Differential Equations: MATH-UA 262-003/MA-UY 4204-B

Fall 2021 Syllabus

Lecture	MW 9:30-10:45	**Instructor**	Naima Hammoud
Classroom	RGSH 707	**Email**	hammoud@cims.nyu.edu
Office Hours	R 10:00-11:00	**Office**	TR: WWH 721, MW: 2MTC 876
Recitation	F 9:30-10:50 (Shreya Thirumalai)		

- **Objectives**

  This is a first course in differential equations that will mainly focus on applications of differential equations in the physical world. We will cover methods for solving first- and second-order equations that can be solved exactly, qualitative behavior of first-order equations, Laplace transforms, numerical techniques, series solutions, systems of linear equations, nonlinear dynamical systems and phase plane analysis, eigenvalue problems, and Fourier series.

- **Textbook**
  - Martin Braun, *Differential Equations and Their Applications*, 4th edition
  - Steven Strogatz, *Nonlinear Dynamics and Chaos*, Addison-Wesley

- **Grade breakdown and test dates**
  - Homework to be (scanned and) submitted on Gradescope: 25%, usually due weekly on Fridays at 23:59 New York time, unless otherwise specified.
  - Recitation Attendance and participation: 5%.
  - Exam 1: 17.5%, during class time on Wednesday, October 20, 2021.
  - Exam 2: 17.5%, during class time on Monday, November 22, 2021.
  - Programming Assignment: 5%.
  - Final Project: 20%, due at 23:59 on December 15, 2021.
  - Presentation: 10%, 10:00-12:00 on December 15, 2021.
  - No extra credit projects will be offered.

- **Homework and examination policy**
  - Guide to submitting homework on Gradescope.
  - Late homework will not be accepted.
  - Homework extensions may be granted in cases when there is a good reason to believe that you may have difficulty completing homework on time even with proper time planning (e.g. joined the course late or prolonged illness). Please contact me well in advance and explain your reason(s) if you would like to request a homework extension.
  - You are encouraged to discuss homework with fellow students, but homework must be written in your own words.
  - The lowest homework score will **not** be dropped.

- In one lecture, you will be introduced to programming in Python, and you will be given a programming assignment. Prior programming experience is not required.
- The programming assignment should be written in Python and submitted in a Jupyter Notebook to Brightspace.
- An end of term group project is due on December 15 at 23:59 New York time, and a 15 minute presentation is scheduled on the same day from 10:00 to 12:00. Your group must submit a project idea no later than November 15. The project must be typed out in LaTeX, otherwise points will be deducted.
- Only a limited number of out-of-sequence examinations can be accommodated due to limited availability of proctors. Out-of-sequence examinations may be approved in the following cases:
  * Medical excuse
  * University-sponsored event such as an athletic tournament or a performance, or certain other academic- or career-related activities that cannot be rescheduled, such as a job interview or graduate school visit. Athletic practices and rehearsals do not qualify. Please request a supervisor or faculty advisor to contact me, or consult with me whether your academic- or career-related activity qualifies.
  * Religious holiday
  * Extreme hardship such as a family emergency

  Out-of-sequence examinations will not be accommodated for purposes of more convenient travel, including already purchased tickets. Scheduled out-of-sequence examinations (those not arising from emergencies) must be taken before the actual test. Please contact the lecturer at least a week in advance to schedule them.
- If you miss an examination due to an emergency, you must contact me as soon as possible to schedule a make-up examination.
- Graded assignments and tests will be returned on Gradescope. If you have any questions about the grading of an assignment or test, please contact me or submit a regrade request within a week of having it returned; regrade requests will not be considered after that. Questions regarding quiz grading should be directed to your teaching assistant first.

- **Other resources**
  - Free tutoring at the Mathematics Department Undergraduate Tutoring Center
  - Free tutoring at the University Learning Center
  - Free tutoring at Tandon
- **Academic integrity**
  - You are expected to follow codes of academic integrity as specified by the university, the College of Arts and Sciences and Tandon School of Engineering:
    * Academic Integrity for Students at NYU
    * CAS Academic Integrity
    * CAS Honor Code
    * Tandon Student Code of Conduct

MATH-UA 262/MA-UY 4204: Differential Equations
Schedule

[B] Martin Braun, *Differential Equations and Their Applications*, 4th edition (Springer)
[S] Steven Strogatz, *Nonlinear Dynamics and Chaos* (Addison-Wesley)

Date	Section in textbook	Topic(s)
09/08/2021	1.1, 1.2 [B]	first order linear ODEs: homogeneous vs nonhomogeneous
09/13/2021	1.3, 1.4 [B]	first order separable ODEs
09/15/2021	1.5, 1.8 [B]	applications to 1st order ODEs: population models + mixing/heating/cooling
09/20/2021	additional	nondimensionalization + higher order ODEs that reduce to 1st order
09/22/2021	2.1–2.4 [S]	Qualitative behavior of first order ODEs: fixed points and stability
09/27/2021	3.1, 3.2, 3.4, 3.6 [S]	Bifurcations
09/29/2021	3.4, 3.6 [S]	Bifurcations and Hysteresis
10/04/2021	1.13, 1.15 [B]	Intro to numerical solutions of first order ODEs
10/06/2021	2.1, 2.2 [B]	second order linear ODEs: constant coefficients (homogeneous)
10/12/2021	2.3 [B]	second order linear ODEs: constant coefficients (non- homogeneous)/undetermined coefficients *(Legislative Day)*
10/13/2021	2.4 [B]	Reduction of order/variation of parameters
10/18/2021	2.6 [B]	resonance/forcing near resonance
10/20/2021		Exam 1
10/25/2021	2.9 [B]	introduction to Laplace transforms
10/27/2021	2.10 [B]	Solving first and second order ODEs using Laplace transforms
11/01/2021	2.11 [B]	Laplace transform of ODEs involving discontinuous forcing
11/03/2021	2.12 [B]	Laplace transform of ODEs involving impulsive forcing
11/08/2021	5.1, 5.2 [S]	systems of equations: intro + qualitative ideas
11/10/2021	5.3 [S]	systems of equations: love affairs
11/15/2021	6.1-6.4 [S]	nonlinear systems of equations
11/17/2021	6.1-6.4 [S]	nonlinear systems of equations (applications)
11/22/2021		Exam 2
11/24/2021	2.8.1 [B]	Equidimensional second (and higher) order ODEs
11/29/2021	2.8 [B]	Power series and series solutions for 2nd order ODEs
12/01/2021	additional	Legendre equation + Gamma function
12/06/2021	2.8.2, 2.8.3 [B]	Bessel equation; intro to Frobenius
12/08/2021	6.4, 5.4 [B]	Eigenvalue problems; orthogonality of eigenfunctions; Fourier Series & Principal Component Analysis
12/13/2021	5.5 [B]	Fourier Series
		Final examination (date and time TBD)