Mixed Electronics Lab II
Spring, 2023
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, state machines, tone detection filters and digitization, and an integrated 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 state machines on FPGA using Verilog.
- 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.

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.*

Textbook: *Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, Third Edition, McGraw-Hill, 2014*

Course schedule

Date	Lab	Topic
Jan. 20		Syllabus and Canvas Navigation
Jan. 27, Feb. 3	Lab 1	Solar Power System
Feb. 10, 17, 24, Mar. 3	Lab 2	State Machine
Mar. 10	Lab 3	Tone Detector
Mar. 17	Holiday	
Mar. 24, 31	Lab 3	Tone Detector
Apr. 7	Holiday	
Apr. 14, 21, 28	Lab 4	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. 27 and the materials for Lab 1 will be available on Canvas by Jan. 20.

In Labs 1-3, each lab requires students to submit an informal report. In the report, students need to complete each task (highlighted in yellow) to earn the associated points. There is no specific formatting requirement for the informal reports.

In Lab 4, students will form a team with 2 to 4 members, select a team leader, set up clear goals for each step, plan tasks for each member, and evaluate the goal completion rate. The team leader is responsible for evaluating the task completion rate of each team member, including himself or herself. Each team will submit one formal report with specific formatting requirements. Each team member will receive the same score based on the report.

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. 10. 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.

Lecture: On the first day of each lab, a lecture will be provided to review the background, principles and challenges of the lab assignments related to the topic.

In-class open discussion: For review purposes, an open discussion will be held prior to the lecture portion, linking knowledge learned in previous labs to real-world applications. The instructor will lead the discussion with questions and the students will discuss in small groups. *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 panel, voltage regulator, etc.). Multi-angle wedge plate, digital angle gauge and flashlight are only allowed to be used in the laboratory.