New York University |Courant

Tandon School of Engineering

MA-UY 2034 Linear Algebra & Differential Equations
Course Information and Lecture Schedule

Summer 2021 BX (6W1)

Course Coordinator: Rachel Jacobovits rj606@nyu.edu

Course Website: NYU Classes

Course Pre-requisites: You are expected to have mastery of the concepts and skills covered in MA-UY 914, MA-UY 1024/1324, and MA-UY 1124/1424

Course Description:
Linear algebra and differential equations are central to modern mathematics and engineering. The concepts in linear algebra have the power to explain fundamental principles and simplify calculations in engineering, computer science, mathematics, physics, biology, statistics, digital media and economics. In this course you will learn the basic concepts and skills of linear algebra that are needed for later math courses, such as differential equations, multivariable calculus, and by other courses needed for your major. The course combines abstract thinking with elementary calculations. The abstract concepts you will learn in linear algebra are as important as the computations. Differential equations play an important role in modeling virtually every physical, technical, or biological process, from celestial motion to aerospace design, from bridge design to animation, from financial trends to the interactions between neurons. This course is an introduction to the field of differential equations and will include the study of the fundamental concepts and techniques for the analytic and numeric solutions of ordinary differential equations, as well as classic applications.

Course Objectives: Students are expected to:

- Formulate, solve, apply, and interpret systems of linear equations in several variables using Gaussian elimination;
- Learn the properties of matrices and apply them to the solutions of systems of linear equations;
- Understand the notions of vector spaces and basis, and apply their understanding to the solution of problems;
- Develop an understanding of linear transformations and be able to apply that knowledge;

- Learn to calculate eigenvalues and eigenvectors, and be able to use them in context.

- Model and solve first order differential equations.

- Solve higher order linear ordinary differential equations and initial value problems.
- Solve a linear system of first order differential equations with constant coefficients.
- Be familiar with elementary concepts of numerical analysis, especially numerical solutions of initial value problems for ordinary differential equations.
- Formulate, solve, apply, and interpret systems of linear equations in several variables.

Course Structure: This 4-credit one-semester course meets for three 200 minute lectures each week. Due to the continuing COVID-19 pandemic, the official mode of instruction for this course will be online. There will be three Weekly Lectures- the recordings will be available on Zoom. The password for the recordings is DELA*2021

> *Students who participate in this class with their camera on or use a profile image are agreeing to have their video or image recorded solely for the purpose of creating a record for students enrolled in the class to refer to, including those enrolled students who are unable to attend during the scheduled class time.*

You are also expected to study outside of class, a good 'rule of thumb 'is two to three hours of study for each hour of class.

Course Requirements: (The grading policy is detailed in a section below).

- Three Weekly Lectures
- Mandatory WebAssign Online Homework—WebAssign can be accessed from NYU Classes.
- Projects/Worksheets
- Daily Quizzes
- 2 In-Class Exams
- Final Exam

Examinations: Two 120-minute exams will be given during class time, as will a 150-minute *cumulative* Final Exam. Additional time will be allocated for uploading exam files.

Exam Dates

- Exam 1 Tuesday June 8, 2020
- Exam 2 Tuesday, June 22, 2020
- Final Exam Thursday, July 1, 2020

Important Exam Information:

- **The Department of Mathematics reserves the right to impose the strongest academic sanctions for violations of Academic Integrity.**
- **You must comply with the Honor Code, whether or not you sign it.**

Policies for Exams, Worksheets and Homework:

- If you have missed, or will need to miss an exam and want a make-up, please refer to the full make-up exam policy online: https://math.nyu.edu/tandon/policy.html

- Late worksheets/projects will not be accepted without authorization from the Office of Student Affairs or the instructor.

- It is University policy that an out-of-sequence exam can be administered only if there is prior authorization by the Mathematics Department or the Office of Student Affairs. If you miss an exam for a medical, religious, or family emergency reason, you must provide written documentation to the Math Department at soe.math@nyu.edu in order to schedule a make-up exam within 2 days of the missed exam, or upon your first day returning to class if the documentation excuses a longer absence. Make-ups will not be granted to students who do not notify the Math Department in a timely manner. Students may be asked to seek additional approval from the Office of Student Affairs.

- We cannot accommodate out-of-sequence exams, worksheets, and finals for reasons of convenient travel, even if you have already purchased tickets. Please note carefully the date of your exams and final and plan your travel schedule accordingly.

Religious Observance Policy As a nonsectarian, inclusive institution, NYU policy permits members of any religious group to absent themselves from classes without penalty when required for compliance with their religious obligations. The policy and principles to be followed by students and faculty may be found here: The University Calendar Policy on Religious Holidays. The procedure to be followed by students who require consideration due to religious observance can be found at http://engineering.nyu.edu/life/student-affairs/advocacy-privacy-and-compliance.

Moses Center for Students with Disabilities If you are student with a disability who is requesting accommodations, please contact New York University's Moses Center for Students with Disabilities at 212-998-4980 or mosescsd@nyu.edu. You must be registered with CSD to receive accommodations. Information about the Moses Center can be found at www.nyu.edu/csd.

Textbook:
Worldwide Differential Equations with Linear Algebra by Robert McOwen. Center of Math, 2015. ISBN: 978-0-9842017-2-1 v. 0603162120
You can purchase a copy Digital $14.95 / Print $39.95
http://www.centerofmathematics.com/wwcomstore/index.php/diffeqns.html

Also recommended for a more in-depth treatment of the topics. You may use a combination of:

Linear Algebra and its Applications, 4th Edition by David C Lay. Addison Wesley, 2012. ISBN-13: 978-0-321-38517-8.

A First Course in Differential Equations by Dennis Zill Brooks/Cole/Cengage ISBN-13:978-0-495-10824-5.

Having a copy of a good Linear Algebra & DE textbook will greatly facilitate learning the course material!

Homework We will be using WebAssign for the homework in this course. You can access WebAssign from NYU Classes.

The best 90% of your homework points will count—in other words 10% of the homework points will be dropped.

If you have any questions about accessing WebAssign, please contact your instructor. **If you have problems with a particular question in WebAssign, please use the Communications tab in WebAssign, 'Ask Your Teacher', to request help and someone will respond to your question.**

WebAssign extensions are automatic. You have 2 days after the deadline to request the automatic extension. There will be a penalty imposed on the remaining points. The penalty will be 30% on the unearned points. The extension will be for 3 days and must be requested within the 2 days after the due date. Exceptions made for extenuating circumstances with appropriate supporting documentation.

Projects Some projects will be individual projects and others will be assigned to groups. Projects will be posted on NYU Classes and must be submitted as per instructions on the project.

Worksheets Worksheets will be posted on NYU Classes and must be submitted using Gradescope. You will receive more information about how to use Gradescope in class.

Quizzes Quizzes will be in Gradescope. They will be taken at the beginning of most classes. Accommodations will be made for global students and those registered with the Moses Center.

Grading Policy

Course Grade: Your final course grade will be the higher of the averages calculated using the table below:

	Average 1	**Average 2**
In-Class Exams	2 exams, 15% each Total 30%	Lower Exam 10% Higher Exam 15%
Final Exam	20%	25%
Daily Quizzes	10%	10%
Worksheets/ Projects	20%	20%
WA Homework	15%	15%
Participation	5%	5%

Conversion of Course Average to Course Grade

Course Average	*Course Grade*
90-100	A
87-89	A-
84-86	B+
80-83	B
77-79	B-
74-76	C+
70-73	C
67-69	C-
64-66	D+
63-55	D
below 55	F

Exam Regrading: You have an opportunity to review your exams and to discuss the grading with your instructor. If you feel a question needs to be re-graded, you can submit a regrade request by using the Gradescope program. Regrade requests need to be make within 24 hours after the graded exams are posted.

MA2034 Lecture Schedule

Lecture 1 First Order Differential Equations

- 1.1 Differential Equations and Mathematical Models
- 1.2 Geometric Analysis and Existence and Uniqueness
- 1.3 Separable Equations & Applications

Lecture 2 First Order Differential Equations

- 1.4 Linear Equations
- 1.5 Additional Methods for Solving First Order DE-Change of Variables
- Euler's Method & Numerical Solutions (Supplemental notes on NYU Classes)
- Applications of First Order D.E.s

Lecture 3 Laplace Transforms

- 3.1 Laplace Transform and Its Inverse
- 3.2 Transforms of Derivatives and Initial Value Problems

Lecture 4 Second Order Differential Equations

- 2.1 Introduction to Higher-Order Linear Equations
- 2.2 General Solutions for Second-Order Linear Differential Equations
- 2.3 Homogeneous Differential Equations with Constant Coefficients

Lecture 5 Second Order Linear Differential Equations

- 2.4 Nonhomogeneous Equations with Constant Coefficients-Method of Undetermined Coefficients
- Variation of Parameters (Supplemental Notes provided on NYU Classes)
- Laplace Transforms of Second Order IVPs

Lecture 6 Catch up & Review

- Cauchy-Euler (Supplemental notes on NYU Classes)

Lecture 7 Exam 1 Covers material from Lectures 1—5

Lecture 8 Systems of Linear Equations and Matrices

- 4.1 Introductions to Systems and Matrices
- 4.2 Gaussian Elimination
- 4.3 Reduced Row-Echelon Form and Rank
- 4.4 Inverse of a Square Matrix

Lecture 9 Determinants and Matrix Inverse

- 4.5 Introduction to Determinant of a Square Matrix
- 4.6 Cofactor Expansion and matrix inverse

Lecture 10 Intro to Vector Spaces

- 5.1 Vector Spaces in R^n
- 5.2 General Vector Spaces
- 5.3 Subspaces and Spanning Sets
- 5.4 Linear Independence

Lecture 11 Vector Spaces

- 5.5 Basis and Dimension, Change of Basis
- 5.6 Row and Column Spaces, Null Space
- 6.1 Introduction to Linear Transformations & Eigenvalues and Eigenvectors

Lecture 12 Catch up & review

- 6.1 Eigenvalues & eigenvectors

Lecture 13 Exam 2 Covers material from Lectures 8—11

Lecture 14 Eigenvalues, Eigenvectors, & First Order Systems

- 6.2 Diagonalization and Similarity
- 7.1 Introduction to Linear First Order Systems
- 7.2 Eigenvalue Method for Homogeneous Systems
- 7.3 Real Distinct Eigenvalues

Lecture 15 Eigenvector Method for First Order Linear Systems

- 7.3 Complex Eigenvalues
- 7.3 Generalized Eigenvalues
- Variation of Parameters Method for Nonhomogeneous Systems (Supplemental Notes provided on NYU Classes)

Lecture 16 Catch up and review

- 3.4 Discontinuous Inputs & Applications
- Solving Systems of Linear Equations using Laplace Transforms

Lecture 17 FINAL EXAM Covers material from Lectures 1—16

Additional Learning Resources:

General Math Workshops		
Days	*Hours*	*Location*
M--Th	TBA	TBA

Math Resource Center schedule will be announced
Please check the Resources Tab on NYU Classes for additional resources

Internet Resources

http://web.mit.edu/18.06/www/Video/video-fall-99.html

http://tutorial.math.lamar.edu/ Paul's Online Math Notes, Choose Class Notes and then the course you want.

www.Youtube.com There are many good Linear & DE lectures, the Khan Academy is a favorite for many students.

Important: General Exam Policies

Time and Place:
It is your responsibility to consult the web site to know when and where an exam is being held. You will not receive any special consideration for being late or missing an exam by mistake.

Neatness and Legibility:
You are expected to write as neatly and legibly on your exam. Your final answer must be clearly identified (by placing a box around it). Points will be deducted if the grader has difficulty reading or finding your answer.

Missed Exams:
If you missed an exam due to a medical reason, then University policy requires you to provide written documentation to the Office of Student Affairs. It is University policy that the Mathematics Department may not give make-up exams without prior authorization by the Office of Student Development.

Academic Integrity:
Any incident of cheating or dishonesty will be dealt with swiftly and severely. The University does not tolerate cheating. (There is no such thing as "a little bit of cheating.")

During Exams no cell phones, iPads or other devices that can communicate with the internet or with others may be used. Any such equipment found with the power on may well be interpreted as "cheating".

The Department of Mathematics reserves the right to impose the strongest academic sanctions for violations of Academic Integrity.

NYU School of Engineering Policies and Procedures on Academic Misconduct

Introduction: The School of Engineering encourages academic excellence in an environment that promotes honesty, integrity, and fairness, and students at the School of Engineering are expected to exhibit those qualities in their academic work. It is through the process of submitting their own work and receiving honest feedback on that work that students may progress academically. Any act of academic dishonesty is seen as an attack upon the School and will not be tolerated. Furthermore, those who

A. breach the School's rules on academic integrity will be sanctioned under this Policy. Students are responsible for familiarizing themselves with the School's Policy on Academic Misconduct.

B. Definition: Academic dishonesty may include misrepresentation, deception, dishonesty, or any act of falsification committed by a student to influence a grade or other academic evaluation. Academic dishonesty also includes intentionally damaging the academic work of others or assisting other students in acts of dishonesty. Common examples of academically dishonest behavior include, but are not limited to, the following:

1. Cheating: intentionally using or attempting to use unauthorized notes, books, electronic media, or electronic communications in an exam; talking with fellow students or looking at another person's work during an exam; submitting work prepared in advance for an in-class examination; having someone take an exam for you or taking an exam for someone else; violating other rules governing the administration of examinations.

2. Fabrication: including but not limited to, falsifying experimental data and/or citations.

3. Plagiarism: intentionally or knowingly representing the words or ideas of another as one's own in any academic exercise; failure to attribute direct quotations, paraphrases, or borrowed facts or information.

4. Unauthorized collaboration: working together on work that was meant to be done individually.

5. Duplicating work: presenting for grading the same work for more than one project or in more than one class, unless express and prior permission has been received from the course instructor(s) or research adviser involved.

6. Forgery: altering any academic document, including, but not limited to, academic records, admissions materials, or medical excuses.