University of International Business and Economics
International Summer School

MAT 220 Linear Algebra and Differential Equations

Term: June 15 - July 16, 2020
Instructor: Sema Salur
Home Institution: University of Rochester
Email: semasalur@gmail.com
Class Hours: Monday through Thursday, 120 minutes each day (2,400 minutes in total)
Office Hours: 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 (3rd Edition), Pearson Prentice Hall, 2007.
Attendance:
Students are expected to be present at all class meetings and examinations.

Grading Policy:

There will be daily quizzes, three midterms and one final exam. All exams will be closed-book. No notes, calculators, or other electronic devices will be allowed, and having such a device in view during the exam is an academic honesty violation.

Grading Scale:

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

- Quizzes: 10%
- Midterm 1: 20%
- Midterm 2: 20%
- Midterm 2: 20%
- Final Exam: 30%

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

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- How Differential Equations Arise
Supplementary Problems: 1, 7, 8, 13, 14
1.2- Basic Ideas and Terminology
Supplementary Problems: 1, 3, 5, 8, 14, 24, 30, 39
1.3- The Geometry of First-Order Differential Equations
Supplementary Problems: 1, 3, 5, 9, 15 17, 21, 27, 33
1.4- Separable Differential Equations
Supplementary Problems: 1, 3, 9, 13, 15, 19, 22, 23
1.6- First-Order Linear Differential Equations
Supplementary Problems: 1-13(odd), 17, 19, 23, 26, 28, 29
1.7- Modeling Problems using First-Order Linear Differential Equations
Supplementary Problems: 1, 3, 5, 9, 13, 17
2.1- Matrices: Definitions and Notation
Supplementary Problems: 1, 3, 9, 11, 15, 17, 19, 21, 27
2.2- Matrix Algebra
Supplementary Problems: 1, 3, 7, 13, 15, 19, 27
2.3- Terminology for Systems of Linear Equations
Supplementary Problems: 3, 7, 9, 13, 17
2.4- Elementary Row Operations and Row-Echelon Matrices
Supplementary Problems: 9, 11, 13, 19, 21, 25

Week 2

Assignment

Exam 1: Date TBD
2.5- Gaussian Elimination
Supplementary Problems: 1-13 odd, 17, 21, 23
2.6- The inverse of a Square Matrix
Supplementary Problems: 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: 9-21 odd
3.2- Properties of Determinants
Supplementary Problems: 3, 5, 7, 9, 13, 15, 17, 21, 23, 37, 39
3.3- Cofactor Expansions
Supplementary Problems: 15, 17, 19, 25, 27, 31, 39

Week 3

Assignment

Exam 2: Date TBD
3.4- Summary of Determinants
Supplementary Problems: 3, 7, 9, 11, 15, 17, 19
4.1- Vectors in R^n
Supplementary Problems: 1, 3, 5, 7,
4.2- Definition of a Vector Space
Supplementary Problems: 1, 3, 5, 7, 11, 13, 15
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, 23, 25, 31
4.6- Bases and Dimension
Supplementary Problems: 3, 5, 11, 13, 15, 21, 27

Week 4

Assignment

Exam 3: Date TBD
4.7- Change of Basis
Supplementary Problems: 1, 3, 5, 7, 9, 11, 13, 17, 19, 21, 23, 25
4.8- Row Space and Column Space
Supplementary Problems: 1, 3, 5, 7, 9, 11
4.9- The Rank-Nullity Theorem

Supplementary Problems: 1, 3, 5, 7, 9, 11
4.10- The Invertible Matrix Theorem II
Supplementary Problems: 1, 3, 5, 9
6.1- General Theory for Linear Differential Equations
Supplementary Problems: 1-27 odd, 33, 37,
6.2- Constant-Coefficient Homogeneous Linear Differential Equations
Supplementary Problems: 1-35 odd
6.3- The Method of Undetermined Coefficients: Annihilators

Week 5
Assignment
5.6- The Eigenvalue/Eigenvector Problem
Supplementary Problems: 1-27 odd, 31, 33
5.7- General Results for Eigenvalues and Eigenvectors
Supplementary Problems: 1-27 odd
7.1- First-Order Systems
Supplementary Problems: 1-17 odd
7.2- Vector Formulation
Supplementary Problems: 1-13 odd
7.3- General Results for First-Order Linear Differential Systems
Supplementary Problems: 1, 3, 5
7.4- 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, appoint the office hours with me immediately! It is much is 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 during class: you are responsible for reading the text. In particular, it is to your advantage to read the material before class; in this way the student becomes an active participant rather than a passive recipient.
5. 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!