USTU 020 for Spring 2024

A pilot offering of EE 005: Designing and Building EE Systems

Instructor: Ayush Pandey (meet with me 1-on-1 using this URL)

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Course Reader: Mahanth Mohan (mmohan3@ucmerced.edu)

🏛️ **Class Discussions:** Mon from 5.30pm to 7.20pm at COB1 263

📓 **Ayush's office hour:** Mon 4.30pm to 5.30pm in SE2 381 and Wed 3.00 pm to 4.00 pm in SE2 381

🙉 **Group debugging sessions (led by Mahanth):** Mon 12.30pm - 1.30pm in SE 2 lobby

Too long; didn't read summary of the syllabus:

- You will learn how to create your own intelligent robots, gadgets, and even mini computers!
- CatCourses is your best friend for all deadlines and announcements. Bring your laptop to the class to participate in learning together with everyone.
- Contact Ayush for any extension requests and feel free to ask for help in office hours! We are here to support your learning and ensure that you can excel in this course.

Course prerequisites:

All UC Merced students are welcome! There are no course pre-requisites to take this class and excel in it. It is expected that all students are comfortable with middle school algebra and in using computers. This is intentionally defined in a subjective manner to welcome students from all backgrounds and experiences. This course serves as a training platform for all students interested in the broad area of electrical engineering. This course will actively attempt to create a welcoming climate for everyone without relying on prior experience in circuits or computer programming. However, if you do have prior experience in any of the course topics, you will find many opportunities to grow and create advanced systems. If needed, feel free to discuss your preparation with the instructor or the course staff.

Course learning goals and outcomes:

By the end of this course, you will be able to design and build simple engineering systems that can read physical signals by interfacing sensors, make logical decisions with electrical circuits, and act

on the surrounding environment. You will learn to compare engineering design choices and effectively communicate this decision-making in writing and in presentations.

The **main outcome** of the course is the final project where you will **design a functioning robot** in a team and compete with the rest of the teams in the course for a prize!

Course overview:

EE 005 will be a hands-on, projects-based course on circuits design, computational thinking, and building engineering systems. In Spring 2024, the USTU 020 course is being used to pilot EE 005 before it is officially launched in Spring 2025. The course will include brief introduction to theoretical topics such as RC circuits, programming logic in C, and introduction to signals. Practical topics in the course include soldering, breadboarding, control of actuators, sensors, and interfacing electronic devices with microcontrollers. Optional practical topics such as GUI design, interfacing hardware with software, and 3D printing will be discussed as well. The course also emphasized the development of soft skills like teamwork, communication, and studying strategies. For the final project, students will work in teams of three/four to complete an engineering design project focused on robot design. The theoretical topics in the course will be structured as hands-on activities that make up the formative assessments using lab assignments. Students will design an independent mini project in the midterm by combining parts of lab assignments together to design an intelligent device. The final project will be scaffolded with weekly milestones so that students can make consistent progress towards the final project.

Course policy and expectations:

1. **Lectures** will be designed as hands-on class discussions where you will be able to learn most of the key concepts required and get a head start on the tasks for the week. So, please bring your laptop to the class and be prepared to work with the supplies that will be provided to you.
2. Try to make the best of the **office hours**, we are here to answer your questions and we will be understanding of any issues that you may be facing.
3. If you ever need an **extension**, contact Ayush. All legitimate extension requests will be granted for lab assignments. We can decide on the length of extension based on the individual circumstances. Late work is still eligible for a 50% partial credit (no matter how late). Extensions to the final project will only be given after a review of documented reason for absence.
4. **Academic honesty:** You are expected to write your own code and any other answers. Asking for help in understanding a concept, learning from discussions online, and asking ChatGPT for explanations are all OK — but, you must write your own essays and code after you have understood the concepts. Remember that learning fundamentals in a class like this will enhance your future education and career, so copying your answers will impede

your learning and progress. The full university academic honesty policy PDF is posted on CatCourses. Please review that PDF.

5. **Class Conduct and Community:** Remember that contributions from each of us can help in building a respectful, courteous, and an intellectually stimulating class environment. Language or behavior that prevents any student to participate fully in class is not acceptable. It is important to remain open to each other's thinking and engage in rigorous, challenging discussion about issues of shared concern. Oppressive behavior such as racism, sexism, homophobia, transphobia, and ableism are designed to keep people out of conversations and participation. So, it is important to be actively mindful of such biases in conversations to promote a welcoming and inclusive climate.

6. UC Merced is committed to providing an **equal opportunity environment** for all students and employees that remains free of all forms of discrimination, harassment, and exploitation. Discrimination and harassment based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. If you witness or experience any form of harassment, please seek support and guidance. For more information, please visit https://ophd.ucmerced.edu/

7. **Emailing/direct messaging on CatCourses:** If the syllabus does not answer your question, please reach out to the TA. If your question needs urgent attention, you can send an email to the TA or the instructor (make your best judgement on who might answer your question best and quickest). Please **mention the course number in the subject** of any email you send.

Assessment structure:

1. All **in-class activities** (polls, worksheets, exit quizzes) are graded for participation – **20%** of your total grade. You can skip 10% of the total number of in-class activities and still get full points. Participation score = (Number of activities participated) / (total activities - 0.1 * total activities).

2. Five hands-on individual **lab assignments** (Breadboard circuits, Programming circuits, Arduino C programming, Microcontroller signals, Sensing and actuation) constitute **30%** of the total score. Two lowest scoring lab assignments will be dropped from the final grade computation. The labs will cover the main topics in the course and most lab work will be completed during class discussions.

3. **Mid-term individual project** is worth **20%** of your final grade. This is a mini project that combines the lab assignments from the class to build something "interesting". You can choose a project from a list of choices that we will provide to you or propose your own project. The project will consist of the following components:

    1. Technical worksheet for your project (a fillable template will be provided) --- the proposal, the milestone, and the presentation.
    2. Project demonstration (5-minute demo in class)
4. The **final team project** is worth **30%** of your final grade. The project will consist of the following components:
    1. Self-reflections on project progress, team bonding, work ethic, and challenges.
    2. Project presentation (15-minute presentation in class).
    3. Team report (a template will be provided).
    4. Grading for final project comprises of 30 points from the motor driving milestone, 20 points from algorithm and programming milestone, 10 points from self-reflection, and 40 points from the final demonstration.
    5. Milestone 1 is individually graded with all team members working on one submission. Milestone 2 is team graded with all team members working on one submission. Self-reflection is individually graded. Final demonstrations are graded based on the team.
5. The **robotics competition** is worth **exciting prizes** and bragging rights!!
6. **Extra credit activities** will be assigned throughout the semester. You can earn a maximum of **5%** toward your total grade by working on extra credit. It will never hurt your grade, will only help.

Grading scheme according to final score (out of 105, because of 5 extra credit points):

- Score in [96, 105] is A+, [92, 96) is A, and [88, 92) is A-
- Score in [84, 88) is B+, [80, 84) is B, and [75, 80) is B-
- Score in [70, 75) is C+, [66, 70) is C, and [62, 66) is C-
- Score in [58, 62) is D+, [54, 58) is D, and [50, 54) is D-

The course topics for each week are described in the table below. Each week's topics are divided between a theory component and related practice. If you cannot attend a particular class, please let Ayush know and request access to any material that may help you finish the required tasks.

Date	Weeks	Topics	Notes and supplemental reading
Jan 15	Week 1	Blank week	No class
Jan 22	Week 2	Logistics: Introductions, course expectations, learning outcomes, supplies and facilities. Topic: Blinking an LED on an Arduino.	

Jan 29	Week 3	Theory: Intro to resistors, capacitors, and circuit design. Practice: Breadboards, electrical safety	
Feb 5	Week 4	Soldering and 3D printing workshop at ***SRE 101 Makerspace***	Lab 1 due on Feb 5
Feb 12	Week 5	Theory: Intro to programming, branching, and loops in C Practice: Arduino programming	Extra office hours on Wed Feb 14 at 4pm and Fri Feb 16 on Zoom at 10am.
Feb 19	Week 6	President's Day Holiday; No class.	Lab 2 due on Feb 19 Lab 2 help and hints video. Explore IR sensor specifications
Feb 20	Week 6	Programming practice session at 11am on Zoom	Recorded video.
Feb 26	Week 7	Theory: Analog and digital signals Practice: Control of devices using an Arduino microcontroller	Lab 3 due on Feb 26. Hints on Lab 3 video. Explore CircuitPython if you are interested.
Mar 4	Week 8	Theory: Time and frequency domain Practice: Sensor interfacing with Arduinos	Lab 4 due on Mar 4. Midterm project proposals due on Mar 4.
Mar 11	Week 9	Electrical circuit schematics.	Midterm project milestone due on Mar 11. Midterm debugging help on Wed at 12pm and 3pm, and on Thu at 2pm. Midterm grade will be posted on Mar 11.
Mar 18	Week 10	Midterm project presentations	Midterm project demo.
Mar 25	Week 11	Spring recess; No class.	--
Apr 1	Week 12	Midterm project demo.	All remaining project demo. Final project team formations.

Apr 8	Week 13	Reading integrated chips datasheets. Interfacing an IC on a breadboard (L298 motor drive)	
Apr 15	Week 14	Line follower robot.	Milestone 1 due for final project on Wed Apr 24.
Apr 22	Week 15	Algorithms for robots	Milestone 2 due for final project on Apr 29.
Apr 29	Week 16	Looking ahead: The EE program	Final project prep.
May 6	Week 17	Final presentations.	Final project presentations and reports due.