Revised Fall 2009

COLLIN COUNTY COMMUNITY COLLEGE
COURSE SYLLABUS

COURSE NUMBER: Math 2318

COURSE TITLE: Linear Algebra

CREDIT HRS: 3 **LECTURE HRS:** 3 **LAB HRS:** 0 **CLN/REC HRS:** 0

PREREQUISITE: Math 2414 or Math 2419

COREQUISITE: None

TEXTBOOK:

Elementary Linear Algebra, 6th by Larson/Falvo, ©2009, Houghton Mifflin Harcourt Publishing Company.

CATALOG DESCRIPTION:

Systems of linear equations, matrices, determinants, finite dimensional vector spaces, inner product spaces, linear transformations, and eigenvalues and eigenvectors.

SUPPLIES: Graphing calculator required

COURSE MEASURABLE LEARNING OUTCOMES:

Upon completion of this course the students should be able to do the following:

1. Solve systems of linear equations with applications using, Gauss Jordan elimination, matrix inverse, and determinants.
2. Determine if a set is a vector space and find its dimension; find the solution space of homogeneous and non-homogenous systems.
3. Find the inner product to determine the norm, the distance and the angle between two vectors; use the Gram-Schmidt orthonormalization process to find an orthonormal basis; solve applications of inner product spaces
4. Identify linear transformations and determine their kernel, range, nullity and rank; determine if a linear transformation is an isomorphism; find the inverse of a linear transformation.
5. Find eigenvalues, eigenvectors, and eigenspaces; determine if a matrix is symmetric, diagonalizable or orthogonal; diagonalize square matrices and orthogonally diagonalize symmetric matrices; solve applications of eigenvalues and eigenvectors.

COURSE REQUIREMENTS:

Attending lectures, completing assignments and exams.

COURSE FORMAT:

Lecture and guided practice.

METHOD OF EVALUATION:

A minimum of four written exams and a comprehensive final exam. Homework and/or quizzes may be used in place of one exam or in addition to exams. The weight of each of these components of evaluation will be specified in the individual instructor's addendum to this syllabus. All out-of-class course credit, including take-home exams, home assignments, service-learning, etc. may not exceed 25% of the total course grade; thus, at least 75% of a student's grade must consist of exams given in the class or testing center, and no student may retake any of these exams.

ATTENDANCE POLICY:

Attendance is expected of all students. If a student is unable to attend it is his/her responsibility to contact the instructor to obtain assignments. Please see the schedule of classes for the last day to withdraw.

RELIGIOUS HOLY DAYS:

In accordance with section 51.911 of the Texas Education Code, the college will allow a student who is absent from class for the observance of a religious holy day to take an examination or complete an assignment scheduled for that day within a reasonable time. A copy of the state rules and procedures regarding holy days and the form for notification of absence from each class under this provision are available from the Admissions and Records Office.

COURSE REPEAT POLICY:

All students may repeat this course only once after receiving a grade, including W. For example students who have taken this course twice have to choose a different course to take after two trials.

ADA STATEMENT:

It is the policy of Collin County Community College to provide reasonable and appropriate accommodations for individuals with documented disabilities. This college will adhere to all applicable federal and state laws, regulations, and guidelines with respect to providing reasonable accommodations as required to affording equal educational opportunity. It is the responsibility of the student to contact the ACCESS office located in room G200 at the Spring Creek Campus, phone (972)881-5898 or TDD (972)881-5950, in a timely manner if he/she desires to arrange for accommodations.

ACADEMIC ETHICS:

The college may initiate disciplinary proceedings against a student accused of scholastic dishonesty. Scholastic dishonesty includes, but is not limited to, statements, acts, or omissions related to applications for enrollment or the award of a degree, and/or the submission of material as one's own work that is not one's own. Scholastic dishonesty may involve one or more of the following acts: cheating, plagiarism, collusion, and/or falsifying academic records.

Cheating is the willful giving or receiving of information in an unauthorized manner during an examination, illicitly obtaining examination questions in advance, using someone else's work for assignments as if it were one's own, copying computer disks or files, and any other dishonest means of attempting to fulfill the requirements of a course.

Plagiarism is the use of an author's words or ideas as if they were one' s own without giving credit to the source, including, but not limited to, failure to acknowledge a direct quotation. Contact the Dean of Students at 972.881.5771 for the student disciplinary process and procedures or consult the CCCCD Student Handbook

SPECIFIC REQUIREMENTS/COURSE CONTENT:

The student will be responsible for knowing all definition and statements of theorems for each section outlined in the following modules.

MODULE 1: Systems of Linear Equations

The student will be able to:

1. Recognize, graph, and solve a system of linear equations in *n* variables.
2. Use back-substitution to solve a system of linear equations.
3. Determine whether a system of linear equations is consistent or inconsistent.
4. Determine if a matrix is in row-echelon form or reduced row-echelon form.
5. Use elementary row operations with back-substitution to solve a system in row-echelon form.
6. Use elimination to rewrite a system in row-echelon form.
7. Write an augmented or coefficient matrix from a system of linear equations, or translate a matrix into a system of linear equations.
8. Solve a system of linear equations using Gaussian elimination and Gaussian elimination with back-substitution.
9. Solve a homogeneous system of linear equations.
10. Set up and solve a system of equations to fit a polynomial function to a set of data points, as well as to represent a network.

MODULE 2: Matrices

The student will be able to:

1. Write a. system of linear equations represented by a matrix, as well as write the matrix form of a system of linear equations.
2. Write and solve a system of linear equations in the form $A\mathbf{x} = \mathbf{b}$.
3. Use properties of matrix operations to solve matrix equations.
4. Find the transpose of a matrix, the inverse of a matrix, and the inverse of a matrix product (if they exist).
5. Factor a matrix into a product of elementary matrices, and determine when they are invertible.
6. Find and use the *LU*-factorization of a matrix to solve a system of linear equations.
7. Use a stochastic matrix to measure consumer preference (optional).
8. Use matrix multiplication to encode and decode messages.
9. Use matrix algebra to analyze economic systems (Leontief input-output models) (optional).
10. Use the method of least squares to find the least squares regression line for a set of data (optional).

MODULE 3: Determinants

The student will be able to:

1. Find the determinants of a matrix and a triangular matrix.
2. Find the minors and cofactors of a matrix and use expansion by cofactors to find the determinant of a matrix.
3. Use elementary row or column operations to evaluate the determinant of a matrix.
4. Recognize conditions that yield zero determinants.
5. Find the determinant of an elementary matrix.
6. Use the determinant and properties of the determinant to decide whether a matrix is or nonsingular, and recognize equivalent conditions for a nonsingular matrix.
7. Verify and find an eigenvalue and an eigenvector of a matrix.
8. Find and use the adjoint of a matrix to find its inverse.
9. Use Cramer's Rule to solve a system of linear equations.
10. Use determinants to find the area of a triangle defined by three distinct points, to find an equation of a line passing through two distinct points, to find the volume of a tetrahedron defined by four distinct points, and to find an equation of a plane passing through three distinct points.

MODULE 4: Vector Spaces

The student will be able to:

1. Perform, recognize, and utilize vector operations on vectors in R^n.
2. Determine whether a set of vectors with two operations is a vector space and recognize standard examples of vector spaces
3. Determine whether a subset *W* of a vector space *V* is a subspace.

4. Write a linear combination of a finite set of vectors in *V*.
5. Determine whether a set S of vectors in a vector space *V* is a spanning set of *V*.
6. Determine whether a finite set of vectors in a vector space *V* is linearly independent.
7. Recognize standard bases in the vector spaces R^n, $M_{m,n}$, and P^n.
8. Determine if a vector space is finite dimensional or infinite dimensional.
9. Find the dimension of a subspace of R^n, $M_{m,n}$, and P^n.
10. Find a basis and dimension for the column or row space and a basis for the nullspace of a matrix.
11. Find a general solution of a consistent system $A\mathbf{x} = \mathbf{b}$, in the form $\mathbf{x}_p + \mathbf{x}_h$.
12. Find $\mathbf{x}_B$ in R^n, $M_{m,n}$, and P^n.
13. Find the transition matrix from the basis *B* to the basis B' in R^n.
14. Find $\mathbf{x}_{B'}$ for a vector $\mathbf{x}$ in R^n.
15. Determine whether a function is a solution of a differential equation and find the general solution of a given differential equation.
16. Find the Wronskian for a set of functions and test a set of solutions for linear independence. Identify and sketch the graph of a conic or degenerate conic section and perform a rotation of axes.
17. Know applications of vector spaces (optional).

MODULE 5: Inner Product Spaces

The student will be able to:

1. Find the length of $\mathbf{v}$, a vector $\mathbf{u}$ with the same length in the same direction as $\mathbf{v}$, and a unit vector in the same or opposite direction as $\mathbf{v}$.
2. Find the distance between two vectors, the dot product, and the angle θ between $\mathbf{u}$ and $\mathbf{v}$.
3. Verify the Cauchy-Schwarz Inequality, the Triangle Inequality, and the Pythagorean Theorem.
4. Determine whether two vectors are orthogonal, parallel, or neither.
5. Determine whether a function defines an inner product on R^n, $M_{m,n}$, and P^n, and find the inner product as defined for two vectors $\langle \mathbf{u}, \mathbf{v} \rangle$ in R^n, $M_{m,n}$, and P^n.
6. Find the projection of a vector onto a vector or subspace.
7. Determine whether a set of vectors in R^n is orthogonal, orthonormal, or neither. 8. Find the coordinates of $\mathbf{x}$ relative to the orthonormal basis R^n.
9. Use the Gram-Schmidt orthonormalization process.
10. Find an orthonormal basis for the solution space of a homogeneous system.
11. Know applications of inner product spaces (optional).

MODULE 6: Linear Transformations

The student will be able to:

1. Find the image and preimage of a function.
2. Determine whether a function from one vector space to another is a linear transformation.
3. Find the kernel, the range, and the bases for the kernel and range of a linear transformation *T*, and determine the nullity and rank of *T*.
4. Determine whether a linear transformation is one-to-one or onto.
5. Verify that a matrix defines a linear function that is one-to-one and onto.
6. Determine whether two vector spaces are isomorphic.
7. Find the standard matrix for a linear transformation and use this matrix to find the image of a vector and sketch the graph of the vector and its image.
8. Find the standard matrix of the composition of a linear transformation.
9. Determine whether a linear transformation is invertible and find its inverse, if it exists.
10. Find the matrix of a linear transformation relative to a nonstandard basis.
11. Know and use the definition and properties of similar matrices.
12. Identify linear transformations defined by reflections, expansions, contractions, shears, and/or rotations. (optional).

MODULE 7: Eigenvalues and Eigenvectors

The student will be able to:

1. Find the eigenvalues and corresponding eigenvectors of a linear transformation, as well as the characteristic equation and the eigenvalues and corresponding eigenvectors of a matrix *A*.
2. Find the eigenvalues of diagonal, triangular, and similar matrices.
3. Determine whether a matrix is triangular, diagonalizable, symmetric, and/or orthogonal.
4. Find (if possible) a nonsingular matrix *P* for a matrix *A* such that $P^{-1}AP$ is diagonal.
5. Find a basis *B* (if possible) for the domain of a linear transformation *T* such that the matrix of *T* relative to *B* is diagonal.
6. Find the eigenvalues of a symmetric matrix and determine the dimension of the corresponding eigenspace.
7. Find an orthogonal matrix *P* that diagonalizes *A*.
8. Solve a system of first-order linear differential equations (optional).
9. Find a matrix of the quadratic form associated with a quadratic equation (optional).
10. Use the Principal Axes Theorem to perform a rotation of axes and eliminate the *xy*-, *xz*-, and *yz*-terms, and find the equation of the rotated quadratic surface (optional).