# EE4311 Embedded Microcontroller Systems
# EE5314 Embedded Microcontroller Systems
## Fall 2021

## Instructor Information

**Instructor:**
Jason Losh, Ph.D.

**Office Number:**
ERB 649

**Office Telephone Number:**
+1 817-272-3785 (CSE Department)

**Email Address:**
jlosh@uta.edu

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

**Office Hours:**
Before and after class or by appointment for maximum flexibility.

**Graders:**
Gauri Jadhav, gauribharat.jadhav@mavs.uta.edu.

## Course Information

**Section Information:**
001, 10x (EE5314 only)

**Time and Place of Class Meetings:**
Lectures:     MW 5:30-6:50, WH 402 (Section 001)
Laboratory:   M 7-9:50pm (Section 101)
              W 7-9:50pm (Section 103)
              Th 7-9:50pm (Section 104)
              EE 4311 students will need to find an EE Department lab to complete the labs
              as no lab was created for this course.

**Description of Course Content:**
Hardware/software development techniques for microcontroller systems with an emphasis on hardware-software interactions, programming internal peripherals, interfacing with external sensors and devices, and real-time control applications. Prerequisite: EE 3310, EE 3314, or equivalent.

**Student Learning Outcomes:**
Upon successful completion of this course, students will have knowledge of:
- Proficiency in C programming
- Differences between Harvard and von Neuman architectures
- Differences of microcontroller and microprocessor architectures
- Comparison of standard microprocessor and digital signal processor memory bus and ALU architectures

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- Study of microcontroller peripherals including timers, PWM, interrupts, GPIO ports, and ADCs
- Determining microcontroller memory, speed, and capabilities to solve a task
- Interfacing with SPI and serial buses
- Measurement and instrumentation applications
- Digital filtering applications
- Device control: Motors, servos, relays, heavy AC and DC loads
- Real-time control applications

**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 EE5314-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 EE5314-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 at http://ranger.uta.edu/~jlosh/.

All students are required to have a TM4C123GXL evaluation kit. Information on this board is available at http://www.ti.com/tool/EK-TM4C123GXL. You can order from TI directly, mouser.com, or other parts distributors.

**Major Assignments and Examinations:**
C Quiz:        Monday, August 30
Test 1:        Monday, October 11
Test 2:        Monday, November 22
Project:       Monday, December 6

**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.

**Lab Safety Training:**
Students registered for this course must complete all required lab safety training prior to entering the lab and undertaking any activities. Once completed, Lab Safety Training is valid for the remainder of the same academic year (i.e., Fall through Summer II) and must be completed anew in subsequent years. There are no exceptions to this University policy. Failure to complete the required training will preclude participation in any lab activities, including those for which a grade is assigned. The safety website for EE is http://www.uta.edu/ee/current-students/UG-lab/safety.php. You must complete this form at this link and submit it to be able to work in the lab.

## Grading Information

**Grading:**
- Grade scale: A (90-100), B (80-89), C (70-79), D (60-69), and F (0-59)
- Grade calculation: C Quiz (10%), Test 1 (30%), Test 2 (30%), Project (30%)

- The instructor reserves the right to make reasonable changes in performance evaluation as needed.
- The instructor also reserves the right to make substantial changes in the structure of the course if the modality of the course must be changed.
- 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.

**C Quiz:**
- The quiz is on-campus
- Tests is closed-book, no notes, no calculator allowed.
- No makeup will be provided.

**Tests:**
- Tests are on-campus
- 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 80 hours to complete.
- Projects are individual assignments. Discussing project topics is allowed, but the submissions must be unique to the team. Sharing of code is not allowed.
- Interim deadlines for hardware construction and some software milestones will be announced as the class progresses.

**Labs:**
- Lab attendance is required.
- You should complete and submit each week's lab assignment by the beginning of your lab session in the following week. There is reduced credit for work submitted after this time.

## Course Schedule

- Architecture (3 hrs)
- Important C Language Details (e.g. C99 stdbool/stdint, volatile keyword) (0.5 hrs)
- Basic I/O cell design, application with port masking, bitbanding (4 hrs)
- Clocks (1 hr)
- Assembly/C mixed code, register and calling conventions (2.5 hrs)
- Pipeline operation and cycle-exact functions (1.5 hrs)
- UART theory and application (2 hrs)
- SPI bus theory and application to graphics LCD, graphics drivers (3 hrs)
- Exam 1 (1.5 hrs)
- Pulse-width modulation theory and application (1.5 hrs)
- Analog-to-digital theory (SAR) and application (2 hrs)
- Interfacing to signal conditioning and measurement techniques (3 hrs)
- Finite and infinite impulse response digital filtering, ring buffers (1.5 hrs)
- Keyboard interfacing (debouncing theory, open-drain outputs) (0.5 hr)
- Interrupt theory and application to a keyboard driver (1.5 hrs)
- Timer and CCP theory and application to frequency and time measurement (1.5 hrs)
- PID controller theory and application (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 copied 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

## 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

**Face Covering Policy:**
While the use of face coverings on campus is no longer mandatory, all students and instructional staff are strongly encouraged to wear face coverings while they are on campus. This is particularly true inside buildings and within classrooms and labs where social distancing is not possible due to limited space. If a student needs accommodations to ensure social distancing in the classroom due to being at high risk they are encouraged to work directly with the Student Access and Resource

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Center to assist in these accommodations. 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.

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.

In this course, attendance in-class, on campus is expected.

**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

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