BUTTE COLLEGE
COURSE OUTLINE

I. **CATALOG DESCRIPTION**

MATH 42 - Linear Algebra **3 Unit(s)**

Prerequisite(s): MATH 30
Recommended Prep: MATH 31

Transfer Status: CSU/UC
51 hours Lecture

This course develops the techniques and theory needed to solve and classify systems of linear equations. Solution techniques include row operations, Gaussian elimination, and matrix algebra. Investigates the properties of vectors in two and three dimensions, leading to the notion of an abstract vector space. Vector space and matrix theory are presented including topics such as inner products, norms, orthogonality, eigenvalues, eigenspaces, and linear transformations. Selected applications of linear algebra are included. This course is offered only in spring. (C-ID MATH 250).

II. **OBJECTIVES**

Upon successful completion of this course, the student will be able to:

A. Find solutions of systems of equations using various methods appropriate to lower division linear algebra.
B. Use bases and orthonormal bases to solve problems in linear algebra.
C. Find the dimension of spaces such as those associated with matrices and linear transformations.
D. Find eigenvalues and eigenvectors and use them in applications.
E. 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.

III. **COURSE CONTENT**

A. **Unit Titles/Suggested Time Schedule**

	Lecture
Topics	Hours
1. Techniques for solving systems of linear equations including Gaussian and Gauss-Jordan elimination and inverse matrics	4.00
2. Matix algebra, invertibility, and the transpose	2.00
3. Relationship between coefficient matrix invertibility and solutions to a system of linear equations and the inverse matrices	2.00
4. Special matrices: diagonal, triangular, and symmetric	2.00
5. Determinants and their properties	4.00
6. Vector algebra for $\mathbf{R^n}$	2.00
7. Real vector space and subspaces	3.00
8. Linear independence and dependence	2.00
9. Basis and dimension of a vector space	2.00
10. Matrix-generated spaces: row space, column space, null space, rank, nullity	5.00
11. Change of basis	3.00
12. Linear transformations, kernel and range, and inverse linear transformations	3.00
13. Matrices of general linear transformations	3.00

14. Eigenvalues, eigenvectors, eigenspace	3.00
15. Diagonalization including orthogonal diagonalization of symmetric matrices	4.00
16. Inner products on a real vector space	1.00
17. Dot product, norm of a vector, angle between vectors, orthogonality of two vectors in $\mathbf{R^n}$	2.00
18. Angle and orthogonality in inner product spaces	2.00
19. Orthogonal and orthonormal bases: Gram-Schmidt process	2.00
Total Hours	51.00

IV. METHODS OF INSTRUCTION

A. Lecture
B. Collaborative Group Work
C. Homework: Students are required to complete two hours of outside-of-class homework for each hour of lecture
D. Discussion
E. Board Work

V. METHODS OF EVALUATION

A. Exams/Tests
B. Quizzes
C. Daily Homework Assignments, where the student will demonstrate problem-solving skills
D. Class Assignments and Class Response

VI. EXAMPLES OF ASSIGNMENTS

A. Reading Assignments
   1. Read the section in the textbook on Vector Spaces and be able to state the axioms which define a vector space, as well as give examples of sets which are vector spaces and also give examples of sets which are not.
   2. Read the section in the textbook on Basis and Dimension, and be able to state the conditions for a set of vectors to be a basis for a given vector space.

B. Writing Assignments
   1. Explain the idea of linear independence, how to determine if a system of linear equations is independent or dependent. Be sure to discuss why in a set of linearly independent vectors no member of the set can be written as a linear combination of other members of the set.
   2. Define a linear transformation, and give examples which are linear and those that are not.

C. Out-of-Class Assignments
   1. Review the section in the textbook on Linear Transformations and do the problems assigned by the instructor showing all work.
   2. Review the section in the textbook on Eigenvectors and Eigenvalues, and do the problems assigned by the instructor showing all work.

VII. RECOMMENDED MATERIALS OF INSTRUCTION

Textbooks:

A. Lay, D.C. Linear Algebra and Its Applications. 4th Edition. Pearson, 2012.

Materials Other Than Textbooks:

A. Graphing calculator with row reduction capabilities

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