SELECTED TOPICS IN MODERN ALGEBRA II

Ma 623

1. Course Description

This course studies: vector spaces, Euclidean space, sets of linear transformations and matrices, and bilinear and quadratic forms. Selected Topics in Modern Algebra I is not a prerequisite.

2. Goals of the Course

1. To investigate linear algebra topics from an axiomatic viewpoint.
2. To introduce the students to higher mathematics concepts
3. To prepare students for graduate studies at the doctoral level
4. To demonstrate that linear algebra is a very useful subject with wonderful applications in many fields.

3. Instructional Procedures

1. Lecture/discussion
2. Small group and independent study
3. Use of computer software and graphing calculators
4. Assigned written presentation of an application of linear algebra.

4. Course Content

1. Systems of Linear Equations
   a. Introduction to Systems of Linear Equations
   b. Gaussian Elimination and Gauss-Jordan Elimination
   c. Applications of Systems of Linear Equations
2. Matrices
   a. Operations with Matrices
   b. Properties of Matrix Operations
   c. The Inverse of a Matrix
   d. Elementary Matrices
   e. Applications of Matrix Operations
3. Determinants
   a. The Determinant of a Matrix
   b. Evaluation of a Determinant Using Elementary Operations
   c. Properties of Determinants
   d. Applications of Determinants
4. Vector Spaces
   a. Vectors in R^n
   b. Vector Spaces
   c. Subspaces of Vector Spaces
   d. Spanning Sets and Linear Independence

e. Basis and Dimension
f. Rank of a Matrix and Systems of Linear Equations
g. Coordinates and Change of Basis
h. Applications of Vector Spaces

5. Inner Product Spaces
   a. Length and Dot Product in R^n
   b. Inner Product Spaces
   c. Orthonormal Bases: Gram-Schmidt Process
   d. Mathematical Models and Least Squares Analysis
   e. Applications of Inner Product Spaces
6. Linear Transformations
   a. Introduction to Linear Transformations
   b. Kernel and Range of a Linear Transformation
   c. Matrices for Linear Transformations
   d. Transition Matrices and Similarity
   e. Applications of Linear Transformations
7. Eigenvalues and Eigenvectors
   a. Eigenvalues and Eigenvectors
   b. Diagonalization
   c. Symmetric Matrices and Orthogonal Diagonalization
   d. Applications of Eigenvalues and Eigenvectors
8. Numerical Methods (optional)
   a. Gaussian Elimination with Partial Pivoting
   b. Iterative Methods for Solving Linear Systems
   c. Power Method for Approximating Eigenvalues
   d. Applications of Numerical Methods

5. Evaluation Measures for Determining Students' Grades

1.	Tests	44%
2.	Application project	22%
3.	Final exam	34%

Note: Individual instructors may weigh evaluation measures differently.

6. Bibliography

A. Required Text

Larson, Roland E. and Edwards, Bruce H., Elementary Linear Algebra, 3d ed, D. C. Heath and Company, Lexington, MA, 1996.

Note: In mathematics courses it is usually preferable to have a designated textbook which helps to focus the discussion and standardize the language and symbolism.

B. Additional Required Readings

None

C. Supporting Bibliography

Apostol, Tom M., Linear Algebra : A First Course, With

Applications to Differential Equations, John Wiley & Sons, New York, NY, 1997

Bhatia, Rajendra, Matrix Analysis (Graduate Texts in Mathematics, 169), Springer Verlag, 1996

Curtis, Morton L., Abstract Linear Algebra, (Universitext), Springer Verlag, 1990

Evans, Benny and Johnson, Jerry, Linear Algebra With Derive , John Wiley & Sons, New York, NY, 1993

Gelfand, I.M., A. Shenitzer (Translator), I. M. Gel'fand, Lectures on Linear Algebra , Dover Publications, 1989.

Halmos, Paul Richard, Finite-Dimensional Vector Spaces, Springer Verlag, 1986

Lax, Peter D., Linear Algebra, (Pure and Applied Mathematics), John Wiley & Sons, New York, NY, 1996

Roman, Steven, Advanced Linear Algebra, (Graduate Texts in Mathematics, 135), Springer Verlag, 1992

D. Relevant Periodical Sources

None

E. Relevant Software

Derive
MatrixPad

F. **Other**

TI-82 or TI-83 Graphing Calculator