New York University Polytechnic School of Engineering

Mathematics Department

Course Outline
MA-UY 2012 Linear Algebra

Fall 2014 All Tuesday & Thursday Sections

Course Coordinator: Dr. Lindsey Van Wagenen
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Office Hours: M &W 3:30—5:30
& by appointment.

Course Website: NYU Classes & www.math.poly.edu

Course Pre-requisites: You are expected to have mastery of the concepts and skills covered in MA0902, MA0912, MA1024/1324, and MA1124/1424.

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 2-credit one-half-semester course meets for two 110 minutes lectures each week. 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).

- Two Weekly Lectures
- Mandatory WebAssign Online Homework—WebAssign can be accessed from NYU Classes.
- One Midterm Exam
- Final Exam

Examinations: Three 100-minute exams will be given during class time, and a 100-minute *cumulative* Final Exam. **The only calculator permitted is the TI-30, no substitutions.**

Exam Dates:

- Exam 1 Thursday, September 25, 2014.
- Final Tuesday, October 21, 2014.

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.

Textbook: You can use either:
Differential Equations and Linear Algebra, 3rd Edition by Stephen W. Goode and Scott A. Annin. Pearson/Prentice Hall 2007

Or for a more in-depth treatment of the topics you can use a combination of:

Linear Algebra and its Applications, 4th Edition by David C Lay. Addision 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.
New copies of the 9th edition are on sale in the bookstore, and new and used copies of previous editions are available online

New copies are on sale in the bookstore, and new and used copies of previous editions are available online. Older editions are very similar and will be fine for use in class. Having a copy of a good Linear Algebra textbook will greatly facilitate learning Linear Algebra!

Homework We will be using WebAssign for this course. You can access WebAssign from NYU Classes or from your browser at https://www.webassign.net/nyu/login.html. 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 Dr. Van Wagenen at vwagenen@nyu.edu, if you have problems with a particular question in Web Assign, please use the Communications tab inside Web Assign to request help and someone will respond to your question.

Grading Policy

Course Grade: Final grades will be calculated according to the rules below. The course grade is determined by the best of your course averages using the table below.

	Average 1	*Average 2*
Midterm Exam	35%	15%
Final Exam	50%	80%
Homework	15%	5%

Information about the grading scale conversion to letter grades can be found on the www.math.poly.edu website.

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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. The Moses Center is located at 726 Broadway on the 2nd floor.

Course Lecture Syllabus (The sections are quoted from the 4th edition of Lay, the 9th edition of Zill and the 3rd edition of Goode and Annin.)

Lecture 1 Matrices and Systems of Linear Equations
(Goode & Annin 2.3—2.5; Lay 1.1—1.3)

- Systems of Linear Equation
- Row Reduction and Echelon Forms
- Vector Equations

Lecture 2 Matrices and Systems of Linear Equations
(Goode & Annin 2.3—2.5, 3.5, 4.6; Lay 1.4—1.6)

- The Matrix Equation $\mathbf{A}\,\mathbf{x} = \mathbf{b}$.
- Solution Sets of Linear Equations
- Applications of Linear Systems

Lecture 3 Matrices and Systems of Linear Equations
(Goode & Annin 4.5, 5.1, 5.2,5.4 (definitions);Lay 1.7—1.9)

- Linear Independence Section
- Introduction to Linear Transformations
- The Matrix of a Linear Transformation (Definitions: one-to-one and onto),

Lecture 4 Matrices and Systems of Linear Equations
(Goode & Annin 2.1, 2.2, 2.6; Lay 2.1—2.3)

- Matrix Operations
- Inverse of a Matrix
- Characterizations of Invertible Matrices

Lecture 5 Determinants
(Goode & Annin 3.1—3.3; Lay 3.1—3.2)

- Introduction to Determinants
- Properties of Determinants
- Cofactor Expansion; Cramer's Rule

Lecture 6 Determinants & Vector Spaces
(Goode & Annin 3.4, 4.1,4.2 ; 3.3)

- Summary of Determinants
- Vectors in R^n
- Vector Spaces

Lecture 7 Vector Spaces (Goode & Annin 4.3: Lay 2.8, 4.1)

- Subspaces
- Catch up & Review

Lecture 8 Midterm Exam Covers Lectures 1—7

Lecture 9 Vector Spaces (Goode & Annin 4.4—4.6; Lay Sections 4.2—4.5)

- Spanning Sets
- Linear Dependence and Linear Independence
- Basis and Dimension

Lecture 10 Vector Spaces(Goode & Annin 4.6, 4.7—4.10; Lay)

- Basis and Dimension
- Row and Column Space
- Rank-Nullity Theorem
- Invertible Matrix Theorem

Lecture 11 Linear Transformations (Goode & Annin 5.1—5.4; Lay 1.8, 1.9)

- Intro to Linear Transformations
- Transformations of R^2
- The Kernel and Range of a Linear Transformation
- Additional Properties of Linear Transformations

Lecture 12 Linear Transformations (Goode & Annin 5.5—5.8; Lay 4.2)

- Matrix of the Linear Transformation
- Eigenvalue-- Eigenvector Problem
- The Characteristic Equation

Lecture 13 Eigenvalues and Eigenvectors (Goode & Annin 5.8; Lay 5.6)

- Diagonalization
- Catch up & Review

Lecture 14 Final Exam—Includes Lectures 1--13.

Final Exam Review Room TBA

Comprehensive Final Examination scheduled during Finals Week.

Additional Learning Resources:

General Math Workshops		
Days	*Hours*	*Location*
M--Th	6AM-9PM	JAB 373 Room 2C
F	9AM-6PM	TBA

Internet Resources

Math Department Website: www.math.poly.edu This comprehensive website has the course policies as well as old exam and practice materials for both the midterm and final exam.

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

Valuables (especially your laptop!):
Please do not bring your laptop or any other valuable items to the exam. You are required to leave your bags and books at the front of the exam room.

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.

Identification:
You are required to bring your NYU ID to the exam. If for any reason you are unable to do so, another photo ID, such as a drivers license, is acceptable.

Before the Exam:
You must wait outside the exam room before the start of an exam. You must sit only in seats where there is an exam for your course. You **must not** move the exam to a different seat.

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 Development (JB158). 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 an exam you are not allowed to borrow or lend a calculator; borrowing or lending a calculator will be considered cheating.*

TI-30 is the only calculator allowed! No Exceptions