

MA 240: Spring 2025 Differential Equations

Mathematics

Albert Nerken School of Engineering at The Cooper Union

Course Description:

Ordinary differential equations of the first order, linear equations of higher order with constant coefficients, eigenvalues and eigenvectors, first-order systems of linear equations, phase plane analysis for nonlinear two-dimensional systems, Laplace transformation, and Fourier series.

3 credits. Prerequisite: Ma 110, Pre/Corequisite: Ma223

Instructor:

Mili Shah (mili.shah@cooper.edu)

41 Cooper Room 311

Lectures:

Tuesdays 2:00PM-2:50PM, 41 Cooper Room 201

Wednesdays 10:00AM-11:50AM, 41 Cooper Room 505

Office Hours:

Tuesdays 3:00PM-4:00PM or by appointment, 41 Cooper Room 311

Participation:

Please contribute to the classroom environment by asking questions and participating in discussions. Your interaction will be considered when assigning borderline grades, as will improving performance throughout the course of the semester.

Grading:

25% Quizzes, 45% Exams, 30% Final

Homework:

Suggested homework problems will be posted in class. These homework problems will not be graded but are representative of information that is required. Similar problems will be presented on quizzes and exams.

Quizzes:

There will be quizzes based on problems from the previous week given throughout the semester due **Tuesdays at 11:59pm** and posted at

<https://webwork-hosting.runestone.academy/webwork2/cooper-shah-ma240-spring2025>

Your initial login is your Cooper username and your password is your Cooper ID number without the leading zeros. Collectively, these quizzes will constitute 25% of the final grade. The lowest quiz grade will be dropped.

Exams:

Two exams and one final will be given during the semester. You may not use outside resources: calculators, other students, other books, etc. The first exam will constitute 20% of your total grade, the second exam 25%, and the final will constitute 30% of your total grade.

Exam 1: Wednesday, February 19

Exam 2: Wednesday, April 2

Final Exam: Wednesday, May 14

Note: I reserve the right to adapt exam dates.

Required Text:

Differential Equations with Boundary-Value Problems, Zill, D., Wright, W. and Cullen, M., 8th Edition, 2013.

<https://cooperunion.sharepoint.com/:b:/s/library.department/EagcpupPnN5EhdPXNmVbd1EBgBmWIJJHfYkDvfG1vTPriQ?e=aUgqwy>

Suggested Texts:

Cuoco, A., Waterman, K. Kerins, B. Kaczorowski, E., Manes, M., *Linear Algebra and Geometry*, AMS/MAA, Vol. 46, 2019.

https://cooperunion.sharepoint.com/sites/library.department/Shared%20Documents/Material%20Repo/Books/Cuoco%20et%20al_2019_Linear%20Algebra%20and%20Geometry.pdf

Interactive Linear Algebra

<https://textbooks.math.gatech.edu/ila/>

Disabilities:

If you believe you are entitled to an accommodation on assessments through the Americans with Disabilities Act, you must self-identify to the Office of the Dean of Students and meet with me during the first week of the term to discuss arrangements for meeting your accommodation.

Timeline

Please note that this schedule is tentative and will likely be adjusted as the semester progresses.

Week	Topics	Sections
1/21/2025	Basic definitions and terminology. Initial-value problems. Math Models	ZWC:1.1-1.3
1/28/2025	Solution curves without a solution. Separable first-order equations. Linear first-order equations.	ZWC:2.1-2.3
2/4/2025	Exact first-order equations. Solution by substitution.	ZWC:2.4-2.5
2/11/2025	Linear and nonlinear models. Review of linear combinations.	ZWC:3.1-3.2
2/18/2025	Exam	
2/25/2025	Linear combinations. Independence/Dependence. Kernel.	AMS:3.3-3.5
3/4/2025	Introduction to higher-order equations. Boundary value vs. initial value problems. Basic theory of linear differential equations. Homogeneous/non homogeneous. The special case of constant coefficients.	ZWC:4.1,4.3
3/11/2025	Reduction of order. Undetermined coefficients (both superposition and annihilator approaches). Cauchy-Euler form	ZWC:4.2,4.4-4.5,4.7
3/18/2025	Review of determinants. Eigenvalues. Diagonalization	ILA
3/25/2025	Linear models. Systems of linear DE by elimination. Preliminary theory of linear systems. Homogeneous linear systems	ZWC:4.9,5.1,8.1-8.2
4/1/2025	Exam	
4/8/2025	Nonhomogenous linear systems. Matrix exponentials	ZWC:4.6,8.3-8.4
4/15/2025	Spring Break	
4/22/2025	Introduction to Laplace transform formalism. Inverse transform of derivatives and solution to initial value problems. Operational properties I	ZWC:7.1-7.3
4/29/2025	Operational properties II. Impulsive forcing and Dirac Delta formalism. Introduction to inner product structure and orthogonal functions	7.4-7.5,11.1
5/6/2025	More on orthogonal functions. Fourier series. Fourier sine and cosine series	11.1-11.3
5/13/2025	Final Exam on Wednesday May 14	