MISSOURI WESTERN STATE UNIVERSITY

COLLEGE OF LIBERAL ARTS AND SCIENCES

DEPARTMENT OF COMPUTER SCIENCE, MATHEMATICS, AND PHYSICS

COURSE NUMBER: MAT 306

COURSE NAME: Linear Algebra

COURSE DESCRIPTION:

Linear Algebra carries three (3) semester credit hours. MAT 306 includes the study of vector spaces, linear transformations, matrix operations, determinants, matrix inversion, linear systems, eigenvalues, and conical forms. Offered Fall semester.

PREREQUISITE:

Credit or concurrent enrollment in MAT287.

TEXT:

Elementary Linear Algebra: A Matrix Approach, Spence, Insel, and Friedberg, Edition 2nd 08, Pearson, ISBN 9780131871410

COURSE OBJECTIVES:

A major goal of this course is to provide the student with understanding and proficiency sufficient to enable the successful student to appreciate and utilize matrix and linear methods in modeling processes and to pursue further mathematical study, on study in areas which rely upon understanding and proficiency in linear algebra. Students will learn how to:

1. Perform vector operations in Euclidean M-space.
2. Derive vector equations of lines and planes.
3. Solve systems of linear equations.
4. Perform matrix operations and utilize matrix methods to analyze real world mathematical sciences.
5. Evaluate determinants and utilize their properties.
6. Identify algebraic structures as vector spaces.

7. Determine if a set of vectors is independent or dependent.

8. Verify that a particular set of vectors is a basis.

9. Identify a linear transformation.

10. Provide the matrix representation of a linear transformation.

11. Change basis for a vector space.

12. Find eigenvalues and eigenvectors.

13. Verify properties related to the concepts of linear systems of equations, matrices and determinants, vector spaces, basis and dimension, and linear transformations.

14. Perform matrix operations and linear programming utilizing a computer.

15. Utilize linear techniques in modeling realistic problem situations.

16. Demonstrate verbal and written communication skills in mathematical situations.

COURSE COMPETENCIES:

In order to meet the above objectives, successful students will:

1. Understand and utilize algebraic properties of functions.

2. Provide matrix representations of linear transformations.

3. Identify and give examples of vector spaces.

4. Determine whether or not a specific algebraic structure is a vector space.

5. Determine whether a given set of vectors is linearly independent.

6. Find basis for vector spaces.

7. Perform a change of basis for a vector space.

8. Prove that there exists a one-to-one and onto linear transformation between vector spaces of the same dimension.
9. Construct formal proofs using direct and indirect arguments and mathematical induction.

10. Construct and solve mathematical models for real world problem situations

where linear and matrix techniques are employed in the model analysis.

11. Utilize computers to perform matrix operations, solve linear systems and linear programming problems.

12. Demonstrate verbal and written communication skills in mathematical situations.

COURSE OUTLINE:

I. Geometry of R^m

- A. Vectors in R^2 and R^3
- B. Dot and Cross Products
- C. Lines and Planes
- D. Euclidean m-Space

II. Linear Equations and Matrices

- A. Systems of Linear Equations
- B. Matrices and Row Reduction of Linear Systems
- C. Operations on Matrices
- D. Matrix Equations and Inverses
- E. Theory of Linear Systems

III. Determinants

- A. Definition of Determinant
- B. Properties of Determinants
- C. Cramer's Rule

IV. Independence and Basis in R^m

- A. Linear Dependence and Independence
- B. Subspaces of R^m
- C. Basis and Dimension
- D. Rank of a Matrix

V. Vector Spaces

- A. Vector Spaces and Subspaces
- B. Linear Independence, Basis, and Dimension
- C. Coordinate Vectors
- D. Inner-Product Spaces

VI. Linear Transformations

A. Definition of a Linear Transformation
B. Algebra of Linear Transformations
C. Kernel and Image
D. Matrix of a Linear Transformation
E. Change of Basis

VII. Eigenvalues and Eigenvectors

A. Definitions and Examples
B. Diagonalization
C. Complex Eigenvalues and Eigenvectors

VIII. Applications of Linear Algebra

A. Polynomial Curve Fitting
B. Applications to Physics and Economics: Kirchhoff's Laws and Leontief Models
C. Markov Chains
D. Quadric Surfaces

IX. Linear Programming

A. Introduction and Terminology
B. The Simplex Algorithm
C. The Two-Phase Problem
D. Theory of Linear Programming