work together for a few hours a week on labs and projects.
- Every student needs to get a TI TM4C123 LaunchPad.

Policies on Plagiarism

Plagiarism is defined as using someone else’s ideas or work as one’s own without giving proper credit to the source. The source include public (books, journals, magazines, newspapers, internet, etc.) as well as private (unpublished reports, internal documents, personal work, etc.) materials. The instructor will not accept excuses such as “I forgot to give credit to ...,” “It’s an oversight,” or “It’s a clerical error.”

Students are solely responsible for materials submitted for the course so “My roommate must have done that without my knowledge” is not an acceptable excuse either. That is, no excuses will be accepted if plagiarism is discovered. If a submitted work is found to contain plagiarized material, the work will receive zero credit and the student may be reported to the Student Judiciary Affairs for disciplinary actions. Cheating on tests will also be reported to the Student Judiciary Affairs. Disciplinary actions may include disqualification from the university.

Disability Policy Statement

Students with disabilities who need reasonable accommodations are encouraged to contact the instructor. The Disability Programs and Resource Center (DPRC) is available to facilitate the reasonable accommodations process. The DPRC is located in the Student Service Building and can be reached by telephone (voice/TTY 415-338-2472) or by email (dprc@sfsu.edu).

(<http://www.sfsu.edu/~dprc>)

Student disclosures of sexual violence

SF State fosters a campus free of sexual violence including sexual harassment, domestic violence, dating violence, stalking, and/or any form of sex or gender discrimination. If you disclose a personal experience as an SF State student, the course instructor is required to notify the **Dean of Students**. To disclose any such violence confidentially, contact:

The SAFE Place - (415) 338-2208; http://www.sfsu.edu/~safe_plc/

Counseling and Psychological Services Center - (415) 338-2208; <http://psyservs.sfsu.edu/>

For more information on your rights and available resources: <http://titleix.sfsu.edu>

Policy on observance of religious holidays

If a student wishes to observe religious holidays and such observances require the student to be absent from class activities, it is the responsibility of the student to inform the instructor, in writing, about such holidays during the first two weeks of the class each semester. If such holidays occur during the first two weeks of the semester, the student must notify the instructor, in writing, at least three days before the date that he/she will be absent. Please check <http://www.interfaithcalendar.org/> for world religious days.