**Hands-On Practical Electronics (HOPE)**

EE 98/198  
Wednesday 8:00–10:00PM, 140 Cory Hall  
http://ieee.berkeley.edu/hope/

**Objectives:**

This course is designed to introduce electrical engineering and design concepts through hands-on, practical labs and projects to a broad audience, particularly non-electrical engineers. Students will acquire basic knowledge of circuits, microcontrollers, and sensors while learning lab and troubleshooting techniques.

**Course Format:**

This course is designed to be taught minimally through lecture and allow maximum exposure to equipment and tools for hands on learning. Classes begin with a 20–30 minute lecture with slides, videos, and live demonstrations to teach basic concepts and exhibit lab techniques. Since we expect many of the students in the target audience to not have exposure to the level of math and physics necessary to fully understand the workings of the concepts we discuss, we will not be emphasizing it. The mathematical and physical descriptions will also be included for completeness. Most of the class time is dedicated to a hands-on lab. Labs will usually consist of two parts. The first part will be a simple circuit that applies the concepts of the lesson followed by more challenging circuits for those who wish to attempt it. Labs do not need to be turned in.

**Course Specifics:**

The course spans 13 weeks, with two hours of lecture and lab plus an additional hour of individual preparation per week. Students are expected to spend 6 hours outside of class during the last three weeks to complete the final project (45 hours total).

**Week 1: Introduction**

- Preparation: Review syllabus and complete preliminary survey
- Introduction to electronics engineering, overview of course material, syllabus review, address enrollment issues

**Week 2: Safety, Soldering, Terminology**

- Preparation: Review department lab safety guidelines
- Soldering demonstration with facilitators
- Build, troubleshoot, and demonstrate LED blinker with 555 timer

**Week 3: Measurements and Schematics**
- Preparation: Mini-bio of electrical pioneer (e.g. Faraday, Volta, Tesla, Marconi)
- Learn to use digital multimeter to measure voltage, current, and resistance
- Draw schematics for LED blinker circuit and determine test points

Week 4: Ohm’s Law, Equivalent Resistance, and Power
- Preparation: Back-of-the envelope power and voltage calculations
- Apply Ohm’s law to predict voltages and currents on a live circuit from the schematic
- Use load line analysis to predict voltages in LED circuit using I-V curves

Week 5: Capacitance
- Preparation: Research one application of capacitors in real circuits.
- Demonstrate charge storage in an electrolytic capacitor
- Basic transient analysis of capacitive circuits

Week 6: Amplifiers
- Preparation: feedback gone wrong: applications and misbehavior of amplifiers in real life. Research an amplifier application and explain how to cause positive feedback.
- Theory of open loop gain of commercial op-amp, simple feedback theory.
- Speccing an op-amp: slew rate, offset voltages, and GBWP
- Building noninverting and inverting amplifiers in lab.

Week 7: Oscillators
- Preparation: Gentle introduction to complex numbers. Links can be shared in class – ask an instructor.
- Build a relaxation oscillator using an op-amp.
- Mild theoretical explanation of oscillators and use in industry.

Week 8: Silicon and Semiconductors
- Preparation: Go over silicon lecture slides on the HOPE website
- Guest lecture from Stanford EE Ph.D student.

Week 9: Transistors
- Preparation: Estimate number of transistors in your personal devices
- Transistors as a switch, amplifier, and logic element
- Introduction to transistor technology (BJT, FET)
- Demonstrate transistor as a gate in saturation mode

Week 10: Digital Logic
• Preparation: start thinking about final project – form teams and research.
• Introduce a binary adder with combinational logic
• Demonstrate boolean equivalence by implementing logic functions using AOI logic using 74xx TTL.

Week 11: Microcontrollers [project, prep begins]
• Preparation and individual time: research and prepare final project proposals
• Introduction to C, pointers, memory mapping, masks, and interrupts
• Set up Arduino IDE, deploy firmware to Arduino

Week 12: Start Final Projects [project, build begins]
• Outside class: build final projects
• In-class “office hours” with facilitators for project debugging

Week 13: Finish Final Projects
• Final project demonstration and videos

Course Materials:

Lecture slides, lab handouts, and readings are available at:

https://ieee.berkeley.edu/hope/

Please check for updated readings the week before the associated lecture.
Grading:

Your grade is primarily based on attendance and your effort in class. Completion of the final project is also required, although if significant effort is demonstrated it will still count. The goal of the final project is to apply the concepts learned in the class to a practical or fun project that can be reasonably completed within a few weeks. The facilitators will help out with the completion of the projects as much as possible. Participation and completion of labs is strongly advised. There will be attendance through sign in sheets or forms at the beginning of each session. Please ensure that you sign in each session.

Grade Breakdown:

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<tbody>
<tr>
<td>Attendance</td>
<td>60</td>
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<tr>
<td>Final Project</td>
<td>20</td>
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<tr>
<td>Decorum and Effort</td>
<td>20</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
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Attendance Policy:

You can miss three classes unexcused. Please contact the facilitator and let them know at least 3 hours before the class. Any additional absences could result in a NP. Beyond the 3 unexcused absences, each absence results in a loss of 10 points from the Attendance score (out of 60).

Final Project is graded on effort and the video demonstration describing their work.

“Decorum and Effort” is based on behaviour in class, participation and observance of safety instructions.

Students need to get at least 60 points to pass the course.

Course Facilitators:

Kevin Zheng (kevinz@berkeley.edu)

Sudip Guha (sudipguha@berkeley.edu)