SE 423 – INTRODUCTION TO MECHATRONICS

Spring 2026

http://coecsl.ece.illinois.edu/se423

Course Information

Lecture:

Monday and Wednesday, 9:00 AM – 9:50 AM, Room 1302 Siebel Center for Computer Science

Laboratory Sections:

- Lab AB1: Wednesday, 3:00 PM – 5:50 PM, Room 3080 ECEB
- Lab AB2: Thursday, 2:00 PM – 4:50 PM, Room 3080 ECEB
- Lab AB3: Thursday, 9:00 AM – 11:50 AM, Room 3080 ECEB

Instructional Staff

Instructor:

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Office Hours: Tuesday 2:00–5:00 PM in 3080 ECEB and by appointment

Teaching Assistants:

- Dan Block
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  Office Hours: Tuesday 2 – 5PM and by appointment
- Sam Folorunsho
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  Office Hours: Monday 4 – 6PM By appointment
- Lakshmi Manoj
  Email: lmanoj2@illinois.edu
  Office Hours: Tuesday 11 AM – 1 PM in 3080 ECEB and by appointment

Textbook

Not required but recommended:
- Herbert Schildt, *Teach Yourself C*, Third Edition, Osborne McGraw-Hill, 1997.

• Beej's Guide to C Programming. https://beej.us/guide/bgc/
Any equivalent C programming textbook is acceptable.

Prerequisites

SE 320 or an equivalent control systems course. Prior experience with C programming is highly recommended.

References

- J. Edward Carryer, R. Matthew Ohline, and Thomas W. Kenny, *Introduction to Mechatronic Design*, Prentice Hall, 2011.
- David G. Alciatore and Michael Histand, *Introduction to Mechatronics and Measurement Systems*, 2nd ed., McGraw-Hill, 2003.
- Thomas J. Bress, *Effective LabVIEW Programming*, NTS Press, 2013.
- John Billingsley, *Essentials of Mechatronics*, Wiley-Interscience, 2006.
- Roland Siegwart and Illah R. Nourbakhsh, *Introduction to Autonomous Mobile Robots*, MIT Press, 2004.
- Gene F. Franklin, J. David Powell, and Abbas Emami-Naeini, *Feedback Control of Dynamic Systems*, Addison-Wesley.

Assignments and Assessments

Homework and lab due dates are listed in the course schedule. Due dates may be adjusted as needed and announced in class.

The Lab "check off" procedure will be explained thoroughly in your lab section.

If you are late for an assignment you will be given a 0% for the grade, and only for special circumstances would this be exempt (DRES, family problems, etc.).

Quizzes

Lecture quizzes are not planned but may be introduced depending on attendance.

Semester Project

This is where you will put it all together. I still have not made up my mind on the exact final project for this semester but it will be similar to previous semesters. See the listing on the right side of the screen at htttp://coecsl.ece.illinois.edu/se423. You will work in groups of 4 to complete the project. There will be specified "checkpoint" due dates to make sure you keep on the right track and do not wait until the last week to finish all the work.

Grading of this project is heavily focused on the amount of work you put into the project throughout the semester and not necessarily on the success of the project. Even though this is a group project, you will be graded individually on the amount of work you put into the project.

Groups will have at least one weekly meeting with me (or one of the TAs) to demonstrate progress but I expect we will be meeting even more often as you have questions, etc. with your project.

Grading Breakdown

All students are encouraged to attend every class period. The lecture content will follow the laboratory assignments in an obvious manner, so failure to attend a lecture will be a severe handicap in the lab.

Component	**Weight**
Lab Check-offs	30%
Homework	25%
LabVIEW Assignments	5%
Quizzes	5%
Semester Project	35%

The semester project will represent the entire content of the class and is representative of a final exam grade. You are REQUIRED to attend the final project demonstration day which will be **May 15th, 2026, from 11:00am to 2:00pm**. Make sure to write this date in your calendar for this semester.

Academic Integrity

Policy on cheating

Students are encouraged to work together on homework assignments; however, original solutions are required. For homework, the threshold of cheating is defined as follows: If the person grading the assignments is able to identify students who have worked together by their solutions or specific aspects of their solution approach, then the solutions are not original! A homework or other assignment where cheating is found will automatically be given a zero grade

Copying of information from websites without proper citation is considered cheating. Any copying of information without proper citation will result in a zero grade for the assignment.

Policy on AI-Generated Content

Students are allowed to use AI tools to help with their work, primarily for brainstorming, debugging, and conceptual support; however, it is highly recommended to avoid them for whole-code generation, especially if you are a beginner software engineer, as this will prevent you from learning and understanding what you are doing. Generally, it is highly recommended not to use code from AI tools, and if you do, you should understand it, be able to explain it in detail to a TA, and later be able to reimplement it without using AI. If you are unable to reach that level of understanding, you will be asked to delete and redo the work. You are here to learn, not just copy and paste!

Due to the niche hardware we will be working with, it is also unclear how accurate the AI tools will be in helping with specific hardware or software problems. Please check the code and hardware

documentation before running anything or ask a TA for help instead. An AI content detector may be used to verify the originality of your content in case your work is not your own.

If you have relied on AI for content, you are expected to comment the lines that have been copied and pasted from AI with code comments stating the AI model used at the lines that have been copied and pasted, and for written work, have a statement saying:

"During the preparation of this work, X used ChatGPT (OpenAI) to X. After using this tool, X reviewed and edited the content as needed and takes full responsibility for the content."

Course Schedule

Table 1: Lecture Topics and Lab Schedule

Lecture Date	**Topics**	**Current Lab**
Wednesday, January 21	Introduction. What is Mechatronics? What parts are we focusing on? Walk through Syllabus.	Lab #1
Monday, January 26	• Look at the LaunchXL-F28379D board and the green expansion board. Start to understand the pinout. What are System and Peripheral Registers? Hex numbers and Bitwise operators. • Code Composer Studio Development Environment • Default starter code • Timers and Digital I/O Pins	
Wednesday, January 28	• Digital Outputs. Turn on and off an LED • Digital Inputs. Pull-up resistor. Passive Push Button • What is a peripheral register? How many I/O pins does the F28379D have? Talk about the pin multiplexer.	Lab #1 / Soldering
Monday, February 02	• What is a CPU interrupt? Timer interrupt functions • `printf`, `sprintf`, null terminated strings • RS 232 Serial Port, The ASCII character set • 16 bit and 32 bit integers and 2s compliment numbers	
Wednesday, February 04 **HW#1 Due (9AM)** **LabVIEW #1 Due (5PM)**	• What is a DAC and how does it work? What is an ADC and how does it work? • F28379D ADC Peripheral Architecture	Lab #2

Lecture Date	Topics	Current Lab
Monday, February 09	• Continue with ADC peripheral. ADC Resolution. Successive Approximation Register (SAR) type of ADC. • What is an Optical Encoder? • What is a PWM signal? How to generate a PWM signal with the F28379D EPWM peripheral. • H-bridge, Example circuit	
Wednesday, February 11	• Examples using the EPWM peripheral. The RCservo Motor. • What is an Optical Encoder Sensor? Calculating velocity • Friction Compensation	Lab #3 / Scope
Monday, February 16	• Filter design and implementation, Filter Examples in Matlab • Use DMA to store ADC samples. Using the FFT algorithm to find signal's dominant frequencies. • Ping/Pong Buffering	
Wednesday, February 18	Continue Filter Design and FFT Algorithms.	Lab #3
Monday, February 23	Review three serial ports UART, SPI, I2C. SPI 4 clock modes. F28379D SPI peripheral registers	
Wednesday, February 25 **HW#2 Due (9AM)** **LabVIEW #2 Due (5PM)**	• DAN28027 SPI Interface Datasheet • Connecting multiple slave devices to one SPI serial port. • Understand the F28379D's SPI Receive and Transmit FIFO	Lab #4
Monday, March 02	• PID Control: Integral Windup & Rollover • Robot Speed and Steering Control	
Wednesday, March 04	• Linux for Embedded Systems • Threads, Processes, and Applications • Review Lab #5's LabVIEW display requirements	Lab #4
Monday, March 09	• Sensors: CAN IR, Rate Gyro, LIDAR • Wall-following, Inner-loop and Outer-loop controllers • Review LABVIEW application expectation.	
Wednesday, March 11	• Coordinate Transforms • Dead-reckoning • Handling Gyro Drift • Landmark Detection with distance sensors	Lab #5
Monday, March 16	**Spring Break**	**Spring Break**

Lecture Date	Topics	Current Lab
Wednesday, March 18	**Spring Break**	**Spring Break**
Monday, March 23	• Talk about the LIDAR. How it works and How we interface with it. • Understand the data received by the LIDAR	
Wednesday, March 25 **HW#3 Due (9AM)**	Review SPI serial interface and how to communicate with the MPU-9250 IMU chip.	Lab #6
Monday, March 30	Revisit developing Linux applications. Deciding what processes can run in a non-real-time environment and what processes need to run in a real-time environment.	
Wednesday, April 01	• Introduce Vision Processing • CMOS Cameras and the BAYER format. • Centroid calculation • RGB & HSV color space • Blob detection algorithm	Lab #6
Monday, April 06	• Introduce the OpenMV camera module • Robot following Flash light / Bright Color	
Wednesday, April 08 **HW#4 Due (9AM)**	• Using camera to calculate distance to an object • Using Landmarks to update robot's position	Lab #6 (RC Servo)
Monday, April 13	Path Planning: Bug Algorithms & A*.	
Wednesday, April 15	A* Path Planning Implementation.	Lab #7
Monday, April 20	A* Path Planning (Cont.).	
Wednesday, April 22 **HW#5 Due (9AM)**	A* Path Planning (Cont.).	Lab #7
Monday, April 27	• Dead-Reckoning • Using Landmarks to update robot's position • Using Kalman filtering to help mix OptiTrack motion capture data with Dead-Reckoned robot position	Project
Wednesday, April 29	Kalman Filtering: Code Walkthrough.	Project
Monday, May 04	Kalman Filtering and Move-to-XY Logic.	Project
Wednesday, May 06 **HW#6 Due (9AM)**	Move-to-XY Code Finalization.	Project
Thursday, May 14	**Final Project Presentations (11:00–2:00)**	