University of Oklahoma

School of Electrical and Computer Engineering

ECE 4433/5433: Measurement and Automation

Spring 2025

Time: Monday 1:30 – 5:05 p.m. It is CRITICAL that you attend class and work on your projects during class time. If you skip class, you are skipping a week of class work and will get behind very quickly.

Place:

Lecture: DEH420

Laboratory: Devon Energy Hall Room 125 (Devon Energy Hall First Floor, the glassy laboratory)

Instructor: Dr. Sarah Sharif, s.sh@ou.edu

Teaching Assistants: Sara Aminpour, sara.aminpour-1@ou.edu

Office Hours:

I highly recommend you meet your TA for any questions about HomeWorks and Projects.

- TA office hours
  - TBD

- Instructor's office hours
  - Monday 9 AM – 11 PM I am usually in my office (DEH331).
  - I will also stay in the lab (Deh125) after our class if you have any questions.

- Room DEH 125 is **a shared laboratory**, and it is being used by other courses as well. So, you need to consider this fact and try to work on your homework and your project in advance.

- Also, TA time is the best time for you to come and work on your projects if you need extra time or if you miss a class.

- Try to use the discussion post instead of sending emails because we have multiple people who will be able to provide responses, and we will all be able to see if someone has responded. You are also encouraged to respond to other student's posts. We encourage you to help each other if you can't figure out how to do something but make sure all work is done independently and you understand everything you have in your code. We reserve the right to have you go over your code with us to make sure it was done independently.

Learning Management System/website: Canvas Course page (https://canvas.ou.edu/courses/296836) (https://canvas.ou.edu/courses/296837)

Course Prerequisites: ECE 3793 or instructor permission or systems course in another major.

Prerequisites by topic: 1. Laplace Transform

2. Differential Equations, eigenvalues, eigenvectors
3. Numerical Methods (integration/differentiation)
4. Basic Systems theory, filters, sampling, transforms
5. Logic Gates
6. Basic knowledge of Signal and Systems

Course Description:

- This course provides an introduction to two main methods of controlling, measuring, and carrying out tasks in complex manufacturing and industrial applications.
- You will review the fundamentals of data acquisition and control, and you will do a series of design projects in data acquisition, logging, and real-time analysis, including but not limited to machine vision and image processing, as well as vibration, motion, and real-time control.
- The controlling software will be covered in this course, including LabVIEW software and CLICK PLC software.

Course Goals and Learning Outcomes:

The primary goal of a course on measurement and automation, covering PLC programming and LabVIEW, should be to equip students with a strong understanding and practical skills in designing, implementing, and troubleshooting automated systems.

1- You will gain a deep understanding of the f**undamental principles of measurement, control, and automation.** Some examples are sensors, timers, data acquisition, signal conditioning, control algorithms, and feedback loops.
2- You will get the knowledge and skills required **to program Programmable Logic Controllers (PLCs)** on how to design ladder logic diagrams, create sequential control logic, implement interlocking mechanisms, handle digital and analog signals, and troubleshoot PLC programs.
3- You will get the knowledge and skills required to use **LabVIEW for creating virtual instrument (VI)** applications, such as designing user interfaces, acquiring and processing data, implementing control algorithms, and visualizing results through graphical programming.
4- You will get **hands-on experience** through practical labs and projects. You will be able to apply theoretical knowledge to real-world scenarios, designing and building automated systems, programming PLCs, and creating LabVIEW applications.
5- You will encourage teamwork and effective communication skills by incorporating group projects or collaborative exercises. This reflects real-world scenarios where automation professionals often work together to achieve complex goals.
6- We will foster critical thinking by presenting you with open-ended challenges that require you to apply your knowledge creatively to solve unique automation problems to practice real-world scenarios.

Texts and Materials:

This course will use materials from multiple open-access sources, including the main textbooks below, which are available through the University of Oklahoma Libraries or online. The PowerPoint slides of lectures and any other information will be available through the Canvas platform. To complete your projects, you may need to review the literature available to the public via the Internet to come up with new ideas and architecture. Reviewing peer-reviewed articles is encouraged in this

course to provide you with a solid foundation for our class discussions and project design activities. For the software we are using in this class, I will provide PowerPoint slides, and you can find more references below. Lab instructions and handouts will be given during laboratory hours as needed.

1- Textbook for PLC: Programmable Logic Controllers by John R. Hackworth (I have order the book to be reserved for you at Bizzell Library)
2- Textbook for LabVIEW: https://shareok.org/handle/11244/325397 by Dr. Davis and Dr. Dyer
3- Reference for PLC Software: https://www.automationdirect.com/programmable-logic-controllers/plc-training
4- Reference for LabVIEW Software: https://learn.ni.com/learn/article/labview-tutorial

About Your Instructor:

In addition to my extensive academic background, I possess over a decade of hands-on industrial experience across various renowned companies, including SAMSUNG. My journey has encompassed roles ranging from labor-intensive tasks on assembly lines to a quality control manager overseeing operations on a grand scale. So, I have spearheaded the design and implementation of cutting-edge manufacturing lines, leveraging advanced technologies such as PLC and LabVIEW. The course I offer serves as a comprehensive gateway into the realm of measurement and automation systems, equipping participants with the foundational knowledge essential for navigating diverse applications across industries. This expertise is not only adaptable but also universally applicable, enabling individuals to excel within any system and environment from inception to realization. My ongoing research endeavors are centered around the intricate design and meticulous measurement of optical and quantum optical devices and systems. A paramount focus lies in the development of future-ready nanoscale optical devices and quantum optical systems, encompassing revolutionary domains like quantum communications, quantum radar, and quantum sensing. The ultimate objective of these pursuits is to pave the way for the forthcoming generations of quantum computers, harnessing the potential of quantum phenomena to revolutionize computational paradigms. My boundless enthusiasm for my research field is mirrored in my rich industrial experience, infusing my academic pursuits with real-world relevance. I eagerly anticipate the opportunity to engage in dialogue, address inquiries, and foster interactive learning experiences with each of you. If you are interested to know more about my research or like to join my research group to get research experience or pursue graduate study, please don't hesitate to deliver your interest and ideas. Every semester, I find immense inspiration in the exchange of knowledge with my students, which fuels my enduring passion for both teaching and research. This symbiotic relationship ensures that I remain invigorated and committed to furthering the boundaries of knowledge in my field.

Teaching Philosophy:

My objective is to establish an inclusive class where everyone feels welcome and empowered to learn and excel. Recognizing that each individual has a unique learning style, So, our discussions will encompass a blend of lectures, projects, and assignments. Our journey of acquiring knowledge is a continuous one, sometimes accompanied by the discomfort of delving into unfamiliar subjects. It's important to acknowledge that as we gain more knowledge, we often realize how much more there is to discover. The interconnections between different topics might appear intricate and

perplexing, but this is an integral part of the learning process. Patience is essential throughout this journey. As you concentrate on completing class assignments and project work, you'll engage in active learning by applying concepts in practical designs. **I want to emphasize that it's absolutely fine not to have all the answers right away; that's precisely why we're here – to learn and grow together.** I aspire to cultivate a collaborative learning environment, particularly within the realm of your projects, where mutual support drives your academic progress.

Expectations:

What you can expect from me:

To start and end class on time.

- To assign homework that adequately covers the material and meets the learning objectives of the course while adhering to the time expectations for a 3-credit course.
- To reply to e-mails within 48 hours on weekdays.
- To keep regularly scheduled student hours and to notify you of any changes in my availability.
- To provide you with enough opportunities to demonstrate and receive feedback on your learning objective to help you progress in your learning and to self-assess and identify areas in which you want to improve.
- To give exams that accurately reflect the material covered in class and assigned in homework so that you are provided an opportunity to demonstrate what you have learned. These exams will be appropriately challenging, but my hope is that our low-risk assignments will provide you with the support and practice to be successful.
- To give projects that support extracurricular reading and understanding based on the circuit and layout designs in the literature to make you aware of various approaches and methods and encourage hands-on and self-study in your design.

What I expect from you:

- To have academic Integrity. The Provost's web pages include information on expectations for academic integrity. Please review the material at http://www.ou.edu/provost/pronew/content/integritymenu.html. It is the aim of the faculty of the University of Oklahoma to foster a spirit of complete honesty and a high standard of integrity as well as academic excellence. Any attempt by students to present as their own any work that they have not honestly performed is regarded by the faculty and administration as a serious offense and renders the offenders liable to serious consequences, possibly suspension.
- To assist in maintaining a classroom environment that is conducive to learning. For example, come to class on time so we can maximize our time together, and I can begin and end class on time. In order to ensure that all students have the opportunity to gain from time spent in class. Please do not leave and reenter the classroom except for compelling reasons.
- To be attentive and engaged in class so that you can share your understanding of the material and ask questions when you need clarity. It is important for your learning to engage with both the lecture and design software sides of the course material.

- To spend an adequate amount of time on the homework and/or the project each week, making an effort to solve and understand the problem and the layout design. It will help you to achieve the learning objective of the class when you seek help so that you are provided the resources you need in order to actively engage in class.
- To take care of your experimental setup and be responsible for the lab's equipment.

To be successful in this class, all work on individual exams or projects must be yours and yours alone. We will ask you to look at your code frequently during class and give LabVIEW in-class quizzes to help ensure you are doing the work yourself. Should you see someone else engaging in behavior that does not align with OU's integrity policy, I encourage you to report it to myself or directly to the Office of Academic Integrity Programs. That student is devaluing not only their degree but yours, too. Be aware that it is my professional obligation to report academic misconduct, which I will not hesitate to do. Sanctions for academic misconduct can include expulsion from the University and an F in this course, so don't cheat. It's simply not worth it.

Assigning Grades:

The final grade you receive at the end of the course will be determined by the accumulated points you earn on individual assignments, midterm and final exams, and your contribution to your project. The number of points you earn is based on the quality of the work you submit. I will evaluate your participation and your team performance, efforts based on your reports and presentations, as well as engagement and contributions in group activities of your design projects. The design project will be implemented during class. Every group will be required to provide a classroom presentation of the project. The report is due two weeks before your final exam. The laboratory is an integral part of the course and will be the second part of the course after the lecture. Homework and projects will require extensive use of LabVIEW and PLC Ladder software.

The project report should be written either individually or jointly in the following format.

- Title and Project Description
- Full Logic Level Block Diagram
- Cell Level Description/Cell library
- Logic Level Diagrams, Logic-level Simulations, and Truth Tables
- Layout of Cells
- Code and Results
- Electronic Files of the designed in the software
- References

The project report must be word-processed and submitted in its original form (preferably softcopy). The report should also include your PowerPoint presentation slides.

Grading Overview:

Table 1: Grading Overview, assignments total 100% and this table shows how they are weighted towards your final grade		
Assignment	**Percentage of Final Grade ECE 4433**	**Percentage of Final Grade ECE 5433**
Homework Assignments (will be assigned through the canvas with a week deadline to submit them)	10%	10%
Pop Quizzes	10%	10%
Laboratory Projects	30%	20%
Graduate Student Project	NA	10%
Midterm Exam	15%	15%
Final Exam	15%	15%
Final Project (Report & Presentation will be due two weeks before the final exam)	20%	20%

Grading Scale: Your letter grade will be assigned based on the scale below.

A: 90-100%; B: 80-89.9%; C: 70-79.9%; D: 60-69.9%; F: 59.9% or below

Important: If you miss the deadline for one of the homework assignments or projects, you can still submit it by the next 24 hours after the deadline and get a 10% penalty. If you have a valid reason to get a penalty-free extension, you need to email the instructor and let him know **before the due date.**

Tentative Topics and schedule for the class:

This is a Primary list (not exhaustive) of topics taught in the course content.

Table 2		
Week/date	Topic	Assignment
Jan 13	Introduction about the course, Syllabus, Software installation	HM1
Jan 20	**M.L. King Jr. Day - No School Offices Closed**	
Jan 27	PLC1, HM1 due	Project 1
Fab 03	PLC2, Due Project 1	HM2/Project 2
Fab 10	Quiz 1, Graduate Student Project	Start at 1:30 PM Location: DEH125
Fab 17	PLC3, Due Project 2	HM3/project3
Fab 24	PLC4, Final project proposal, Due HM3, project 3	HM4/project 4 Graduate Students Project Final project proposal
Mar 03	Due Final project **proposal** presentation by students, Due project 4	HM4 and Project 4 is not included Start at 1:30 PM Location: DEH125
Mar 10	Midterm Exam	
Mar 17	**Spring Vacation**	
Mar 24	LabVIEW introduction, Labview 1, Due Graduate Students Project	Project 5
Mar 31	LabVIEW 2, Due Project 5	project 6
Apr 07	LabVIEW 3, Due project 6	Extra time to work on Final Project
Apr 14	LabVIEW 4, Due HM5 in class	HM5
Apr 21	Final Project Presentation 1, Due final project reports	
Apr 28	Final Exam	Start at 1:30 PM Location: DEH125

*Please see below the OU final exam policies:

"Classes meeting one day a week for more than one hour with a start time before 5:00 PM will have the final examination during the last lecture period. Classes in this format have been scheduled with sufficient meeting time during the semester to compensate for time lost in the final examination week."

https://www.ou.edu/registrar/academic-records/academic-calendars/final-exam-schedule/final-exam-policies

General subject for the projects:

1. System modeling and instrumentation
2. Basic controller design
3. Sensing, monitoring, and diagnostics
4. Time Sequence in controlling a system.

5. Fundamentals of data acquisition
6. Digital signal processing and sampling
7. Data acquisition and analysis development
8. Data acquisition and control development
9. Digital image processing
10. Audio acquisition and analysis

Course Policies:

I understand that many of us may be faced with unforeseen circumstances that can prevent us from completing our work on time or attending every session. Our late work and attendance policy exists by providing official documents to show your excuses. Your participation is crucial not only to your own success but also to contribute to the success of your peers, who are able to learn from what you bring to the classroom.

Exam Policy: The Tests, Midterm, and Final Exams will be closed books and closed notes. Makeup exams will not be given. If you miss an exam and your absence is NOT officially excused, you will receive a zero grade for that exam. If you miss an exam and your absence is officially excused, *your Final Exam grade (as a comprehensive exam) will be used in place of the missed exam grade.*

Assignment Policy: Deadlines within this class have been created to allow for: peer engagement, for me to be able to assess if everyone understands the course material or if we need to revisit some of the subjects, and to provide me with the time needed to grade so that you can receive feedback as quickly as possible.

If you miss the deadline for one of the homework assignments or projects, you can still submit it (and get a 10% penalty) as long as the solution has not been released. We usually release the solution several days after the deadline. If you have a valid reason to get a penalty-free extension, you need to email the instructor and let him know before the due date.

Many of the projects will also require you to demonstrate the workability of the project to the instructor or TA prior to submission. The projects are assigned and monitored in the instructional lab, but the students can work on them on their personal computers outside of class as needed.

Homework assignments will generally be due on Canvas at midnight on the published due date. The reason for this policy to not accept late assignments is that accepting a late assignment from one student is unfair to other students who may have stayed up all night to complete the assignment by the deadline. Another reason for this policy is that the overall learning outcomes of the assignment will not be achieved by delaying the posting of homework solutions. However, the due date might be extended a few days in some circumstances might be grated for all students. For paper and pencil homework assignments, you should scan or photograph your solution and upload it to Canvas.

Canvas Upload Errors:

It is your responsibility to make sure the file is really uploaded onto Canvas and that you uploaded the correct file. If your file didn't upload or you uploaded the wrong file, you won't get a 2nd chance. I **highly recommend** clicking on your file to verify it uploaded correctly. If Canvas isn't working, then email it to the instructor before the deadline.

Attendance Policy: In order to fully benefit from our class activities, you are expected to attend class and actively participate in the design project and lectures. Students are responsible for the content of the courses in which they are enrolled, and lecture and laboratory attendance for this course are mandatory. Students have a responsibility to inform faculty prior to absences whenever possible. If you know that you are going to miss class because of an illness or an emergency, please email me to let me know. For this course, you have one automatically excused absence, which cannot be used on presentation days, exam reviews, or exam days. Any assignments that are due on the day would still need to be completed in accordance with our late work policy. Even on the day on which you use your automatically excused absence, you are expected to notify me. If I don't get an email from you and you are absent, I will assume that you have chosen not to attend. If you wait until the end of the semester to excuse your absences and share what happens that keeps you from attending, it will be late, and we have to drop the course or apply for medical waivers. Additional excused absences are at my discretion (accommodations, as communicated, due to ADRC, medical emergencies, etc.). Again, if you miss class, it is your responsibility to find out from one of your colleagues what we covered and to get any information that I gave out in class.

Laboratory Policy: Not only is collaborative work during a design project an important professional skill to develop, it also helps you learn! Teaching one another and discussing the course content together during the design project will help you master the course objectives, as it will require you to develop a deeper understanding. But collaborative work must be truly collaborative in order for everyone to reap the benefits. This means that you will have to contribute meaningfully and share labor. So, I expect everyone engages equally in the project during lab hours. The policy of the laboratory is the same as the lecture (described above). Eating and drinking are strictly forbidden in the laboratory. The use of cellphones is strictly prohibited and your engagement in the design project is essential.

Expectations for Academic Integrity and Plagiarism:

The overall goal of this course is your learning. In order to demonstrate that you have reached this goal, the work you turn in needs to be your own. If you work in a group, seek assistance from a tutor, or use one of the resources on campus, the work you turn in must be in your own words, demonstrating your own understanding of the material that you have gained through the learning process. Putting written work into your own words and citing your sources help you to avoid plagiarism. Penalties for serious offenses include a zero on the assignment and egregious offenses can even result in expulsion from the university, so it is important to understand expectations. The most serious offenses can often be avoided by citing sources—when in doubt, cite it! As part of our work together we will talk about how to accurately and responsibly cite sources, both to avoid plagiarism and strengthen your arguments. Plagiarism as defined by the OU Integrity Office includes

(1) Copying words and presenting them as your own writing; (2) Copying words, even if you give the source unless you also indicate that the copied words are a direct quotation; (3) Copying words and then changing them a little, even if you give the source; and (4) Even if you express it in your own words, it is plagiarism to use someone else's idea as your own.

University Policies:

We also adhere to following university policies in this course.

Mental Health Support Services

Support is available for any student experiencing mental health issues that are impacting their academic success. Students can either been seen at the University Counseling Center (UCC) located on the second floor of Goddard Health Center or receive 24/7/365 crisis support from a licensed mental health provider through TELUS Health. To schedule an appointment or receive more information about mental health resources at OU please call the UCC at 405-325-2911 or visit University Counseling Center. The UCC is located at 620 Elm Ave., Room 201, Norman, OK 73019.

Title IX Resources and Reporting Requirement

The University of Oklahoma faculty are committed to creating a safe learning environment for all members of our community, free from gender and sex-based discrimination, including sexual harassment, domestic and dating violence, sexual assault, and stalking, in accordance with Title IX. There are resources available to those impacted, including: speaking with someone confidentially about your options, medical attention, counseling, reporting, academic support, and safety plans. If you have (or someone you know has) experienced any form of sex or gender-based discrimination or violence and wish to speak with someone confidentially, please contact OU Advocates (available 24/7 at 405-615-0013) or University Counseling Center (M-F 8 a.m. to 5 p.m. at 405-325-2911).

Because the University of Oklahoma is committed to the safety of you and other students, and because of our Title IX obligations, I, as well as other faculty, Graduate Assistants, and Teaching Assistants, are mandatory reporters. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This includes disclosures that occur in: class discussion, writing assignments, discussion boards, emails and during Student/Office Hours. You may also choose to report directly to the Institutional Equity Office. After a report is filed, the Title IX Coordinator will reach out to provide resources, support, and information and the reported information will remain private. For more information regarding the University's Title IX Grievance procedures, reporting, or support measures, please visit Institutional Equity Office at 405-325-3546.

Reasonable Accommodation Policy

The University of Oklahoma (OU) is committed to the goal of achieving equal educational opportunity and full educational participation for students with disabilities. If you have already established reasonable accommodations with the Accessibility and Disability Resource Center (ADRC), please submit your semester accommodation request through the ADRC as soon as possible and contact me privately, so that we have adequate time to arrange your approved academic accommodations.

If you have not yet established services through ADRC, but have a documented disability and require accommodations, please complete ADRC's pre-registration form to begin the registration

process. ADRC facilitates the interactive process that establishes reasonable accommodations for students at OU. For more information on ADRC registration procedures, please review their Register with the ADRC web page. You may also contact them at (405)325-3852 or adrc@ou.edu, or visit www.ou.edu/adrc for more information.

Note: disabilities may include, but are not limited to, mental health, chronic health, physical, vision, hearing, learning and attention disabilities, pregnancy-related. ADRC can also support students experiencing temporary medical conditions.

Religious Observance

It is the policy of the University to excuse the absences of students that result from religious observances and to reschedule examinations and additional required classwork that may fall on religious holidays, without penalty. [See Faculty Handbook 3.15.2]

Adjustments for Pregnancy/Childbirth Related Issues

Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact the Accessibility and Disability Resource Center at 405/325-3852 and/or the Institutional Equity Office at 405/325-3546 as soon as possible. Also, see the Institutional Equity Office FAQ on Pregnant and Parenting Students' Rights for answers to commonly asked questions.

Final Exam Preparation Period

Pre-finals week will be defined as the seven calendar days before the first day of finals. Faculty may cover new course material throughout this week. For specific provisions of the policy please refer to OU's Final Exam Preparation Period policy.

Emergency Protocol

During an emergency, there are official university procedures that will maximize your safety.

Severe Weather: If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather.

1. Look for severe weather refuge location maps located inside most OU buildings near the entrances.
2. Seek refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building.
3. Go to the building's severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows.
4. Get in, Get Down, Cover Up
5. Wait for official notice to resume normal activities.

Additional Weather Safety Information is available through the Department of Campus Safety.

The University of Oklahoma Active Threat Guidance

The University of Oklahoma embraces a Run, Hide, Fight strategy for active threats on campus. This strategy is well known, widely accepted, and proven to save lives. To receive emergency campus

alerts, be sure to update your contact information and preferences in the account settings section at one.ou.edu.

RUN: Running away from the threat is usually the best option. If it is safe to run, run as far away from the threat as possible. Call 911 when you are in a safe location and let them know from which OU campus you're calling from and location of active threat.

HIDE: If running is not practical, the next best option is to hide. Lock and barricade all doors; turn of all lights; turn down your phone's volume; search for improvised weapons; hide behind solid objects and walls; and hide yourself completely and stay quiet. Remain in place until law enforcement arrives. Be patient and remain hidden.

FIGHT: If you are unable to run or hide, the last best option is to fight. Have one or more improvised weapons with you and be prepared to attack. Attack them when they are least expecting it and hit them where it hurts most: the face (specifically eyes, nose, and ears), the throat, the diaphragm (solar plexus), and the groin.

Please save OUPD's contact information in your phone.

NORMAN campus: *For non-emergencies call (405) 325-1717. For emergencies call (405) 325-1911 or dial 911.*

TULSA campus: *For non-emergencies call (918) 660-3900. For emergencies call (918) 660-3333 or dial 911.*

Fire Alarm/General Emergency

If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates:

1. *LEAVE* the building. Do not use the elevators.
2. *KNOW* at least two building exits
3. *ASSIST* those that may need help
4. *PROCEED* to the emergency assembly area
5. *ONCE safely outside, NOTIFY first responders of anyone that may still be inside building due to mobility issues.*
6. *WAIT* for official notice before attempting to re-enter the building.

OU Fire Safety on Campus