

Open Project Space

# Program Syllabus

Fall 2023 - Spring 2024



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**Lab Supervisor:** David Schoening

**Lab Instructors:** Hannah Briseño, Colton Kaneria, Deon Nguyen, Gavin Nguyen, Luke Vargas, Antonio Velasco, Dylan Vu

## Course Description

Open Project Space (OPS) is a year-long technical course in embedded systems. We introduce engineering students to topics relevant to their coursework and potential career paths: integrated circuits, breadboarding, soldering, microcontrollers, embedded programming with C++, PCB design, and hardware communication.

Unlike a traditional college course, we aim to increase engagement with project-based learning. Students individually complete eight projects encapsulating the program's topics, culminating in one final capstone project where they design and build a remote-controlled rover. Regularly scheduled workshops and lectures complement the projects.

## Enrollment Requirements

Undergraduate students attending the University of California, Irvine, can apply for course enrollment. The deadline for application submissions is **October 6th, 2023, at 11:59PM**. Submitting an application does not guarantee acceptance to the program. Students who receive a course acceptance offer must pay the course deposit and fee before enrollment.

## Course Deposit + Fee

You will pay **\$120** (\$60 refundable deposit + \$60 course fee) at the beginning of the program. In exchange, you will receive a parts kit with the components needed to complete the course projects. You will be refunded \$20 upon completing each quarter's required projects. By the end of the year, you can earn the full \$60 deposit back.

## Parts Kit Component List

- 9V Snap Connector (x1)
- Arduino Nano (Micro USB) (x2)
- Ball Caster (x1)
- Ball Caster Spacer Chassis Grip, 3D-Printed (x1)
- Battery, 9V (x2)
- Battery Holder, 3D-Printed (x1)
- Breadboard, 400 Points (x2)
- Buzzer, Piezo, 1.5V (x2)
- Capacitor, Ceramic, 0.1uF, 50V (x2)
- Capacitor, Ceramic, 10uF, 25V (x2)
- Capacitor, Ceramic, 1uF, 50V (x1)
- Custom PCB, 100x100mm (x1)
- DHT 22 (x1)
- Digital Multimeter (x1)
- DIP Socket, 8 (x1)
- Female-Male Jumper, Dupont, 20cm (x20)
- Gearbox Motor (x2)
- Header, 2.54mm, Female, 1x15 (x2)
- Header, 2.54mm, Female, 1x2 (x2)
- Header, 2.54mm, Female, 2x4 (x1)
- Header, 2.54mm, Female, Right Angle, 1x5 (x1)
- Joystick (x1)
- Jumper Cable Kit, 140 Pcs (x1)
- L293D (x1)
- LCD, 16x2 + I<sup>2</sup>C Backpack (x1)
- LED, 5mm, 2.2V/3.2V (x4)
- LED, RGB, 5mm, Common Cathode (x1)
- Micro SD, 8GB (x1)
- Micro SD Adapter (x1)
- Mini MP3 DF Player Module (x1)
- NE555P (x2)
- NRF24L01+ Transceiver (x2)
- Perfboard (x1)
- Photoresistor 5516, 5mm (x1)
- Potentiometer, B10K, 15mm (x3)
- Pre-made PCB (x1)
- Resistor, 10K $\Omega$ , 5%, 1/4W (x3)
- Resistor, 130 $\Omega$ , 5%, 1/4W (x2)
- Resistor, 1K $\Omega$ , 5%, 1/4W (x4)
- Resistor, 390 $\Omega$ , 5%, 1/4W (x2)
- Resistor, 4.7K $\Omega$ , 5%, 1/4W (x2)
- Resistor, 470K $\Omega$ , 5%, 1/4W (x2)
- Resistor, 470 $\Omega$ , 5%, 1/4W (x1)
- Resistor 430 $\Omega$ , 1%, 1/4W (x2)
- Resistor 470 $\Omega$ , 1%, 1/4W (x1)
- Slotted Screwdriver (x1)
- Speaker, 0.5W, 8 $\Omega$ , 500Hz, 40m (x1)
- Switch, Tactile (x5)
- Switch (x2)
- TM1637, 7 Segment Display, I2C (x1)
- T-Shirt (x1)
- Wheels (x2)
- Wood Plate, 4"x4" (x1)

## Projects

With exception to the Spring Quarter, projects are assigned every two weeks. These assignments are typically due two weeks from their start date.

All the required projects must be completed before the final course deadline (TBD) for a student to be eligible for their deposit reimbursement.

Listed below are the projects assigned each academic quarter:

### Fall Quarter

Project	Topics	Description
LED Circuit	Circuits, Voltage, Current, Resistance, Ohm's Law	Build an LED circuit with a switch and solder it to a protoboard.
555 Piano	Circuit Analysis, Nodes, Loops, Kirchhoff's Laws, Multimeters, Integrated Circuits, 555 Timer	Create an electronic piano with the 555 Timer IC, and solder it to a printed circuit board.
C++ Program (Optional)	C++, Compilers, Data Types, Functions, Control Flow, Loops	Solidify your understanding of functional programming, control flow, and loops with an exercise set.
RGB Dimmer	Microcontrollers, Basic Computer Architecture, Arduino IDE, Arduino Nano, Pulse Width Modulation	Build and program a dimmable RGB LED using the Arduino Nano and potentiometers.

## Winter Quarter

Project	Topics	Description
iPoduino v2	Binary Logic, Arduino Libraries, Communication, UART Protocol	Create an interactive MP3 player and upload your favorite tunes.
Weather Station	Communication, I <sup>2</sup> C Protocol, SPI Protocol	Build a weather station that wirelessly transmits temperature and humidity data to an indoor display.
7-Segment Display Stopwatch	Interrupts, Timers	Create a digital stopwatch using interrupts, timers, and a 7-segment display.
555 Blinking LED PCB Design (Optional)	KiCAD, Schematics, PCB Design, PCB Manufacturing	Design a PCB for the 555 Blinker circuit.

## Spring Quarter

Project	Topics	Description
RC Rover	Everything	Build and control a rover remotely with a custom PCB.

## Lectures

Lectures are hosted live every two weeks or pre-recorded unless otherwise stated. The exact dates, times, and locations are tentative. Each lecture discusses the topics relevant to upcoming projects and introduces the next project. All lectures are recorded.

Listed below are the lectures hosted each academic quarter:

### Fall Quarter

Title	Date
Introduction to Electrical Engineering & Embedded Systems	Week 3
Integrated Circuits & Debugging Equipment and Techniques	Week 5
C++ Programming	Week 7
Microcontrollers, Microcontroller Architecture, and Arduino	Week 9

### Winter Quarter

Title	Date
Binary, Digital Logic, and Communication Protocols I	Week 1
Communication Protocols II	Week 3
PCB Design Concepts (Pre-Recorded)	Week 5

### Spring Quarter

Title	Date
Software Engineering & Version Control	Week 1
Current Events in Engineering	Week 3
Designing Projects & Picking Parts	Week 5
Resumes, LinkedIn, and Professional Development	Week 7

## Workshops

Workshops are hosted live or pre-recorded each quarter to supplement the projects. The exact dates, times, and locations are TBD. Each workshop serves as an interactive tutorial.

Listed below are the workshops assigned each academic quarter:

### Fall Quarter

Title	Date
Soldering	Week 4
C++ Programming IDEs (Pre-Recorded)	Week 8

### Winter Quarter

Title	Date
Finite State Machines (Pre-Recorded)	Week 4
PCB Design with KiCad	Week 8

### Spring Quarter

Title	Date
Capstone PCB Design	Week 1
Version Control with GitHub CLI (Pre-Recorded)	Week 2
Capstone Rover Assembly	Week 3
Capstone PCB Assembly	Week 5
Capstone Programming	Week 8

## Agreement

By signing this document, you agree to the statement below:

*I hereby agree to pay the required sixty-dollar deposit and sixty-dollar course fee in exchange for the project materials and access to OPS lectures and workshops. I accept that a full reimbursement of the deposit is contingent on my completion of each project by the course's final deadline.*

*I understand that inappropriate behavior or any other form of misconduct inconsistent with the club constitution or bylaws may result in my removal from the OPS program without reimbursement of the deposit.*

Participant's Full Name (*Print*): \_\_\_\_\_

Participant's Signature: \_\_\_\_\_ / Date: \_\_\_\_\_

## Liability Release

*On this day of \_\_\_\_\_ intending to be legally bound hereby, the undersigned agrees and does hereby release from liability and to indemnify and hold harmless the Institute of Electrical and Electronics Engineers at the University of California, Irvine, and any of its officers as regards to the Open Project Space program and related workshop events. This release is for any and all liability for personal injuries, attorney fees and property losses or damage occasioned by, or in connection with any activity or accommodations for this program. The undersigned further agrees to abide by all the rules and policies promulgated by the Institute of Electrical and Electronics Engineers at the University of California, Irvine and/or its affiliate groups and vendors throughout the program.*

Participant's Full Name (*Print*): \_\_\_\_\_

Participant's Signature: \_\_\_\_\_ / Date: \_\_\_\_\_

If the participant is under 18 years of age, a parent or guardian must sign below:

Parent's Full Name (*Print*): \_\_\_\_\_

Parent's Signature: \_\_\_\_\_ / Date: \_\_\_\_\_