

ECE 576B: Embedded System Design and Optimization – Spring 2022

Time: Monday, Wednesday, Friday, 11am – 11.50am; Credits: 3

Location: Education Rm 331

Instructor

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Office hours: Fridays, 4.30 – 5.30 pm; ZOOM link on D2L welcome page/Piazza.

Course Websites

We will use [Piazza](#) (accessible via *D2L -> Piazza*) for class resources, lecture notes, assignments, and discussion. The system is highly catered to getting you help fast and efficiently from classmates and myself. Unless you have questions specifically related to your grade, personal matters, or similar, you should post your questions to Piazza. All enrolled students *must* [sign up](#) on Piazza (the access code is on the D2L welcome page).

If possible, I encourage you to post questions on Piazza *before* classes so that we can discuss the questions during class if necessary.

We will use D2L (<https://d2l.arizona.edu>) for Grades (via *D2L -> Grades*) and assignment submission (via *D2L -> Assignments*).

Course Overview

An embedded system is any computing system other than traditional computer systems. Embedded systems, which is one of the fastest growing and high-impact areas in computing, comprises a vast variety of applications, including digital cameras, cell phones, automotive systems, wearable devices, pacemakers, etc. As applications grow increasingly complex, so do the complexity of embedded systems devices, many of which are typically resource-constrained.

This course will focus on introducing embedded system design, synthesis, and optimizations. The course will highlight methods and challenges in designing embedded systems, which typically require the tight integration of hardware and software components. The course will provide a broad look into how embedded systems work, covering a broad range of topics, including application analysis, hardware/software partitioning, design space exploration, modeling and specification, real-time operating systems, performance evaluation, and application-specific optimizations targeting area, power, performance, energy, temperature, security, etc.

Topics include, but are not limited to:

- Embedded systems architecture
- Embedded programming paradigms
- Power and energy consumption and optimization techniques
- Modeling and specification
- Design space exploration
- Real-time scheduling and operating systems
- Hardware-software co-design
- Adaptability

The learning objectives include, but are not limited to:

- Develop an understanding of the requirements, constraints, and problems that occur in embedded systems design
- Develop an understanding of real-time computing, real-time operating systems, and practical application design and task management
- Develop an understanding of how to analyze an embedded application to identify its bottlenecks and explore opportunities for optimization using hardware-software co-design
- Develop a broad view of active research areas in embedded systems optimization and design

Textbooks

There is no required textbook. The course will cover materials from various sources, including conference proceedings and journal articles.

Prerequisites

Basic knowledge in computer architectures and C/C++ programming; familiarity with Linux

Reading Assignments and Class Participation

Reading assignments and class participation will be an important component of the class. Reading assignments (typically of research papers) must be completed by the due date to facilitate a discussion environment. We will regularly breakout into small groups to discuss topics of the reading assignments. Class participation will be evaluated through participation in discussions and in-class quizzes.

Communication with the Instructor

In general, questions about class contents should be posted on Piazza. That way, responses can be helpful to other students and other students (or the grader) may also be able to provide quicker responses to questions. Please be respectful in all your posts on Piazza, especially when answering other students' questions, even if the answers are obvious to you.

For questions related to grades and personal matters, please email me. In your emails to me, please **include the course number in brackets in your subject (i.e., [ECE 576B])** so that I can sort my email and give a quicker response.

Grading

Grading for the class will be performed on an individual basis. You will not be competing with other students for your grade. Your grade is only dependent on the effort you put into the class. Letter grades will be assigned using a 10% scale:

- 90 – 100%: A
- 80 – 89%: B
- 70 – 79% C
- 60 – 69% D

The grading will be based on a weighted sum as follows:

- 20% - Homework assignments
- 40% - Project
- 20% - In-Class Quizzes (approximately one per week)
- 20% - Reading assignments and class participation

Required Equipment and Software

All software used for this class can be obtained for free, such as Xilinx Vitis, FreeRTOS, a computer with a Linux operating system or a virtual machine with Linux installed (I recommend Ubuntu).

Policies

- In accordance with the University's policy on face coverings, surgical or higher-grade face coverings are required for all in-person class activities. This will be strictly enforced. For more information, please visit <https://covid19.arizona.edu/face-coverings>.
- ***No academic dishonesty will be tolerated. Unless otherwise instructed, all course work should be done on your own. Please consult the [UA Code of Academic Integrity](#).***
- Students are expected to read any assigned material *before* lecture.
- No late work will be accepted, unless in extraordinary circumstances, e.g., medical emergency, University/College approved absences, etc.
- Given the importance of discussions and class participation, attendance is required. However, students may miss classes for legitimate reasons (e.g., illness) after providing advance notice to the instructor.

Disability/Counseling Resources

Students requesting classroom accommodation must register with the [Disability Resource Center](#) for assistance with obtaining the necessary accommodations, and request the DRC to send me official notification of your accommodation needs ASAP. Please meet with me to discuss accommodations and how to maximize your productivity in this class.

Additionally, resources are available on campus to students having personal problems or lacking clear career and academic goals. Students who need assistance should contact [Counseling and Psych Services](#) for the necessary assistance.

Inclusive Excellence

Inclusive Excellence is a fundamental part of the University of Arizona's strategic plan and culture. As part of this initiative, the institution embraces and practices diversity and inclusiveness. These values are expected, respected, and welcomed in this course.

This syllabus is subject to change at the discretion of the instructor, with proper notice to the students.