CSE 325

Embedded Microprocessor Systems

Instructor

Dr. Ryan Meuth
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Office: BYENG 438
Office Hours:
      Mondays, 1pm-3pm, BYENG 387
      Or By Appointment - https://links.asu.edu/MeetMeuth

Course Website: Assignments, Announcements, and other course materials will be posted to Canvas via myASU. Grades will also be posted on Canvas. Make sure to check Canvas regularly.

Lectures

Mondays and Wednesdays
10:30am to 11:45am
COOR L1-74

Recitation & Demo Sessions

Online and in BYENG 387 Fridays, 10am-12pm.

Course Description

System-level programming and analysis of embedded microprocessors systems. Fundamental concepts of digital system design for embedded system applications. Prerequisites: Computer Systems Engineering BSE or Computer Science BS student; Completion of CSE 220 Programming for Computer Engineering with a C or better; Completion of CSE 230 or EEE 230 Computer Organization and Assembly Language with a C or better. Three (3) credit hours.

For this class, a hardware kit based on the FRDM-KL46Z microcontroller board is required to complete the projects. Kits will be distributed during the first week of class.

Absence and Makeup Policies: Accommodations will be made for:

- **Health Concerns** - If you anticipate not being able to attend any face to face courses due to travel restrictions or personal health concerns, you are expected to contact your professor at the beginning of the semester or as soon as your situation changes to notify them of this fact.
- Excused absences related to religious observances/practices that are in accord with ACD 304–04, "Accommodation for Religious Practices"
- Excused absences related to university sanctioned events/activities that are in accord with ACD 304–02, "Missed Classes Due to University-Sanctioned Activities"
- Excused absences related to missed class due to military line-of-duty activities that are in accord with ACD 304–11, "Missed Class Due to Military Line-of-Duty Activities," and SSM 201–18, "Accommodating Active Duty Military"

Course Objectives

- To develop an ability to analyze microprocessor-based embedded systems, memory components, and bus connections:
  - Analyze the schematic diagrams of microprocessor-based embedded systems to understand the functions and interactions of major components.
  - Explain the characteristics of memory components such as SRAM, DRAM, and flash memory.
  - Explain memory and I/O bus protocols, access arbitration, data transfer operation, and bus timing mechanisms.
  - Analyze addressing schemes for memory and I/O components in microprocessor-based embedded systems.
- To develop design skills for modular application and system software in microprocessor-based embedded systems:
  - Develop time- and event-triggered execution of software tasks for embedded applications.
  - Explain parameter passing schemes between high-level and assembly language programs, and the structure of interrupt service routines.
  - Develop efficient and well-structured programs and interrupt service routines using high-level and assembly language.
- To apply software development tools to efficiently implement and debug programs running in microprocessor systems:
  - Understand host and target development environment for microprocessor systems.
  - Use a tool chain (compiler, assembler, linker, debugger) or an IDE (integrated development environment) to develop application programs in microprocessor systems.
- To gain an ability to analyze I/O interface units and to design software for managing I/O operations:

- ○ Develop programs to manage I/O operations and to handle external events via polling and interrupts.
- ○ Develop software to control the operations of I/O units (e.g., I2C, SPI, UART, A/D converter, PWM).
- ○ Develop software for the operations of human-computer interfaces (e.g., LED's, buttons, switches, potentiometers, Wii Nunchuk).
- ○ Modify or synthesize a schematic to implement a specified addressing scheme.

ABET student outcome to be covered

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

Entrepreneurial Mindset:

This course leans heavily on the entrepreneurial mindset (https://engineeringunleashed.com/), which goes beyond the concept of traditional entrepreneurship and "start-up" mentality to provide the best possible professional preparation for any job in engineering or a career that can be built on the combination of engineering skillset and entrepreneurial mindset.

The core components of the entrepreneurial mindset are the 3C's: **Curiosity, Connections, and Creating Value**. In developing an understanding of these elements, students are expected to consider the following EM@FSE indicators in the course:

- b. Explores multiple solution paths
- c.   Gathers data to support and refute ideas
- d. Suspends initial judgement on new ideas
- e. Observes trends about the changing world with a future-focused orientation/perspective
- g. Applies technical skills/knowledge to the development of a technology/product
- i.   Focuses on understanding the value proposition of a discovery
- k.   Defines a market and market opportunities
- p. Identifies and works with individuals with complementary skill sets, expertise, etc.

Course Structure

Recitation - Lecture Preparation Activities or Project Development. This is a partially "Flipped" course - students are expected to watch topic videos and complete online activities as their Recitation period each week that will prepare them for Lecture activities.

Lectures - In place of traditional lecture presentations, lecture sessions will consist of active problem solving challenges that apply the principles learned during the recitation. Lecture activities will be graded.

Knowledge Check Quizzes - To demonstrate that you have engaged with the lecture preparation material, you must complete a knowledge check quiz. Quizzes are due at least 1 hour before the topic lecture.

Exams - There will be two Mid-Term exams to test your course knowledge.

Projects - Programming projects will be completed as individuals.

Extra Credit - points earned from extra credit apply to your overall project score.

Assessment and Grading

Exams	45%
Projects	45%
Quizzes	5%
Lecture Activities	5%

The final letter grade is decided according to the percentage points obtained as follows:

A, A+	89.6-94.5, 94.6-100%
B, B+	79.6-84.5, 84.6-89.5%
C, C+	69.6-74.5, 74.6-79.5%
D	60-69.5%
E	less than 60%

The grade of "I" (incomplete) can be given ONLY when a student, who is doing otherwise acceptable work (passing grade), is unable to complete a part of work (e.g., the final exam) because of documented illness or other conditions beyond the student's control. In the latter case, the student must discuss with the instructor and complete an application form from the department before the part of work is due or as soon as the circumstances are known. Please see ASU grading policies at:

http://students.asu.edu/grades-grading-policies

Course Requirements:

Attendance
Attendance is **REQUIRED** for all lecture sessions. Students who miss class are responsible for contacting the instructor for lecture/lab materials and homework/assignment information. If you miss more than one class or are late to class regularly, points may be deducted from your grade. An absence will not be counted against a student for excused absences (illness, death in the family, university sanctioned event, etc.) providing that the reason for the absence is documented in writing and the instructor is notified prior to the absence (if possible).

Assignments
All assignments must be turned in by 11:59pm on the date they are due. No late assignments will be accepted except for university accepted reasons (i.e. illness, death in the family, university sanctioned event). Please contact the instructor if you miss an assignment due to sickness, injury or other valid reason.

Academic Integrity

Students in this class must adhere to ASU's academic integrity policy, which can be found at https://provost.asu.edu/academic-integrity/policy). Students are responsible for reviewing this policy and understanding each of the areas in which academic dishonesty can occur. In addition, all engineering students are expected to adhere to both the ASU Academic Integrity Honor Code and the Fulton Schools of Engineering Honor Code. All academic integrity violations will be reported to the Fulton Schools of Engineering Academic Integrity Office (AIO). The AIO maintains record of all violations and has access to academic integrity violations committed in all other ASU college/schools.

Copyright
Course content, including lectures, are copyrighted materials and students may not share outside the class, upload to online websites not approved by the instructor, sell, or distribute course content or notes taken during the conduct of the course (see ACD 304–06, "Commercial Note Taking Services" and ABOR Policy 5-308 F.14 for more information).

You must refrain from uploading to any course shell, discussion board, or website used by the course instructor or other course forum, material that is not the student's original work, unless the students first comply with all applicable copyright laws; faculty members reserve the right to delete materials on the grounds of suspected copyright infringement.

Disability Accommodations

Suitable accommodations will be made for students having disabilities. Students needing accommodations must register with the ASU disabilities resource Center and provide documentation of that registration to the instructor. Students should communicate the need for an accommodation in sufficient time for it to be properly arranged.

Policy Against Threatening Behavior
Students, faculty, staff, and other individuals do not have an unqualified right of access to university grounds, property, or services. Interfering with the peaceful conduct of university-related business or activities or remaining on campus grounds after a request to leave may be considered a crime. All incidents and allegations of violent or threatening conduct by an ASU student (whether on- or off-campus) must be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students.

Student Code of Conduct
The [Student Code of Conduct](#) is designed to ensure an environment that encourages reasoned discourse, intellectual honesty, openness to constructive change, and respect for the rights of all individuals. All Students are expected to follow the [ABOR Student Code of Conduct](#).

Harassment and Sexual Discrimination

Arizona State University is committed to providing an environment free of discrimination, harassment, or retaliation for the entire university community, including all students, faculty members, staff employees, and guests. ASU expressly prohibits discrimination, harassment, and retaliation by employees, students, contractors, or agents of the university based on any protected status: race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, and genetic information.

Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs .

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling is available if you wish to discuss any concerns confidentially and privately. ASU online students may access 360 Life Services, https://goto.asuonline.asu.edu/success/online-resources.html .