APPL 112: Electronics for Everyone

Course description:
This course will give students the basic capability to design and fabricate practical electronics circuits, including interfacing with sensors and actuators. The course will cover basic DC and AC circuit theory, time domain and frequency domain concepts, amplification, filtering, comparators, sensors, actuators, analog and digital conversion, and construction techniques. The course assumes that students have been previously introduced to Ohm's Law and have basic algebra skills.

General information

Contact information:
Collin McKinney
Kenan Labs C240
collin@unc.edu
919-843-5801

Office hours:
After class, or by appointment. Please check with me first to insure my availability.

Meeting place and times:
Kenan C143

Textbook and other instructional materials:

- Optional Online Textbooks:
  - DC Circuits, Chad Davis, University of Oklahoma Libraries, 2016: https://open.umn.edu/opentextbooks/textbooks/dc-circuits
  - AC Circuits, Chad Davis, University of Oklahoma Libraries, 2017: https://open.umn.edu/opentextbooks/textbooks/535

Online resources:

1. Watch this video to learn about the oscilloscope:
   https://www.youtube.com/watch?v=Iq4QlfH-oqk
2. Download and install TINA-TI:
   http://www.ti.com/tool/TINA-TI
3. Bookmark this url in your search engine:
   https://www.intmath.com/complex-numbers/convert-polar-rectangular-interactive.php
   We will use this often.
4. Download and install ExpressPCB:

https://www.expresspcb.com/

5. Download and install Protocase Designer:
   https://www.protocasedesigner.com/?_ga=2.84253841.921136738.1556215309-46657941.1556215309

6. Download and install Arduino IDE:
   https://www.arduino.cc/en/Main/Software

https://www.unc.edu/sakai/
Sakai will be your resource for all course materials and assignments

Prerequisites:
None

Target audience:
Anyone who is interested in understanding electronics and gaining practical experience with circuits.

Policies

I expect all students to

- Watch all online videos that are assigned
- Complete all assignments
- Come to every scheduled class and let me know ahead of time if you cannot attend. Of course if you are sick or have an emergency, your highest priority is to take care of yourself. But since we only have 8 days, you will miss a lot of material if you miss a single class.

Honor code
Unless specified otherwise, assignments can be done in groups or individually. While I encourage you to help each other for individual work, it is a violation of the honor code if you copy or obtain solutions from another student.

Student learning outcomes

By the end of this course, students should be able to:

- Use basic lab instrumentation, including multimeter, oscilloscope, power supply, signal generator, and breadboard.
- Simplify, analyze (manual calculation and simulation), construct, and test basic DC circuits such as voltage dividers.
- Conceptualize time and frequency domain transformations.
- Analyze (manual calculation and simulation), construct, and test basic AC circuits such as voltage dividers and RC filters,

- Analyze (manual calculation and simulation), construct, and test basic OpAmp circuit topologies (i.e., inverting, non-inverting, differential, TIA, and comparator types).
- Analyze (manual calculation and simulation), construct, and test basic OpAmp-based filter circuit topologies (i.e., low pass, high pass, bandpass, notch).
- Understand noise concepts and remediation.
- Understand and use sensors that produce analog outputs (position, temperature, light, magnetic, sound, etc.)
- Understand and use actuators (relay, DC motor, servo motor, stepper motor, buzzer, LED, etc.)
- Understand and use sensors that produce digital outputs (humidity, distance, etc.)
- Understand sensor and actuator interfacing with a microcontroller (Arduino) and develop software to use these devices.

Class topics include the following:

- AC and DC circuits
- OpAmps and filters
- Noise theory
- Sensors
- Actuators
- Arduino
- Construction techniques

Grading

Homework and Labs: 100%

Major course due dates:

This course will fly by quickly in 8 days!
Labs will take place during class time.
A capstone project will be completed in class on day 8.
There will be homework due on days 2,3,4,5,6, and7.

Final letter grades will be calculated with the following grade scale:
A+: 100
A: 95.0-99.9
A-: 90-94.9
B+: 87.0-89.9
B: 83.0-86.9
B-: 80.0-82.9
C+: 77.0-79.9
C: 73.0-76.9
C-: 70.0-72.9
D+: 67.0-69.9
D: 60.0-66.9
F: <60.0

Accommodation for students with disabilities

The University of North Carolina – Chapel Hill facilitates the implementation of reasonable accommodations, including resources and services, for students with disabilities, chronic medical conditions, a temporary disability or pregnancy complications resulting in difficulties with accessing learning opportunities. All accommodations are coordinated through the Accessibility Resources and Service Office. Please visit http://accessibility.unc.edu for more information.

I reserve to right to make changes to the syllabus, including project due dates and test dates, when unforeseen circumstances occur. These changes will be announced as early as possible so that students can adjust their schedules.