



蘇州大學  
Soochow University

# **MAT 376 Applied Dynamic Systems**

**Summer 2024**

**Course Credits:** 4

**Contact Hours:** 56 hours

**Instructor:** TBA

**Email:** TBA

## **COURSE OBJECTIVES**

The course is designed for university students seeking a deep dive into the complexities of dynamic systems. This course encompasses the study of linear and nonlinear equations, equation systems, Laplace domain analysis, and the modeling of physical systems. Students will engage in challenging theoretical concepts and advanced applications, preparing them for sophisticated problem-solving in diverse engineering and scientific contexts.

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

1. Develop a sophisticated understanding of linear and nonlinear equations.
2. Master the analysis of intricate linear and nonlinear equation systems.
3. Acquire advanced proficiency in Laplace domain analysis for dynamic systems.
4. Demonstrate the ability to model complex physical systems using advanced mathematical techniques.
5. Apply dynamic systems principles to solve high-level, real-world problems in engineering and sciences.

## **PREREQUISITES**

CEN 223 Mechanical System Design Fundamentals

## **GRADING**

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

**ITEM**

**POINTS**



2 Assignments	20 Points
2 Quizzes	20 Points
Midterm Exam	25 Points
Final Exam	35 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:

Katsuhiko Ogata, *System Dynamics*, 2014, Pearson

### Recommended (Optional) Texts or Other Materials:

None

## COURSE TOPICS

MODULE	TASKS
Module 1	<p><b>Topics:</b>            Topic 1: Linear Equations(Matrix methods, Eigenvalues and eigenvectors)            Topic 2: Nonlinear Equations and Chaos Theory            Topic 3: Linear Systems(Matrix exponentials, Stability analysis)            Topic 4: Nonlinear Systems Analysis(Lyapunov stability theory)</p> <p><b>Assessments:</b>            Assignment # 1</p>
Module 2	<p><b>Topics:</b>            Topic 5: Laplace Domain Analysis(Partial fraction decomposition, Inverse Laplace transform techniques)            Topic 6: Physical Systems Modeling(Partial differential equation,State-dependent coefficient, Multibody systems)            Topic 7: Time Domain Analysis            Topic 8: Frequency Domain Analysis(Nyquist stability criterion,BODE)</p> <p><b>Assessments:</b>            Quiz # 1</p>



Module 3	<p><b>Topics:</b> Topic 9: Control Systems Topic 10: State Space Representation Topic 11: Advanced System Identification(Bayesian methods) Topic 12: Numerical Methods(High-order numerical schemes,Sensitivity analysis)</p> <p><b>Assessments:</b> Midterm Exam</p>
Module 4	<p><b>Topics:</b> Topic 13: Applications in Robotics and Automation Topic 14: Applications in Aerospace Systems(Aircraft dynamics and control, Orbital mechanics and spacecraft control) Topic 15: Applications in Biomedical Systems Topic 16: Case Studies in Complex Dynamic Systems</p> <p><b>Assessments:</b> Assignment # 2</p>
Module 5	<p><b>Topics:</b> Topic 17: Advanced Project Work(Design and implement) Topic 18: Emerging Trends in Dynamic Systems Research Topic 19: Critical Review and Synthesis Topic 20: Emerging Trends and Technologies(IoT, Blockchain Technology and Network Security)</p> <p><b>Assessments:</b> Quiz # 2 Final Exam</p>

## 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 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.



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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.