The University of Texas at Austin Walker Department of Mechanical Engineering ME 140L Mechatronics Lab Fall 2023

Lectures: Wednesday 12:00-1:00pm in PMA 4.102 Labs: Weekly per unique number in ETC 3.157

SWITCHING LABORATORY SECTIONS IS PROHIBITED, DUE TO SPACE & EQUIPMENT LIMITATIONS

Instructor: Dr. Wei Li

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Teaching Assistants:

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Description

Hands-on laboratory using hand-held and bench-top electronic test and prototyping equipment for circuits and mechatronics applications; computer-aided instrumentation and data acquisition; laboratory study in design, prototyping, and testing with electrical and electronics components and electromechanical devices.

Topics

Brief theory of direct and alternating current circuits: electric current, voltage, and power; DC and AC electric circuit theory; semiconductor electronics: diodes and transistors, operational amplifiers, transformers, logic devices; and electric machinery: elements of power conversion and transmission.

Learning Objectives

- Develop proficiency in using laboratory equipment necessary for testing engineering systems.
- Develop proficiency in constructing basic circuits to study electrical and mechatronic systems.
- Gain practical experience in testing and analysis of mechatronic systems.

Prerequisites

Credit or registration for Mechanical Engineering 340.

Textbook

None.

References

- Hambley, Alan R., Electrical Engineering: Principles and Applications, 6th Ed., ISBN-13: 978-0133116649
- Carryer, Ohline, and Kenny, Introduction to Mechatronics Design, Prentice Hall/Pearson, 2011, ISBN# 978-0-13-143356-4.
- deSilva, Clarence W., MECHATRONICS: An Integrated Approach, CRC Press, 2004, ISBN# 0-8493-1274-4.

Recommended Equipment

 ELEGOO UNO Project Super Starter Kit with Tutorial and UNO R3 Compatible with Arduino IDE

https://www.amazon.com/gp/product/B01D8KOZF4/ref=ppx_yo_dt_b_asin_title_o00_s00?ie=U TF8&psc=1

- AstroAI Digital Multimeter, TRMS 4000 Counts Volt Meter (\$23.99) <u>https://www.amazon.com/gp/product/B07FDBW1PT/ref=ppx_yo_dt_b_asin_title_o01_s00?i</u> <u>e=UTF8&psc=1 (Links to an external site.)</u>
- Belker 12W 3V 4.5V 5V 6V 7.5V 9V 12V Adjustable Voltage Universal AC/DC Adapter Power Supply (\$13.90) <u>https://www.amazon.com/gp/product/B07NKZCWT1/ref=ppx_yo_dt_b_asin_title_o01_s00?</u> <u>ie=UTF8&psc=1</u>

Software

MultisimLive, free online SPICE simulation software <u>https://www.multisim.com/</u>. Sign up required.

Course Website and Materials

 Course materials will be posted on Canvas: <u>https://utexas.instructure.com/courses</u>

These include course syllabus, lab procedures, handouts, announcements, and assignments.

Sharing of course materials outside the class is PROHIBITED: No materials used in this class, including, but not limited to, lab procedures, hand-outs, videos, assessments (projects, assignments), in-class materials, review sheets, and additional instructions, may be shared online or with anyone outside the class unless you have my explicit, written permission. Unauthorized sharing of materials promotes cheating. It is a violation of the University's Student Honor Code and an act of academic dishonesty. I am well aware of the sites used for sharing materials, and any materials found online that are associated with you, or any suspected unauthorized sharing of materials, will be reported to Student Conduct and Academic Integrity in the Office of the Dean of Students. These reports can result in sanctions, including failure in the course.

Class Recordings

Class recordings are reserved only for students in this class for educational purposes and are
protected under FERPA. The recordings should not be shared outside the class in any form.
Violation of this restriction by a student could lead to Student Misconduct proceedings.

Grading

Labs including deliverables, lab participation, overall scholarship and professionalism, such as tidiness of work area after lab session: 75% Final project: 25%

- There is no midterm or final exam for this course.
- Excessive tardiness for labs will result in a zero grade for that lab.
- If you miss three or more labs, you will automatically get an F for the course.
- Course grades may be curved, if deemed appropriate.
- Plus/minus grading will be used to assign final course grades.

93 or above	А
90 - 92	А-
87 - 89	B+
83 - 86	В
80 - 82	В-
77 – 79	C+
73 - 76	С
70 – 72	C-
67 – 69	D+
63 - 66	D
60 - 62	D-
59 or below	F

Grades will be posted on Canvas https://utexas.instructure.com/courses

Lab Deliverable Policies

- All deliverables are to be submitted electronically via Canvas on the assigned due date. Late submission of deliverables within three days of due date will automatically receive a half grade. In rare cases such as medical/family emergency, late deliverables can be accepted after arranging with Instructor/TA.
- Collaboration on lab activities and deliverables with other students is encouraged. However, *all the submitted must be your own work*. Any evidence of plagiarism or other forms of scholastic dishonesty will be grounds for a failing grade.

Attendance

Attendance and participation in all lectures and laboratory sessions are required. Prior arrangements need to be made with Instructor and TA for exception.

Course Schedule

The lecture on Wednesday covers materials related to lab activities of the following week. The table below is a tentative schedule that may change according to class progression.

Week	Lab	Lab Activity
1 (8/21)	No lab	
2 (8/28)	1	Equipment orientation, basic electrical measurements, and using Multisim
3 (9/4)	2	Source/Instrument Impedance, Divider Circuits, and Basic AC Measurements (RMS)
4 (9/11)	3	Introduction to the Oscilloscope; Analyzing First-Order Systems
5 (9/18)	4	Characterizing Diode Behavior, Light-Emitting Diodes, and Rectifier Circuits
6 (9/25)	5	Introduction to Transducers (Sensors), Integrated Circuit (IC) Elements, and Switches
7 (10/2)	6	Introduction to Operational Amplifiers (Op-Amps) and Transistors
8 (10/9)	7	DC Motor Characterization, Digital Encoders, and Speed Control
9 (10/16)	8	Microcontroller
10 (10/23)		
11 (10/30)	Project	Mechatronics Design Project: Windmill/Generator
12 (11/6)		
13 (11/13)	Demo	Demonstration of design project to TAs during lab sessions
14 (11/20)		Fall Break
15 (11/27)		Reserved for catching up

Classroom/Lab Policies

As part of your engineering educational experience, you are expected to conduct yourself professionally, as would be expected in the engineering workplace. As such, all students are expected to assist the Instructor and the TAs in fostering an environment that is conducive to learning. To ensure that all students benefit from time spent in class/lab, please observe the following:

- This course will be conducted in an environment that is open and welcoming to all students, regardless of gender, race/color/ethnicity, sexual orientation, gender expression, religion, political affiliation, prior educational experience, socioeconomic background, disability status, veteran status, etc. Please be respectful to your fellow classmates.
- Arrive to classes and appointments on time.
- The use of mobile phones and other electronic devices other than your laptop for the purposes of streaming during lecture and lab is prohibited, unless otherwise indicated by the Instructor or a TA. Speaking on the phone, texting, listening to music, surfing the web, etc. can disrupt the learning environment.
- Understandably, on occasion you might have to answer an urgent call or text message during

class. Please mute yourself and stop your video before doing so – we want to minimize disruptions to the learning environment.

Inappropriate behavior can distract your fellow classmates and will not be tolerated. You will
be removed from or asked to leave classroom/lab if such behavior becomes problematic.

Safe Practices

- For your safety, please observe "common sense" safety precautions in addition to any guidelines that are indicated by the Instructor, the TAs, and in the course materials. Do not take any unnecessary risks while working on your experiments – if you are unsure about something, ask for guidance from a TA before taking action.
- The following is a list of rules that should be observed when working with electrical equipment:
 - Turn off the power to equipment before inspecting it.
 - Use only tools and equipment with non-conducting handles when working with electrical devices.
 - All current transmitting parts of any electrical devices must be enclosed.
 - Maintain a workspace clear of clutter, such as books, papers, and clothes.
 - Never change wiring with circuit plugged into a power source.
 - Never plug leads into power source unless they are connected to an established circuit.
 - Avoid contacting circuits with wet hands or wet materials.
 - Check circuits for proper grounding with respect to the power source.

Tips for Effective Learning

Your Instructor and the TAs will provide numerous opportunities for learning in lectures and lab sessions, but it is important that you understand that you are also responsible for your own learning. What does this mean?

- When having difficulty with the course material, take the initiative to visit the Instructor and/or the TAs during office hours – or to make an appointment to meet outside of regularly scheduled office hours. You should be prepared to discuss where you are having trouble and what work you attempted up to that point.
- Ask questions and regularly participating in class/lab.
- Make an effort to get to know some of your classmates and get their contact information to keep updated in case you have to miss class, want to form study groups, etc.
- Understand that "productive struggle" is normal and that it is a sign that you are learning.
 Become accustomed to thinking like an engineer: critically thinking through a problem before
- Become accustomed to thinking like an engineer: critically thinking through a problem before writing anything and critically evaluating your answer, e.g., does this make sense?
- Understand that your Instructor or a TA may answer your request for help with a question. This is intentional: they are not trying to make your life miserable. Rather, they are trying to get you to think about a concept and struggle a bit – because, if you arrive at the answer on your own, you will learn it better and become more self-sufficient in the lab. Having said that, if you still struggle, then you are always free to ask for help again. The TA will help you more if it's clear that you are really stuck and/or having trouble with the equipment.

Electronic Communications

• The best way to communicate with Dr. Li and the TAs is through Canvas messaging. Regular e-mail is not considered a secure form of communication, e.g., University faculty and staff are prohibited from communicating private information through e-mail, including student information, registration information, assignment grades, exam grades, etc.

- If you have a question or concern about how your work was evaluated, please send your TA a message via Canvas. Please refrain from using the comments section on the canvas assignment to communicate with your TA. This will save your TA considerable time and will help him/her to address your concerns in a more timely manner.
- Dr. Li and the TAs will use the **Announcements** feature in Canvas to communicate with the class as a whole please make sure that your Canvas settings are configured so that you are alerted whenever a new announcement is posted.

Miscellaneous

- The deadline for dropping a course without possible penalty can be found in the current semester UT calendar, which can be accessed online at: http://www.utexas.edu/student/registrar/cals.html
- Allegations of Scholastic Dishonesty will be dealt with according to the procedures outlined in Appendix C, Chapter 11 of the General Information Bulletin, http://www.utexas.edu/student/registrar/catalogs/
- Student misconduct and academic integrity issues will be reported to Office of the Dean of Students. <u>http://deanofstudents.utexas.edu/conduct/reportanincident.php</u>
- The University of Texas at Austin provides, upon request, appropriate academic adjustments for quailed students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4241 TDD, or the College of Engineering Director of Students with Disabilities, 471-4321.
- Religious Observations: A student who misses classes or other required activities, including
 assignments, for the observance of a religious holy day should inform the Instructor as early as
 possible so that arrangements can be made to complete the missed work within a reasonable
 time.

ABET Program Outcomes Achieved Ability to identify, formulate, and solve complex engineering problems by applying $\sqrt{}$ 1 principles of engineering, science, and mathematics. 2 Ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factor. 3 Ability to communicate effectively with a range of audiences. Ability to recognize ethical and professional responsibilities in engineering situations 4 and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts. Ability to function effectively on a team whose members together provide leadership, 5 create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives. 6 Ability to develop and conduct appropriate experimentation, analyze and interpret $\sqrt{}$ data, and use engineering judgment to draw conclusions. 7 an ability to acquire and apply new knowledge as needed, using appropriate learning \checkmark strategies

ABET Program Outcomes Achieved through this Course