

Instructor

Isuru Godage, PhD.

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Lab Hours

We 5:00 – 5:30 PM and Th 1:30 – 4:45 PM.

Zoom link to the meeting:

<https://depaul.zoom.us/j/96131011191?pwd=aENOMmgYbWFXN3dveHpFRG5QbG1Zz09>

Course Web Page

This syllabus, as well as the class lecture notes, homework assignments, and other links, are available on D2L. Please check the D2L news/discussion forum regularly.

Course Description

CSE 333 is the third in a three-course sequence that provides a comprehensive overview of core CPS topics in an application-driven context and with an emphasis on fundamental engineering design principles of modularity and abstraction.

This second course focuses on understanding the modeling and control of cyber-physical systems. The class consists of two weekly lab sessions; 1.5 hours of discussions covering the material and methods and 3 hours of lab exercises to solidify the theory components covered in the class in the context of designing, analyzing, managing, and testing hardware device models and underlying theoretical foundations.

Course Objectives

In this course, students will:

- Understand the fundamentals of digital hardware and microcontroller system architectures
- Learn different low-level communication protocols and use thereof to interact with sensors and actuators
- Use Arduino, Raspberry Pi, and ESP32 SoCs to develop moderately sophisticated Cyber-physical systems.
- Characterize and error analysis of sensors and transducers
- Analyze the dynamic response of systems
- Derive system transfer functions
- Perform frequency response analysis
- Derive and implement closed-loop controllers
- Combine the system modeling and controller designs to qualitatively and quantitatively meet desired performance indices of cyber-physical systems

Prerequisites

Students must also have taken CSE 332 (or Instructor approval). Also, students must have passed these courses or have been waived out of them. More to the point, students must already know how to solve simultaneous equations, matrix manipulation, and differential equations. Software tools will be used to solve and analyze mathematical relationships governing various cyber-physical systems. If you have any questions, refer to the Instructor.

Important:

- This is both lecture/discussion-based and hands-on class. Students are strongly advised to take part in all the online sessions. Students are not permitted to join the ZOOM sessions 15 minutes after the meeting has started.
- Labs and homework are individual activities.

Course Format

The course provides the material you will need to understand the fundamental concepts covered during the course, including:

- Lectures (1.5 hrs/week).
- Weekly lab (3 hrs/week) for hands-on analyzing, modeling, testing, and verification of physical systems models.
- Weekly lab and homework assignments.
- Resources such as videos, notes, and code files via D2L.
- Self-Assessment resources on D2L, including lecture questions/answers, and unit quizzes/solutions, to assess your progress and understanding.
- A final exam to assess the understanding of the material covered in class.

Required textbooks

Mechatronics: A foundation course (1st edition) by Clarence W. de Silva

(<https://www.amazon.com/Mechatronics-Foundation-Clarence-W-Silva/dp/1420082116/>), 2010.

Getting started with MATLAB

(<https://www.mathworks.com/help/matlab/>). Available as a PDF

(https://www.mathworks.com/help/pdf_doc/matlab/getst art.pdf) by Mathworks Inc.

Getting started with MATLAB Simulink

(<https://www.mathworks.com/help/simulink/index.html>).

Available as a PDF

(https://www.mathworks.com/help/pdf_doc/simulink/sl gs.pdf) by Mathworks Inc.

Grading

The course grade is apportioned as follows:

- Homework 25%
- Lab assignments and reports 45%
- Final Exam 25%
- Participation 5%

Homework: Homework (PDF version; no hard copies will be provided in class) will be available on D2L. Complete the homework and submit it before the next class meeting. The template for lab reports is available on D2L.

Labs Assignments: Lab exercises (PDF version, no hard copies will be provided in class) will be available on D2L. You will need to complete lab assignments, prepare a lab report based on the material covered, and submit (via D2L) the weekly assignment before the next class meeting. The template for lab reports is available on D2L.

Final Exam: Instructions about the final exam will be posted on D2L.

Participation: Your participation in the class and labs will be noted and graded out of 5% assigned for the final grade.

The grading rubric for normalized marks:

A	A-	B+	B	B-	C+
95-100	91-94	88-90	85-87	81-84	77-80
C	C-	D+	D	F	I
73-76	69-72	65-68	61-64	0-60	*

* **Incomplete:** An incomplete grade is given only for an exceptional reason such as a death in the family, a severe illness, etc. Any such reason must be documented. Any incomplete request must be made at least two weeks before the final and approved by the Dean of CDM. Any consequences resulting from a poor grade for the course will not be considered valid reasons for such a request.

To do well in this course: To do well in this course, you should come to class regularly, participate in the discussion and lab activities, read the assigned readings each week as indicated in the homework assignments, and talk to the Instructor promptly if you have any problems.

Policies

Deadlines for adds drops, and withdraws

See the deadlines in <https://www.depaul.edu/university-catalog/academic-handbooks/undergraduate/university-information/Pages/academic-calendar.aspx>

Changes to Syllabus

This syllabus is subject to change as necessary during the quarter. If a change occurs, it will be thoroughly addressed

during class, posted under Announcements in D2L and sent via email.

Online Course Evaluations

Evaluations are a way for students to provide valuable feedback regarding their Instructor and the course. Detailed feedback will enable the Instructor to continuously tailor teaching methods and course content to meet the learning goals of the course and the academic needs of the students. The evaluations are anonymous; the instructor and administration do not track who entered what responses. Students complete the evaluation online in [CampusConnect](#).

Academic Integrity and Plagiarism

This course will be subject to the university's academic integrity policy; the following is an excerpt from the policy. More information is available at <http://academicintegrity.depaul.edu/>.

Academic Policies

All students are required to manage their class schedules each term in accordance with the deadlines for enrolling and withdrawing, as indicated in the University Academic Calendar. Information on enrollment, withdrawal, grading, and incompletes can be found at <http://www.cdm.depaul.edu/Current%20Students/Pages/PoliciesandProcedures.aspx>

Students with Disabilities

Students who feel they may need an accommodation based on the impact of a disability should contact me in private as early as possible in the quarter (preferably within the first week of class), to discuss their specific needs, and make sure that you have contacted the [Center for Students with Disabilities \(CSD\)](#). All discussions will remain confidential.

Syllabus

1. Introduction
2. Revision of sensors and actuators
3. Introduction to Arduino Uno system
4. Interface sensors/actuators using SPI and I2C protocols
5. Interrupts, timers, sleep modes, and power saving techniques
6. Introduction to Raspberry Pi system
7. Networking, remote access, and power management
8. Solar cells and DC-DC power supplies
9. Interface ADC/DAC chips to RPi
10. Introduction to ESP32 system
11. Networking with Bluetooth and wifi
12. Interface motors and implement closed loop control