



蘇州大學
Soochow University

ENR 331 Integrated Mechatronics and Control Systems

Summer 2024

Course Credits: 4

Contact Hours: 56 hours

Instructor: TBA

Email: TBA

COURSE OBJECTIVES

This course provides an in-depth exploration of Embedded Control Systems, focusing on the integration of mechanical and electronic components to design and control complex systems. Students will gain a comprehensive understanding of fundamental principles, embedded software systems, sensors for mechatronic applications, and the intricate balance between control design, computational complexity, and certifiability.

Upon completion of this course, students will be able to:

1. Implement state inference in an embedded system.
2. Design and implement a foundational control solution within an embedded system.
3. Model and incorporate state and actuator constraints into the control solution.
4. Assess the repercussions of control system limitations and the finite computing capabilities of embedded systems, considering design trade-offs between performance, robustness, and certifiability.
5. Illustrate the design of embedded control systems as a comprehensive and synergistic integration of cyber-physical systems.

PREREQUISITES

CS 100 Introductory Computer Science; ENR 151 Electrical and Electronics Control Systems

GRADING

Grades will be determined by accumulating points, with 100 points being the maximum, as follows:



ITEM	POINTS
Class Participation	10 Points
2 Quizzes	20 Points
2 Laboratory Exercise	20 Points
Midterm Exam	25 Points
Final Exam	25 Points
Total	100 Points

Late submissions will be graded at the end of the course. Grades will be assigned according to the following rule:

$$A \geq 90 > B \geq 80 > C \geq 70 > D \geq 60 > F.$$

We reserve the right to make adjustments to the overall grading policy.

COURSE MATERIALS

Required Texts:

1. Godfrey C. Onwubolu, *Mechatronics: Principles and Applications*(1st ed), 2005, Butterworth-Heinemann.
2. Norman S. Nise, *Control Systems Engineering*(7th ed), 2014, Control Systems Engineering.

Recommended (Optional) Texts or Other Materials:

None

COURSE TOPICS

MODULE	TASKS
Module 1	Topics: Topic 1: Introduction to Embedded Control Systems Topic 2: Basics of Mechatronics Topic 3: Embedded System Architecture Topic 4: Real-time Operating Systems for Embedded Systems Assessments: Quiz # 1
Module 2	Topics: Topic 5: Control System Principles Topic 6: Sensors and Actuators in Mechatronics Topic 7: Embedded Software Development Topic 8: Multi-domain State-space Modelling of Embedded Control



	Systems Assessments: Laboratory Exercise # 1
Module 3	Topics: Topic 9: Control Algorithms for Mechatronic Systems Topic 10: Power Electronics for Mechatronics Topic 11: Design of Model-based Control Solutions, from Sensors to Actuators Topic 12: Trade-offs and Constraints for Control Design, Computational Complexity and Certifiability of Embedded Systems Assessments: Midterm Exam
Module 4	Topics: Topic 13: Software, Processor, and Hardware in the Loop Testing Topic 14: System Integration Challenges Topic 15: Motion Control in Mechatronic Systems Topic 16: Wireless Sensor Networks Assessments: Quiz # 2
Module 5	Topics: Topic 17: Automotive Embedded Control Systems Topic 18: Energy Harvesting for Embedded Systems Topic 19: Security and Safety in Embedded Control Systems Topic 20: Validation of embedded control solution against control objectives Assessments: Laboratory Exercise # 2 Final Exam

ATTENDANCE

1) Class attendance is required. Missing classes without permission will lead to decrease in overall grade.

Missing less than two classes: no penalty.

Missing more than two classes: 7% will be taken off from the overall grade.

If the instructor reports a student's frequent missing of class to the Soochow University Academic Administration Office, the student might get a written warning and might be prohibited from attending final exam.

2) Participants in this course are expected to arrive in class promptly and adequately



prepared. The primary objective of this course is to critically engage with the readings and the subject matter. Therefore, course participants are expected to have completed the reading prior to class and prepare thoughtful reflections/commentaries to share with fellow colleagues.

LEARNING REQUIREMENTS

- 1) Late assignments are not acceptable and are subjected to grade deductions.
- 2) Assignments submitted in the wrong format will be counted as not submitted.
- 3) Failure to submit or fulfill any required course component results in failure of the class.
- 4) Make-up for midterm and final exams only with valid excuses, as defined by the University.
- 5) In order to earn a Certificate of Completion, participants must thoughtfully complete all assignments by stated deadlines and earn an average quiz score of 50% or greater.

TECHNOLOGY POLICY

The use of electronic devices in class is distracting, both for the user and for the rest of the class. Only non-programmable calculators can be used in the tests and exam. Any attempts to use cell phones and other electronic communication devices will be seemed as cheating. Laptops are discouraged, unless you use them for activities DIRECTLY related to the course (e.g., note taking, reading course documents).

ACADEMIC INTEGRITY POLICY

Soochow University highly values the academic integrity and aims to promote the academic fairness, honesty and responsibility. Any academic dishonesty behaviors and any attempts to cheats and plagiarism will be reported to the university administration office. A written warning and the relevant penalties will be imposed. The record might be shown on the official university transcript.

DISABILITY ACCOMMODATION

Soochow University is committed to maintaining a barrier-free environment so that



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students with disabilities can fully access programs, courses, services, and activities at Soochow University. Students with disabilities who require accommodations for access to and/or participation in this course are welcome.

Note:

Please contact the University Administrative Office immediately if you have a learning disability, a medical issue, or any other type of problem that prevents professors from seeing you have learned the course material.