Mixed Electronics Lab I
Fall, 2021
Lab: on M W, 14:30 – 17:30 in Workman 116

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Course Description: Intensive laboratory working with analog and digital electronics, FPGAs, and microcontrollers. Project topics include oscilloscope and oscilloscope probe, RC filters, operational amplifier, diodes, transistors, microcontroller interfacing, light detection, LED display and integrated optical ranging system.

Mode of Instruction: Hands-on labs on M W, 14:30 - 17:30 in Workman 116.

Pre-requisites: *EE 252* (Digital Electronics)

Co-requisites: *EE 351* (Microcontrollers) and *EE 353* (Analog Electronics)

Place in Curriculum: This course is normally offered in Fall semester. It is a requirement for the Electrical Engineering major.

Course Learning Outcomes:
After completion of this course, students are expected to be able to:

- Use oscilloscope and probes to analyze circuits and systems.
- Design and implement systems using selective filters, op-amp, diodes, and transistors.
- Program microcontrollers to acquire signal/data in real-time.
- Program FPGAs to implement logic circuits.
- Conduct simulations to determine the performance of a circuit or a system.
- Use sensors, microcontrollers, and FPGAs to create, analyze and process signals.

Program Learning Outcomes: https://www.nmt.edu/academics/eleceng/undergrad/index.php

Course Requirements:
Textbook: *Elementary Linear Circuit Analysis (Second Edition). Leonard S. Bobrow, Oxford University Press 1987.*

Course schedule

Date	Lab	Topic
Aug. 16		Syllabus and Canvas Navigation
Aug. 23, 25	Lab 1	Oscilloscope and Oscilloscope Probe
Aug. 30, Sep. 1	Lab 2	RC Filters
Sep. 6	Holiday	
Sep. 8, 13, 15	Lab 3	Operational Amplifier
Sep. 20, 22	Lab 4	Diodes
Sep. 27, 29	Lab 5	Transistors
Oct. 4, 6, 11, 13	Lab 6	Microcontroller Interfacing
Oct. 18, 20	Lab 7	Light Detection
Oct. 25, 27, Nov. 1, 3	Lab 8	LED Display
Nov. 8, 10, 15, 17	Lab 9	Integrated Optical Ranging System
Nov. 22, 24	Holiday	
Nov. 29, Dec. 1	Lab 9	Integrated Optical Ranging System

Grading:

- Informal lab reports: 80%
- Formal lab report: 20%

A	90-100	C	70-72
A-	86-89	C-	66-69
B+	83-85	D+	63-65
B	80-82	D	60-62
B-	76-79	F	<60
C+	73-75		

Lab reports: The students will submit 8 informal reports for Labs 1-8 and a formal report for Lab 9. The materials will be available on Canvas one week before the lab starts. For example, Lab 1 starts on Aug. 23 and the materials for Lab 1 will be available on Canvas by Aug. 16. For Labs 1-8, each lab requires students to submit an informal report. In the report, students need to clearly present the steps taken to complete each task (highlighted in yellow), observations and conclusions. There is no specific formatting requirement for the informal reports. While for Lab 9, students will submit a formal report with specific formatting requirements. Each lab report will be due by 12:00 pm on the first day of the next lab (avoid procrastination), e.g., the first lab report is due by 12:00 pm on Aug. 30. Late report will not be accepted unless requested via email before the due date with a valid reason. Students do not need to do check-in/out with the TAs, and the final grade only depends on the submitted reports. Students may work together on labs but must turn in individual reports that CANNOT BE IDENTICAL.

In-class open discussion: For review purpose, the 10 minutes from the beginning of the class will sometimes be reserved for an interactive in-class open discussion. The goal of this discussion is to encourage students to regularly review the course contents and practice technical presentation and communication. During this time, students may raise a topic to discuss (e.g., why the bandpass RC filter is a second-order circuit). The instructor may also lead the open discussion with a general topic or a specific problem. *The in-class open discussion does NOT have any impact on the course final grade.*

Some important notes:

1. Cables and oscilloscope probes. At the end of each class, before leaving the digital lab, hang all BNC cables (i.e., BNC-to-BNC, BNC-to-alligator, BNC-to-banana, etc.) back on the wall, put the oscilloscope probes back to the plastic bag and hand it in to TA. Note that the oscilloscope is fragile so handle it gently.
2. Use of analog lab. Analog lab will also be open during the class hours. There is a precision LCR meter hosted in the analog lab for extremely accurate measurement of inductance (L), capacitance (C), and resistance (R). Generally, the precision LCR meter is not needed for the lab assignments. There are also plenty of resistors, capacitors, and inductors stored in the drawer. Remember to put them back to the drawer after use.
3. TA support in the lab. Two TAs will assist in the lab running. Try not to occupy a TA continuously for more than 10 minutes. Also remember that TA is there for advice but not solution.
4. Electronics kit. Every student in the class will receive and own a kit of electronic components (e.g., electronics fun kit bundle, multimeter, op-amp, diodes, transistors, microcontroller, FPGA, etc.). The devices will be distributed according to the progress of the labs, e.g., FPGA used in Lab 8 - LED Display will be distributed later this semester.