Mixed Electronics Lab II
Spring, 2022
Lab: on F, 14:00 – 16:50 in Workman 116

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Course Description: Advanced laboratory working with analog/digital signals and systems. Project topics include solar power system, tone detection filters and digitization, state machines, and an integrated battery-free passcode verification system.

Mode of Instruction: Hands-on labs on F, 14:00 - 16:50 in Workman 116.

Pre-requisites: *EE 361* (Mixed Electronics Lab I)

Co-requisites: *EE 372* (Modeling and Simulation)

Place in Curriculum: This course is normally offered in Spring 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:

- Understand the operation principles of solar cells, such as conduction in semiconductor, formation of P-N junction, photovoltaic effect, and I-V curve of photodiode.
- Design and implement small-scale solar power systems, optimize the power generation, and regulate the voltage output.
- Design and implement analog bandpass filters with designated parameters, such as central frequency, gain at resonant frequency, and Q factor.
- Understand the digitization process of analog signals.
- Design and implement state machines on FPGA using Verilog.
- Understand the design strategies of a battery-free system.

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
Jan. 21		Syllabus and Canvas Navigation
Jan. 28, Feb. 4, 11	Lab 1	Solar Power System
Feb. 18, 25, Mar. 4	Lab 2	State Machine
Mar. 11	Lab 3	Tone Detector
Mar. 18	Holiday	
Mar. 25, Apr. 1	Lab 3	Tone Detector
Apr. 8	Lab 4	Battery-free Passcode Verification
Apr. 15	Holiday	
Apr. 22, 29	Lab 4	Battery-free Passcode Verification

Grading:

- Informal lab reports: 70%
- Formal lab report: 30%

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 3 informal reports for Labs 1-3 and a formal report for Lab 4. The materials will be available on Canvas one week before the lab starts. For example, Lab 1 starts on Jan. 28 and the materials for Lab 1 will be available on Canvas by Jan. 21. For Labs 1-3, 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 4, 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 Feb. 18. 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. *Note: The course final grade completely depends on the lab reports, contact the instructor via email or at (575)835-5932 if students have questions about the score of report.*

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. One TA will be assisting in the lab running. Do not assume the TA has a solution sheet since there is no solution sheet. It is highly recommended to contact the instructor directly when additional support is needed.
4. Electronics kit. Every student in the class will receive and own a kit of electronic components (e.g., solar cell, voltage regulator, microcontroller, FPGA, tone generator etc.). The devices will be distributed according to the progress of the labs, e.g., tone generator used in Lab 3 – Tone Detector will be distributed later this semester.