



University of International Business and Economics International Summer School

MAT 220 Linear Algebra and Differential Equations

Term: May 24 -June 24, 2021

Instructor: Sema Salur

Home Institution: University of Rochester

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Class Hours: Monday through Thursday, 120 minutes each day (2,400 minutes in total)

Office Hours: TBD

Discussion sessions: TBD

Total Contact Hours: 64 contact hours (45 minutes each, 48 hours in total)

Location: WEB

Credit: 4 units

Course Description:

We present core topics in elementary differential equations and related concepts and methods of elementary linear algebra, with emphasis on real world applications: First- and Second-Order Differential Equations; Exact and separable Equations; Mathematical and Numerical Methods; Linear Systems and Matrices; Vector Spaces; Higher-Order Linear Differential Equations.

Course Goals:

Students who satisfactorily complete this course will:

1. Understand what a differential equation is, especially linear differential equations.
2. Understand how differential equations are used to model real life phenomena.
3. Relate the theory to graphical and numerical methods of solutions.
4. Understand the basics of linear algebra.
5. Relate linear algebra to techniques for solving linear differential equations.

Required Textbook:

Stephen Goode and Scott Annin, Differential Equations and Linear Algebra (4th Edition), Pearson Prentice Hall, 2017.

Grading Policy:

There will be one midterm and a final exam in this class. All exams will be closed-book. No notes, calculators, or other electronic devices will be allowed.

The course grades will be calculated based on the following percentages:

- Homework: 30%
- Midterm: 30%

- Final Exam: 40%

The final exam will be cumulative. There will be no make-up exams.

Grading Scale:

Assignments and examinations will be graded according to the following grade scale:

A	90-100	C+	72-74
A-	85-89	C	68-71
B+	82-84	C-	64-67
B	78-81	D	60-63
B-	75-77	F	below 60

Class Rules:

All academic work should be done with the high level of honesty and integrity. Academic misconduct of any kind may result in a grade penalty or the assignment of a failing grade.

Course Schedule:

Week 1

Assignment

Topics Covered:

1.1-Differential Equations Everywhere

Supplementary Problems: 1, 3, 5, 7, 11, 13

1.2-Basic Ideas and Terminology

Supplementary Problems 1, 3, 5, 7, 11, 15, 33, 37

1.3-The Geometry of First-Order Differential Equations

Supplementary Problems: 3, 5, 7, 9, 11, 13, 19, 31

1.4-Separable Differential Equations

Supplementary Problems: 1, 3, 5, 7, 9, 19

1.6-First-Order Linear Differential Equations

Supplementary Problems: 1-13(odd), 17, 19, 23

1.7-Modeling Problems using First-Order Linear Differential Equations

Supplementary Problems: 1, 3, 5

2.1- Matrices: Definitions and Notation

Supplementary Problems: 1-21(odd)

2.2- Matrix Algebra

Supplementary Problems: 1, 3, 7, 11, 13, 15, 19, 27

Week 2

Assignment

Topics Covered:

2.3- Terminology for Systems of Linear Equations

Supplementary Problems: 1, 3, 5, 7, 9, 13, 17, 21

2.4- Elementary Row Operations and Row-Echelon Matrices

Supplementary Problems: 1, 3, 5, 7, 9, 11, 13, 19, 21

2.5- Gaussian Elimination

Supplementary Problems: 1-13 odd, 19, 21

2.6- The inverse of a Square Matrix

Supplementary Problems: 1, 3, 5, 7, 9, 11, 15, 23

2.7- Elementary Matrices and the LU Factorization

Supplementary Problems: 3, 5, 7, 11

2.8- The Invertible Matrix Theorem I

Supplementary Problems: No Assignment

3.1- The Definition of the Determinant

Supplementary Problems: 17, 19, 21, 43

3.2- Properties of Determinants

Supplementary Problems: 3, 5, 7, 9, 15, 17, 21, 23, 33, 37, 39

Week 3

Assignment

Midterm Exam

Topics Covered:

3.3- Cofactor Expansions

Supplementary Problems: 1, 3, 7, 15, 17, 19, 25, 31, 39, 55

3.4- Summary of Determinants

Supplementary Problems: 3, 7, 9, 11, 15, 17, 19

4.1- Vectors in \mathbb{R}^n

Supplementary Problems: 1, 3, 5, 7

4.2- Definition of a Vector Space

Supplementary Problems: 1, 3, 5, 7, 11, 13

4.3- Subspaces

Supplementary Problems: 3, 5, 7, 9, 13, 15, 19, 21

4.4- Spanning Sets

Supplementary Problems: 1, 3, 5, 9, 15, 17, 23

4.5- Linear Dependence and Linear Independence

Supplementary Problems: 1, 3, 5, 7, 11, 13, 21, 25, 33

Week 4

Assignment

Topics Covered:

4.6- Bases and Dimension

Supplementary Problems: 3, 5, 11, 13, 15, 21, 25

4.7- Change of Basis

Supplementary Problems: 1, 3, 5, 7, 9, 11, 13, 17, 19

4.8- Row Space and Column Space

Supplementary Problems: 3, 5, 7

4.9- The Rank-Nullity Theorem

Supplementary Problems: 1, 3, 5, 7, 9

4.10- The Invertible Matrix Theorem II

Supplementary Problems: 1, 3, 5, 9

8.1- General Theory for Linear Differential Equations

Supplementary Problems: 1-17 odd, 23, 27,

8.2- Constant-Coefficient Homogeneous Linear Differential Equations

Supplementary Problems: 1-35 odd

8.3- The Method of Undetermined Coefficients: Annihilators

Supplementary Problems: 1-35 odd

Week 5

Assignment

Topics Covered:

7.1- The Eigenvalue/Eigenvector Problem

Supplementary Problems: 1, 3, 7, 13, 15

7.2- General Results for Eigenvalues and Eigenvectors

Supplementary Problems: 1-27 odd

9.1- First-Order Systems

Supplementary Problems: 1-17 odd

9.2- Vector Formulation

Supplementary Problems: 1-9 odd

9.3- General Results for First-Order Linear Differential Systems

Supplementary Problems: 1, 3, 5

9.4- Vector Differential Systems: Nondefective Coefficient Matrix

Supplementary Problems: 1-19 odd

Final Exam

General Comments:

1. In order to train your minds in mathematical thinking, much of lecture will consist of the “Socratic Method” of questioning. Even if silently, do try to puzzle out the answers. An analogy: the lecture should be a “mental exercise” class. Knowledge cannot be given: it must be stolen. Engage your mind.
2. Many problems will not be solvable at first (or second) viewing. Be patient: clarify any unknown concepts, try to reduce the problem, brainstorm to unearth possibly relevant concepts, and follow your intuition. It may help to, after a period of hard work, put the problem away. Do not worry if you cannot do every problem: what is important is that you try.
3. If you find yourself getting lost in the material, come to office hours immediately! It is much easier to lead a student’s mind individually rather than in a group.
4. Note that we may not dot every i or cross every t in class: you are responsible for reading the text. In particular, it is to your advantage to read the material before coming to class; in this way the student becomes an active participant rather than a passive recipient.
5. Basic etiquette should be maintained. For example: to give your classmates time to think, please do not blurt out answers unless called upon (or overcome with excitement); please do not walk out of class without prior explanation, etc.



6. Using a cell phone in class is not permitted; students using phones will be penalized 5 percentage points on the next exam.
7. Tests will check your understanding of the lectures as well as cover homework-type problems; it will benefit you to check after each lecture to see if you've understood the line of the arguments. Precise knowledge of the theory is vital!