Embedded Systems Design

ECE 4180

Course Overview

This course covers hardware and software design for higher embedded systems. Concepts that can be applied to any embedded system will be covered. Including I/O principles, communication protocols, real time operating systems, interrupts, memory hierarchy, power all in the scope of an embedded system. Specific concepts only applicable to certain embedded systems (but still relatable to other platforms) include the ESP32 Microcontroller.

Prerequisites

((ECE 2031 and (ECE 2035 or ECE 2036)) or (CS 3510 or 3511 or 3240)) or a relative undergraduate degree.

Along with being able to understand the above Boolean expression, C/C++ programming skills and a college level physics 2 understanding of circuits.

Course Staff

Instructor	Diego Fratta
Email	fratta@gatech.edu
Office	Klaus 3354
Office Hours	See Canvas And by Appointment (Email)
GTA	Matt Neto
UTA	Pedro Chen
UTA	Jason Hsiao
UTA	Advaith Menon
UTA	Keshav Parthasarathy
UTA	Dev Patel
UTA	Maddie White
TA OH	See Canvas

Grading

Lab Assignments	25%
Midterm 1	20%
Midterm 2	20%
Final	35%
CIOS Bonus	Up to 1%

I understand that Grades are quite important to you all, and I'm not going to post any official grade scale. Typically, the course grade scale will follow the general A >= 90, B >= 80 and so on. This scale may change if the average GPA of the course is below 3.00 and will be curved to reach that. But an A will never be more than 90%. So don't worry about that.

Additionally, at the end of the semester, once the grades are finalized, please don't email me about a grade bump or rounding up. I know you may provide a good reason, but I need to be fair to all students and keep the grade scale applied consistently. I am very happy to talk about your grades and concerns about them throughout the semester, not at the end of it after all grades have been published.

The CIOS bonus is .5% if 85% of the CIOS is completed per section, and 1% if 90% of the CIOS is completed per section. You should consider this my rounding.

I reserve the right to introduce an attendance grade/pop quizzes that count towards the exam grade if class attendance declines greatly along with adjusting the grade scale.

I also reserve the right to drop your grade by a letter grade if any parts are not returned to the lab room by the end of the semester. Please be responsible with your parts and keep good track of them.

Lastly, if you think I made a mistake with your grades, please don't hesitate to reach out!!

Course Material

Syllabus and Lecture Material: Via Canvas

There is no required textbook in this course.

There is an optional parts kit you will need for Labs 1-4. Labs 1-4 will require the parts kit at this link. If you took ECE 2035 or ECE 2036 you should already have the mbed starter kit. If you want to have your own parts feel free to purchase both kits. All parts for the labs will be distributed from the lab room if you don't want to purchase, but they must be returned by the end of the semester. You are expected to have your own breadboard and wire kit.

Lab Resources

There are 5 graded labs (Lab 0 – Lab 4). All of them can be done in groups of 2.

Lab 0 will be a low-stakes introductory lab to ensure you have the material and environment to do the rest of the labs

Lab 1-4 will be done on an ESP32-C6-DevKitC-1 on the ArduinoIDE.

There is an extra credit policy on labs. If you get a final sign off on Labs 1-4 on the Monday of the week it is due, you get 5 extra points on that assignment. Tuesday is 4 extra points, Wednesday 3, and Thursday 2 extra points. You need to complete all required parts to be eligible for extra credit. Labs will also have extra credit parts as well.

Final Project

In place of a Final Exam, there is a Final Project in the course. The Final Project will be open ended with some requirements for what needs to be included. Details will be provided further along in the semester. You are allowed to work in groups of 2. I expect more out of groups of 2 than an individual.

Deliverables include a project proposal that is completion based. A presentation of your project working, your project code, a brief project report, and a schematic of your project.

During the project presentation, if there is no project to present, you will be given a 0 on the Final Project. Please make sure you budget enough time to make a working final project and reach out to me if external non-academic issues get in the way.

The final project presentation occurs during regular instructional days. Including the final instructional days. The deliverables for the project are due on May 1st. Which does not coincide with any final exam schedule for ECE 4180.

Exams

There will be 2 Midterms in this course. There will be no Final Exam which is replaced by a Final Project. Exams will be delivered on paper in person. Exams are not cumulative, except in the case where I think the class underperformed on an Exam 1 concept and reserve the right to reassess it on Exam 2. You must show up to your assigned section to take the Exam. The only resource you are allowed on the Exam is your brain, writing utensils, embedded system calculator, and any handouts I may provide with the exam.

Course Objectives

By the end of this course, I believe you all will be able to do the following:

- Identify Embedded Systems in the real world along with the problem(s) they solve and how they do so
- Design Embedded Systems using a microcontroller connected to many different peripherals and I/O devices
- Understand how microcontrollers and peripherals communicate with each other different protocols
- Write software for Embedded Systems with and without APIs in both a high-level and low-level language
- Understand hardware timers with respect to the processor's clock
- Analyze and create a real time system to be deployed on an Embedded System

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Ed Discussion

We will be using Ed Discussion for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TAs, and myself. The Ed Discussion is for both sections.

Rather than emailing questions to the teaching staff, I strongly encourage you to post your questions on Ed Discussion. If you have a question, it is incredibly likely someone else has the same question. Kinda like a certain memory concept.

Ed Discussion is directly accessible via Canvas.

Attendance:

Students are responsible for all material covered in class, including changes in exam schedules announced in class. There will be no make-up exams given in the case where you miss class with no prior given reasonable reason. In case you must miss an exam, please inform me of the absence prior to the exam date.

We will abide by the Institute policy on attendance, see http://catalog.gatech.edu/rules/4/. The following policies apply to this course: Students are required to complete all course assignments and in-class activities. Please discuss all absences with the course instructors, prior to the absence if they are planned. If there is not an excused absence, credit will be deducted from project work and other assignments will not be accepted late.

The class is recorded. If you do miss a class, it is up to you to watch the recording. I expect all students to watch the recording within 24 hours of it being posted. Please ask any questions you have that come up during watching the recording on Ed Discussion or at office hours. Even though class is recorded, attendance is still expected.

Religious Considerations:

If you are going to miss class due to religious observances, you must provide a letter with the dates of the absences within the first two weeks of class. The instructors will work with the students on an individual basis to try to accommodate as best as possible. https://catalog.gatech.edu/rules/4/ Section IV.B.5

Accommodations for Students with Disabilities:

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or http://disabilityservices.gatech.edu/, and http://disabilityservices.gatech.edu/content/welcome-accommodate as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible to set up a time to discuss your learning needs.

Accommodations are not applied automatically. You must email me at the beginning of the semester to let me know about your accommodations and to come up with a plan to ensure your success if not already sent from ODS.

Honor Code:

Students are expected to abide by the Georgia Tech Academic Honor Code. Honest and ethical behavior is always expected. All incidents of suspected dishonesty will be reported to and handled by the office of student affairs. You will have to do all assignments individually unless explicitly told otherwise. You may discuss with classmates, but you may not copy any solution (or any part of a solution).

Having one person do all the lab work or final project in a group of 2 is a violation of Georgia Tech's Academic Honor Code and will be handled appropriately.

Using AI in an ethical way is allowed in this course. However, overuse will result in bad exam grades when you don't know how to answer questions on it.

Violations of the Honor Code on an Exam will result in an 'F' in the course

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Late Submissions:

Extensions can be given in the case of medical emergencies, illness, outside factors not related to your academics, Institute sponsored travel, athletics, religious considerations. Please provide a note from your doctor, Institute, or Dean of Students.

Please see the https://catalog.gatech.edu/rules/4/ for more details.

Student Illness

The class is offered in-person with all lectures being recorded. If you feel ill, please watch the recording and return to class when feeling better. All submissions can be done virtually if needed and extensions can be given due to illness.

If you are ill and unable to do course work please contact the Dean of Students, https://studentlife.gatech.edu/request-assistance. Your instructor will not be told the reason and will work with you to facilitate your learning needs.

Statement on Diversity

All students of all walks of life are welcome in my classroom. We, this includes you, celebrate and respect the diverse makeup of students here at Georgia Tech. I strive to create an inclusive environment where all students feel valued no matter their gender identity, sexual orientation, race, ethnicity, religion, and any other protected class not listed. An inclusive classroom is a classroom where students learn best. Learn more at https://eoc.gatech.edu/