College of San Mateo
Official Course Outline

1. **COURSE ID:** MATH 270 **TITLE:** Linear Algebra **C-ID:** MATH 250
   Units: 3.0 units **Hours/Semester:** 48.0-54.0 Lecture hours; and 96.0-108.0 Homework hours
   Method of Grading: Letter Grade Only
   Prerequisite: MATH 252

2. **COURSE DESIGNATION:**
   Degree Credit
   Transfer credit: CSU; UC
   AA/AS Degree Requirements:
   CSM - COMPETENCY REQUIREMENTS: C1 Math/Quantitative Reasoning Basic Competency
   CSU GE:
   CSU GE Area B: SCIENTIFIC INQUIRY AND QUANTITATIVE REASONING: B4 - Mathematics/Quantitative Reasoning
   IGETC:
   IGETC Area 2: MATHEMATICAL CONCEPTS AND QUANTITATIVE REASONING: A: Math

3. **COURSE DESCRIPTIONS:**
   Catalog Description:
   Vectors and matrices applied to linear equations and linear transformations; real and inner product spaces.

4. **STUDENT LEARNING OUTCOME(S) (SLO'S):**
   Upon successful completion of this course, a student will meet the following outcomes:
   1. Find solutions of systems of equations using various methods appropriate to lower division linear algebra;
   2. Use bases and orthonormal bases to solve problems in linear algebra;
   3. Find the dimension of spaces such as those associated with matrices and linear transformations;
   4. Find eigenvalues and eigenvectors and use them in applications; and
   5. Prove basic results in linear algebra using appropriate proof-writing techniques such as linear independence of vectors; properties of subspaces; linearity, injectivity and surjectivity of functions; and properties of eigenvectors and eigenvalues.

5. **SPECIFIC INSTRUCTIONAL OBJECTIVES:**
   Upon successful completion of this course, a student will be able to:
   1. Find solutions of systems of equations using various methods appropriate to lower division linear algebra;
   2. Use bases and orthonormal bases to solve problems in linear algebra;
   3. Find the dimension of spaces such as those associated with matrices and linear transformations;
   4. Find eigenvalues and eigenvectors and use them in applications; and
   5. Prove basic results in linear algebra using appropriate proof-writing techniques such as linear independence of vectors; properties of subspaces; linearity, injectivity and surjectivity of functions; and properties of eigenvectors and eigenvalues.

6. **COURSE CONTENT:**
   Lecture Content:

   1. Techniques for solving systems of linear equations including Gaussian and Gauss-Jordan elimination and inverse matrices;
   2. Matrix algebra, invertibility, and the transpose;
   3. Relationship between coefficient matrix invertibility and solutions to a system of linear equations and the inverse matrices;
   4. Special matrices: diagonal, triangular, and symmetric;
   5. Determinants and their properties;
   6. Vector algebra for $\mathbf{R}^n$;
   7. Real vector space and subspaces;
   8. Linear independence and dependence;
   9. Basis and dimension of a vector space;
   10. Matrix-generated spaces: row space, column space, null space, rank, nullity;
   11. Change of basis;

12. Linear transformations, kernel and range, and inverse linear transformations;
13. Matrices of general linear transformations;
14. Eigenvalues, eigenvectors, eigenspace;
15. Diagonalization including orthogonal diagonalization of symmetric matrices;
16. Inner products on a real vector space;
17. Dot product, norm of a vector, angle between vectors, orthogonality of two vectors in $\mathbf{R}^n$;
18. Angle and orthogonality in inner product spaces; and
19. Orthogonal and orthonormal bases: Gram-Schmidt process.

7. **REPRESENTATIVE METHODS OF INSTRUCTION:**
Typical methods of instruction may include:
    A. Lecture
    B. Discussion
    C. Other (Specify): Out-of-class assignments: problem sets requiring students to compute, solve, construct, prove, and assess.

8. **REPRESENTATIVE ASSIGNMENTS**
Representative assignments in this course may include, but are not limited to the following:
Writing Assignments:
Students will be required to explain concepts and compose logical arguments in writing assignments.
o Example: x1, x2, and x3 are linearly independent vectors in vector space V. T is a one to one linear transformation from V to vector space W. Prove that T(x1), T(x2), T(x3) are linearly independent.
Reading Assignments:
Assignments requiring the student to read sections of the (linear algebra) textbook and/or selected materials supplied by the teacher.
o Example: Read the section in the textbook on the null space and range space of a linear transformation.
o Example: Read the instructor's handout on using matrix diagonalization to solve a system of differential equations.
Other Outside Assignments:
Assignments (see 1 and 3 above) that require students to calculate, judge, assess, construct, and solve. Also students will be encouraged to discuss and debate conceptual questions in classroom discussion. And of course students are always encouraged to question whatever the teacher or other students do.
o Example: T(x,y) = (x + y, 3x + 3y) is a linear transformation from R^2 to R^2. (a) Is T one to one? Explain why or why not. (b) Is T onto? Explain why or why not.
o Example: T is a linear transformation from R3 to R3 in homogeneous coordinates. T acts to reflect the point (x,y) (what is this in homogeneous coordinates?) across the line y = 2x + 1. Calculate the standard matrix for T. Explain why your standard matrix works.
o Example: x1, x2, and x3 are linearly independent vectors in vector space V. T is a one to one linear transformation from V to vector space W. Prove that T(x1), T(x2), T(x3) are linearly independent.

9. **REPRESENTATIVE METHODS OF EVALUATION**
Representative methods of evaluation may include:
    A. Class Work
    B. Exams/Tests
    C. Group Projects
    D. Homework
    E. Papers
    F. Projects
    G. Quizzes
    H. Written examination

10. **REPRESENTATIVE TEXT(S):**
Possible textbooks include:
    A. Lay, David C.. *Linear Algebra and its Applications*, ed. Pearson, 2021
    B. Leon, Steven J.. *Linear Algebra with Applications*, ed. Pearson, 2019

Origination Date: November 2021
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Course Originator: Christopher Walker