CSE4342 Embedded Systems II
CSE5342 Embedded Systems
Fall 2020

Instructor Information

Instructor:
Jason Losh, Ph.D.

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ERB 649

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Faculty Profile:
https://mentis.uta.edu/explore/profile/jason-losh

Office Hours:
E-mail and virtual Q&A sessions in Teams.

Grader:
Raj Ramesh Sawant (rajramesh.sawant@mavs.uta.edu). See the lab and grader e-mail sent earlier for the times and lab rooms.

Course Information

Section Information:
001

Time and Place of Class Meetings:

Lectures:	Videos will be recorded on campus in Echo360 and available in Canvas on demand. Live sessions will be held in Teams for office hours and interactive help sessions.
Tests:	On campus, TTh 3:30-4:50pm, Rooms ERB 124 and 125
Laboratory:	Labs in ERB 124, 125, 126, and 127 can be used for soldering, construction, and testing of your project. Lab access is limited to times when labs for other courses are not meeting and lab utilization is less than 20%.

Description of Course Content:
Advanced Admitted into an Engineering Professional Program. C or better in each of the following: CSE 3323, CSE 3442, and CSE 3313. course in design of microcontroller-based systems. Emphasis is on the application of microcontrollers to real-time problems. Topics include the study of the differences in bare metal and embedded Linux implementations, developing applications including PID controllers, and system aspects such as bootloader design and watchdog supervision.

Prerequisites: Admitted into an Engineering Professional Program and a grade of C or better in each of the following: CSE 3323, CSE 3442, and CSE 3313.

Student Learning Outcomes:
Upon successful completion of this course, students will have knowledge of:

- Proficiency in C programming
- Microcontroller peripherals including timers, PWM, interrupts, GPIO ports, and ADCs
- Robust controller code basics, including watchdog timers, alternatives to recursion
- Determining microcontroller memory, speed, and capabilities to solve a task
- Interfacing with SPI, I2C, and serial buses
- Measurement and instrumentation applications
- Digital filtering applications
- PID controller real-time control application
- Bootloader theory and application (PC code, M4F code)
- Linux device driver introduction, usage, and development
- Comparison of I/O performance (speed and latency) with bare-metal and Linux solutions

Class Web Page:
Additional files will be provided as needed on the course web site at http://ranger.uta.edu/~jlosh/.

Communication:
All class-wide communication by the instructor, including distribution of homework sets, will occur via the class listserv. Please sign up for the CSE4342-L listserv by sending an e-mail from your UTA e-mail account to listserv@listserv.uta.edu from your UTA e-mail account (no subject line needed) and the command SUBSCRIBE CSE4342-L as the message body. You will then receive an e-mail from the listserv server to which you must acknowledge to join the listserv with "OK" in an e-mail. You must sign up to this listserv between the first and third day of class (it is part of your class grade).

Canvas will only be used for Echo360 access.

Textbooks and Other Course Materials:
No textbook will be required for this course. Extensive references, datasheets, application notes, and class notes will be provided on the course web site.

All students are required to have a Raspberry Pi 3 (with appropriate accessories to power it and make it work) for both CSE2100 and some CSE2312 sections.
The CanaKit Raspberry Pi 3 kit has been used by many students in the past and is recommended: https://www.amazon.com/CanaKitRaspberry-Complete-Starter-Kit/dp/B01C6Q2GSY/.
Students do not need to buy the above kit, however they need to at least have a Raspberry Pi 3 motherboard, power supply, and 16GB or larger (32GB is better) and reader for your PC.
In addition, students will need the following components at home to work with the Raspberry Pi 3 natively:

- USB keyboard and mouse
- Monitor accepting HDMI or DVI and a proper HDMI to DVI cable

Alternatively, instead of using an monitor, SFTP and SSH access from a PC is possible with an Ethernet cable after configuration.

All students are also required to have a TM4C123GXL evaluation kit. Information on this board is available at http://www.ti.com/tool/EK-TM4C123GXL. You will also need a prototyping board with donut rings for soldering your project. These are available in the IEEE office in NH for $2 or from other sources.

Major Assignments and Examinations:
Test 1: Thursday, October 8
Test 2: Tuesday, November 24
Project: Tuesday, December 8

Technology Requirements:
Students will need a computer capable of accessing Canvas and watching the Echo360 lectures. The computer and OS must be capable of running appropriate cross-compiler tools for programming the microcontroller.

Grading Information

Grading:

- Grade scale: A (90-100), B (80-89), C (70-79), D (60-69), and F (0-59)
- Grade calculation: Join class listserv between 1st and 3rd day of class (5%), Test 1 (30%), Test 2 (30%), Project (35%)
- The instructor reserves the right to make reasonable changes in performance evaluation as needed.
- Any request for re-grading must be submitted to the Grader within one week of the completion of grading. If, after requesting a re-grade from the Grader and getting a response, you may refer the case to the instructor iif you think further action is needed.

Tests:

- Tests are open-book, open-notes, calculators allowed.
- No makeup will be provided for any test missed. Generally, you can request an incomplete in the course and makeup the missed test in the following semester.

Project:

- The project will consist of hardware construction and firmware development and it is expected that it will take approximately 70 hours to complete.
- Projects are individual assignments. Discussing project topics is allowed, but the submissions must be unique. Sharing of code is not allowed.
- An interim deadline for hardware construction will apply.

Course Schedule

- Review of M4F Architectural Basics (3 hrs)
- Review of GPIO, UART, and SPI (1.5 hrs)
- I2C theory and application (1.5 hrs)
- Interrupt vectors and power-on initialization (1 hr)
- M4F Bootloader development and PC-side app (3 hrs)
- RTC operation (1.5 hrs)
- Watchdog theory and application (1.5 hrs)
- Exam 1 (1.5 hrs)
- QE theory and application (1.5 hrs)
- Signal conditioning theory and applications (3 hrs)
- Signal processing and DSP theory and applications (4.5 hrs)
- PID controller theory and application (3 hrs)
- Linux device driver background (1.5 hrs)
- Linux device drivers for GPIO, SPI, I2C peripheral (4.5 hrs)
- I/O performance (speed and latency comparison of bare-metal and Linux OS (3 hrs)
- Project support lecture content (7 hrs)
- Exam 2 (1.5 hrs)

The instructor reserves the right to make changes in the schedule as needed as the class progresses.

The official dates for registration, census, and dropping are available at www.uta.edu/acadcal.

Academic Integrity

This information is extracted from http://www.uta.edu/conduct/academic-integrity/index.php.

The University of Texas at Arlington strives to uphold and support standards of personal honesty and integrity for all students consistent with the goals of a community of scholars and students seeking knowledge and responsibility. Furthermore, it is the policy of the University to enforce these standards through fair and objective procedures governing instances of alleged dishonesty, cheating, and other academic/non-academic misconduct.

Scholastic dishonesty includes, but is not limited to, cheating, plagiarism, and collusion on an examination or an assignment being offered for credit. Each student is accountable for work submitted for credit, including group projects.

- Cheating
  - Copying another's test or assignment (added note: remember this includes homework!)
  - Communication with another during an exam or assignment (i.e. written, oral or otherwise)
  - Giving or seeking aid from another when not permitted by the instructor
  - Possessing or using unauthorized materials during the test
  - Buying, using, stealing, transporting, or soliciting a test, draft of a test, or answer key
- Plagiarism
  - Using someone else's work in your assignment without appropriate acknowledgement
  - Making slight variations in the language and then failing to give credit to the source
- Collusion
  - Without authorization, collaborating with another when preparing an assignment

Safety Rules for ERB 124, 125, 126, and 127 Labs:

Scope:

- All UTA safety rules and regulations must be followed.
- These rules are in addition to UTA lab safety rules.
- In the event that a rule contained below is in conflict with UTA lab safety rules, the UTA safety rules shall supersede.

General rules:

- Students can only be in the lab when a graduate teaching assistant (GTA), faculty member, or staff member is present.
- Students should be professional at all times in the lab.
- Food and drinks are not allowed in the lab at any time.
- When leaving the lab, all work surfaces and floors should be clear of breadboards, cables, wires, and tools prior to leaving.
- When leaving the bench, turn off all lab equipment and unplug soldering irons.
- When leaving the bench, make sure that all cables, tools, and soldering equipment are properly stored in the correct location.
- Please ensure that the lab is kept in a neat and tidy manner.
- Please pick up any loose wires or parts on the bench and floor before leaving the lab. There is a push broom and dust pan in both rooms.
- Note any hazards observed in the lab to the GTA, faculty, or staff member immediately.
- For test equipment incorporating multi-language menus, such as oscilloscopes, please return the language to English before leaving the bench.
- When returning parts that are not consumables, make certain that the parts are returned to the correct drawer. If you are not certain, please leave them with the GTA, faculty member, or staff member.

- Students should store backpacks and similar items in a way that does not create a trip hazard to others.

Personal protective equipment (PPE):
- Soldering must be performed in the labs only at the soldering benches.
- Soldering irons should be used with care, while wearing safety glasses, and only after receiving training.
- Safety glasses must be worn at all times when using the soldering irons or using cutting tools, such as diagonal cutters, in the lab.
- Face masks must be worn at all times in the lab.

Soldering irons:
- Soldering must be performed in the labs only at the soldering benches.
- Soldering irons should be used with care, while wearing safety glasses, and only after receiving training.
- When soldering and removing parts, or reworking a board, please use special care to ensure that solder is not splattered.
- Soldering irons must be placed back in their soldering station holder when not soldering to reduce the chance of injury or fire.
- Please keep the soldering station sponges wet when cleaning the iron tip but ensure that water is not spilled on the floor creating a slip hazard.
- Use the soldering iron smoke absorber fan units when soldering. Use them so that the exhaust air flow upwards.
- Some solders can contain lead, so wash hands thoroughly after using the soldering irons. No eating or drinking is allowed in the lab, as previously stated.
- No self-contained butane soldering irons are permitted.

Hand tools:
- Hand tools must be used with care and only when safety glasses are being worn.
- Diagonal cutters in particular can create tension on the wires during the cutting process, ejecting the loose wire, so please use special care.

Small powered rotary tools:
- Short use of powered cutting tools such as “Dremel” or small drill/driver can only be used at the soldering tables using a backup board to prevent damage to the tables.
- You must wear safety glasses.
- You must remove jewelry, necklaces, and lanyards and tie back long hair.
- For extended machining tasks, please use the designated Makerspace areas that are designed to handle the additional safety requirements and dust inhalation hazards instead.

Electrical hazards:
- The labs for these classes use voltages of 30V or less, but care must always be shown in using electrical circuits, regardless of the voltage.
- Do not use voltages of more than 30V unless approved in writing by the instructor.
- Do not modify the wiring or attempt repair of any lab equipment.
- Most of the lab equipment operates from 120V AC, which is a lethal voltage. Never pull on a cord to unplug it as this can cause damage to the strain relief and insulation,potentially resulting in exposed conductors.
- Please notify the GTA, faculty member, or staff member and stop using the equipment immediately if you see nicks or damage to a power cord.

Computers:
- Students should not install any software on the lab computers without approval of the GTA, faculty member, or staff member.
- Students should not remove any of the cables on the computer and the monitor on the bench.

- For external connection, an HDMI cable is provided at each workstation for configuring Raspberry Pi and similar computer hardware. This cable should not be disconnected from the monitor.

Institution Information

UTA students are encouraged to review the below institutional policies and informational sections and reach out to the specific office with any questions. To view this institutional information, please visit the Institutional Information page (http://www.uta.edu/provost/administrative-forms/course-syllabus/index.php) which includes the following policies among others:

- Drop Policy
- Disability Accommodations
- Title IX Policy
- Academic Integrity
- Student Feedback Survey
- Final Exam Schedule

Additional Information

Mandatory Face Covering Policy:
All students and instructional staff are required to wear facial coverings while they are on campus, inside buildings and classrooms. Students that fail to comply with the facial covering requirement will be asked to leave the class session. If students need masks, they may obtain them at the Central Library, the E.H. Hereford University Center's front desk or in their department. Students who refuse to wear a facial covering in class will be asked to leave the session by the instructor, and, if the student refuses to leave, they may be reported to UTA's Office of Student Conduct.

Attendance:
At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator of student success. Each faculty member is free to develop his or her own methods of evaluating students' academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section, However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients "begin attendance in a course." UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report must the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Canvas. This date is reported to the Department of Education for federal financial aid recipients.

Emergency Exit Procedures:
Should we experience an emergency event that requires evacuation of the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, do not take an elevator but use the stairwells instead. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Student Success Programs:
UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring by appointment, drop-in tutoring, etutoring, supplemental instruction, mentoring (time management, study skills, etc.), success coaching, TRIO Student Support Services, and student success workshops. For additional information, please email resources@uta.edu, or view the Maverick Resources website.

Emergency Phone Numbers

In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911. Non-emergency number 817-272-3381