Course Syllabus

Lecture	Monday, Wednesday 9:30AM - 10:50AM, Jacobs Hall 202 (6 MTC)
Recitation	Friday 9:30AM – 10:50AM, 2 MTC 817
Instructor	Mike O'Neil 2 MTC 854 and CIWW 1119 cims.nyu.edu/~oneil oneil@cims.nyu.edu 212-998-3125
Office hours	Monday 11:00AM – 12:00PM, 2 MTC 854 Tuesday 11:00AM – 12:00PM, CIWW 1119 Or by appointment
Teaching assistant	Ashley Sobolewski as21142@nyu.edu
Course website	cims.nyu.edu/~oneil/ode25

Prerequisites

- Grade of C in MATH 123 Calculus III or MATH 213 Math for Economics III (or equivalent).
- Grade of C in MATH 140 Linear Algebra (or equivalent).

Description

A first course in ordinary differential equations. This course covers methods for solving first-order linear and nonlinear equations, existence and uniqueness of solutions, and analytical methods for finding solutions. We will also study second-order linear equations, general theory and Wronskians, constant coefficient theory and mechanical vibrations, variation of parameters, and series solutions. More advanced topics toward the end of the semester will include systems of linear equations, eigenvector methods, qualitative analysis of nonlinear systems of equations, boundary-value problems, and an introduction to Fourier Series and Sturm-Liouville theory. Time permitting, we will also discuss the Laplace Transform and how it can be used to solve ODEs, as well as Green's function methods for solving differential equations.

Learning Objectives

Classification of ordinary differential equations. Conditions for existence and uniqueness of solutions, requirements for initial and boundary data. Methods of solution for first order, linear second order, and systems of linear first order differential equations. Understanding of the rarity of analytical solutions, and the limitations and uses of numerical approximations. Introductory understanding of series solutions and special functions, boundary value problems, Fourier series, and Sturm-Liouville theory.

Materials

The following text is required for the course:

- Martin Braun, *Differential Equations and Their Applications*, 4th ed., Springer, 1993.

The above text is available online through NYU Libraries for free:

http://proxy.library.nyu.edu/login?url=https://link.springer.com/book/10.1007/978-1-4612-4360-1

The following text may be useful as supplementary material:

- Boyce, DiPrima, and Meade, *Elementary Differential Equations and Boundary Value Problems*, 11th ed., Wiley, 2017.
- Coddington, *An Introduction to Ordinary Differential Equations*, Dover, 1989.

Assignments

There will be a mix of homework assignments, two preliminary exams, and a final exam. The homework assignments during the semester will be released, submitted, and graded on Gradescope. A link to the course on Gradescope can be found on Brightspace. Assignments will generally be issued and collected on a weekly basis. More details regarding homework and exams will be provided in-class and/or via Brightspace.

Grading

The overall course grade will be determined from a final numerical weighted average. The following breakdown will be used to compute an overall numerical grade:

10%	Homework (approximately weekly assignments, lowest grade dropped)
25%	Preliminary Exam 1 (**Mon Oct 6th**)
25%	Preliminary Exam 2 (**Mon Nov 10th**)
40%	Final exam (Date TBD)

All homework and exams will be written work and will not require any programming. There is no extra credit. The overall numerical grade will be converted to a letter grade with equivalencies:

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95% <= A  <= 100%
90% <= A- <   95%
86% <= B+ <   90%
83% <= B  <   86%
80% <= B- <   83%
75% <= C+ <   80%
70% <= C  <   75%
60% <= D  <   70%
       F  <   60%
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The final letter grade may be curved depending on the overall distribution of grades in the course, but only as to increase the corresponding letter grade.

Policies

- There will not be makeup homework assignments or exams without *prior approval* of the instructor. Late homework is not accepted without prior approval of the instructor. Exceptions will only be made in extraordinary circumstances (e.g. illness, emergencies, etc.). Official documentation may be required for some absences.
- While attendance/participation does not factor into the overall grade in the course, attendance and class discussions will likely be crucial to the success of students in the course.
- Collaboration and discussion are strongly encouraged on homework assignments, but each student must write-up and turn in their own work.

Weekly schedule

Each week, there will be two lectures plus a recitation section. The lectures will cover various theorical concepts and applications of these ideas. The recitation section will further enforce the concepts presented in the lecture by working through example problems, as well as spending more time on specific details surrounding particular topics. More details of specific references for each topic (e.g. sections from a textbook) will be posted to the course webpage or to Brightspace.

Below is a week-by-week schedule assuming two meetings per week, with relevant sections from the reference texts listed in italics:

1. Overview, first order equations
2. Separable and exact equations
3. Existence and uniqueness
    a. Picard iterations
4. Linear 2nd order equations
    a. Constant coefficient equations
    b. Algebraic solutions
5. Linear 2nd order equations
    a. Non-homogeneous equations
6. Linear 2nd order equations
    a. Series solutions
    b. Singular points
    c. Indicial equation
7. Linear 2nd order equations
    a. Laplace transforms
    b. Delta functions
8. Systems of equations
    a. Vector spaces and linear algebra
9. Systems of equations
    a. Eigenvalue-eigenvector method
    b. Fundamental matrix solutions
10. Qualitative theory
    a. Phase plane, stability
11. Qualitative theory
    a. Phase portraits
    b. Predator-prey systems
12. Boundary value problems
    a. Intro to PDEs
    b. Fourier series
13. Sturm-Liouville Theory
14. Green's functions
15. Review, additional topics

Disability Disclosure Statement
Academic accommodations are available for students with disabilities. The Moses Center website is www.nyu.edu/csd. Please contact the Moses Center for Student Accessibility (212-998-4980 or mosescsd@nyu.edu) for further information. Students who are requesting academic accommodations are advised to reach out to the Moses Center as early as possible in the semester for assistance.

Academic Integrity, Plagiarism, and Cheating
Academic integrity means that the work you submit is original. Obviously, bringing answers into an examination or copying all or part of a paper straight from a book, the Internet, or a fellow student is a violation of this principle. But there are other forms of cheating or plagiarizing which are just as serious — for example, presenting an oral report drawn without attribution from other sources (oral or written); writing a sentence or paragraph which, despite being in different words, expresses someone else's idea(s) without a reference to the source of the idea(s); or submitting essentially the same paper in two different courses (unless both instructors have given their permission in advance). Receiving or giving help on a take-home paper, examination, or quiz is also cheating, unless expressly permitted by the instructor (as in collaborative projects). (Above is adapted from the website of the College of Arts & Science: https://cas.nyu.edu/content/nyu-as/cas/academic-integrity.html)

Student Wellness
In a large, complex community like NYU, it is vital to reach out to others, particularly those who are isolated or engaged in self-destructive activities. Student wellness is the responsibility of all of us.
https://cas.nyu.edu/content/nyu-as/cas/academic-programs/student-wellness.html
The NYU Wellness Exchange is the constellation of NYU's programs and services designed to address the overall health and mental health needs of its students. Students can access this service 24 hours a day, seven days a week by emailing wellness.exchange@nyu.edu or calling (212) 443-9999. Students can call the Wellness Exchange hotline (212-443-9999) or the NYU Counseling Service (212-998-4780) to make an appointment for Single Session, Short-term, or Group counseling sessions.
https://www.nyu.edu/students/health-and-wellness/wellness-exchange.html