

Math 244: Linear Algebra

Syllabus

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- **Course Contents**

Matrices: Matrices and matrix operations; elementary row and column operations; inverse of a matrix; special matrices.

Determinants: Definition of determinant of a matrix; evaluation of a determinant; properties of determinants; adjoint of a matrix and its properties.

Linear Systems: Systems of linear equations; Gauss and Gauss – Jordan elimination methods; homogeneous systems of linear equations; Cramer’s Rule.

Vector Spaces: Definition of a vector space and examples; subspaces; linear combinations and linear span of a sets of vectors; linear dependence and linear independence of a set of vectors; basis and dimension of a vector space; coordinates of a vector with respect to a basis; change of basis; rank and nullity of a matrix.

Inner Product Spaces: Definition of inner product and inner product space with examples; orthogonal and orthonormal sets of vectors; orthonormal basis; Gram-Schmidt orthonormalization process.

Linear Transformations: Definition of a linear transformation and examples; basic properties of linear transformations; kernel and image spaces of a linear transformation; matrix of linear transformation.

Eigenvalues, Eigenvectors and Diagonalization: Eigenvalues and eigenvectors of a matrix; diagonalization of a matrix.

- **Texts:** “Elementary Linear Algebra (Applications Version)” by Howard Anton and Chris Rorres, 11th Edition, Wiley, USA, 2014.

Sections, Topics, Exercises

Chapter 1: Systems of Linear Equations and Matrices

1.1 Introduction to Systems of Linear Equations: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23.

- 1.2 Gaussian Elimination: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 32
- 1.3 Matrices and Matrix Operations: 1, 2, 3, 4, 5, 6, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27.
- 1.4 Inverses; Algebraic Properties of Matrices:
1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33.
- 1.5 Elementary Matrices and a Method for Finding A^{-1} : 2, 4, 6, 8, 10, 12, 14, 16, 18, 20
- 1.6 More on Linear Systems and Invertible Matrices:
9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20.
- 1.7 Diagonal, Triangular, and Symmetric Matrices:
1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25.

Chapter 2: Determinants

- 2.1 Determinants by Cofactor Expansion:
1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31.
- 2.2 Evaluating Determinants by Row Reduction:
2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30.
- 2.3 Properties of Determinants; Cramer's Rule:
2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32.

Chapter 4: General Vector Spaces

- 4.1 Real Vector Spaces: 1, 3, 5, 7, 9, 11, 13, 15.
- 4.2 Subspaces: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, 22.
- 4.3 Linear Independence: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.
- 4.4 Coordinates and Basis:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22.
- 4.5 Dimension: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20.
- 4.6 Change of Basis: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.
- 4.7 Row Space, Column Space, and Null Space : 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21.
- 4.8 Rank, Nullity, and the Fundamental Matrix Spaces:
1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21.
- 4.10 Properties of Matrix Transformations: 5, 6, 7, 8, 9, 10, 11, 13, 15, 17, 19.

Chapter 5: Eigenvalues and Eigenvectors

- 5.1 Eigenvalues and Eigenvectors: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14.
- 5.2 Diagonalization: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20.

Chapter 6: Inner Product Spaces

Chapter 7: Diagonalization and Quadratic Form

Chapter 8: General Linear Transformations

- **Attendance Policy:** Students are expected to attend every class, to arrive on time, and to participate in all class activities. You are responsible for material covered if you are absent. If you miss 25% of the class meetings, your grade will be DN (Denied).
- **Exams and Grading Policy:**
 - Two quizzes: 20 points (10 for each quiz).
 - Second midterm: 30 points.
 - Final Exam: 40 points. In class on Sunday 6/11/1443.
 - 10 points for the TA.

Final grade will be calculated in the following way: $100 - 95 = A+$, $> 95 - 90 = A$, $> 90 - 85 = B+$, $> 85 - 80 = B$, $> 80 - 75 = C+$, $> 75 - 70 = C$, $> 70 - 65 = D+$, $> 65 - 60 = D$, and $> 60 = F$.