CENTRAL TEXAS COLLEGE
SYLLABUS FOR MATH 2318
Elementary Linear Algebra

Semester Hours Credit: 3

INSTRUCTOR: Mrs. Cabaniss

I. INTRODUCTION

A. Elementary Linear Algebra is a three semester hour course which covers vector spaces, linear transformations, matrices, systems of linear equations.

B. This class meets three lecture hours per week.

C. This course serves students majoring in engineering, computer science, mathematics, economics, statistics, science, or operations research.

D. Prerequisite for Elementary Linear Algebra is Math 2414 with a grade of C or higher.

II. OVERALL OR GENERAL OBJECTIVES OF THE COURSE

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

A. Perform vector operations. (F4, F8)
B. Find the span of vectors and relate it to linear systems. (F8, F9)
C. Relate the matrix-vector product to linear combinations and linear systems. (F8, F9)
D. Identify vector spaces and subspaces. (F8, F9)
E. Connect dimension, linear independence, spanning sets, and bases together. (F8, F9)
F. Identify matrix plane transformations. (F8, F9)
G. Compute linear transformations, kernals, ranges, isomorphisms, and dimensions. (F4, F8)
H. Compute eigenvalues and eigenvectors. (F4, F8)
I. Solve problems involving properties of orthogonal matrices. (F4, F8, F9)

III. INSTRUCTIONAL MATERIALS

The Instructional materials identified for this course are viewable through
http://www.ctcd.edu/im/im_main.asp

IV. COURSE REQUIREMENTS

A. Assignments will be made daily. All assignments are to be completed by the following class meeting.

B. Students are expected to attend every class and to arrive at each class on time and remain in class for the entire period. Students who are absent from class 12.5% of

the number of class meetings for any reason will be dropped from the class with a grade of "F".

C. The instructor will post office hours after semester commences. Consult the instructor during office hours. If your visit may tend to be lengthy, make an appointment with the instructor so that he may set aside some time for you.

V. EXAMINATIONS

A. Examinations will be given at appropriate intervals. Each examination will be announced at least one week in advance, and each examination will be worth 150 points. The comprehensive final examination will be worth 300 points. The number of examinations depends on class progress.

B. Students who miss an exam should discuss with the instructor the circumstances surrounding the absence. The instructor will determine whether a make-up exam is to be given. Make-up examinations are given by appointment only.

VI. SEMESTER GRADE COMPUTATIONS

A. Your point total is determined by adding the point earned on each examination and the homework score. Your letter grade for the course is then determined by the following formula:

$$\frac{\text{Your Point Total}}{\text{Total Points Possible}} \times 100$$

If the result is between 90 and 100, your grade is a(n)	A
80 and 89	B
70 and 79	C
60 and 69	D
0 and 59	F

** NOTE: Grade Computation is determined by instructor. Please see your instructor for how your grade will be determined. This is just an example.

VII. NOTES AND ADDITIONAL INSTRUCTIONS FROM COURSE INSTRUCTOR

A. Withdrawal from Course: It is the student's responsibility to officially drop a class if circumstances prevent attendance. Any student who desires to, or must, officially withdraw from a course after the first scheduled class meeting must file an Application for Withdrawal or an Application for Refund. The withdrawal form must be signed by the student.

Application for Withdrawal will be accepted at any time prior to Friday of the 12th week of classes during the 16 week fall and spring semesters. The deadline for sessions of other lengths is as follows.

Friday of 3rd week for 5-week courses
Friday of 4th week for 6-week courses
Friday of 6th week for 8-week courses
Friday of 7th week for 10-week courses
Friday of 9th week for 12-week courses
Friday of 12th week for 16-week courses

The equivalent date (75% of the semester) will be used for sessions of other lengths. The specific last day to withdraw is published each semester in the Schedule Bulletin.

Students who officially withdraw will be awarded the grade of "W", provided the student's attendance and academic performance are satisfactory at the time of official withdrawal. Students must file a withdrawal application with the college before they may be considered for withdrawal.

A student may not withdraw from a class for which the instructor has previously issued the student a grade of "F" or "FN" for nonattendance.

B. An Administrative Withdrawal: An administrative withdrawal may be initiated when the student fails to meet College attendance requirements. The instructor will assign the appropriate grade on the Administrative Withdrawal Form for submission to the registrar.

C. An Incomplete Grade: The College catalog states, "An incomplete grade may be given in those cases where the student has completed the majority of the course work but, because of personal illness, death in the immediate family, or military orders, the student is unable to complete the requirements for a course..." Prior approval from the instructor is required before the grade of "I" is recorded. A student who merely fails to show for the final examination will receive a zero for the final and an "F" for the course.

D. The use of cellular phones/beepers will not be tolerated in class.

E. Students are expected at all times to conduct themselves in a manner that is supportive to classroom activities. Each instructor may have additional instructions regarding classroom requirements.

F. The Math Department operates an Advanced Mathematics Lab in Building 152, Room 145. All courses offered by the Math Department are supported in the lab with appropriate tutorial software. Walk-in tutoring is also available in Building 152, Room 236. Calculators and Graphlink are available for student use in the lab. Students are encouraged to take advantage of these opportunities. See posted hours for the Walk-in tutoring and Lab Hours.

VIII. COURSE OUTLINE

A. **Unit One**: The Geometry of the Plane and 3-Space

1. Learning Objectives: Upon successful completion of this unit, the student will be able to:

   a. Perform basic vector arithmetic and interpret geometrically.
   b. Determine linear combinations.
   c. Compute the length of a vector, the dot product, and the angle between vectors.
   d. Compute the orthogonal projection of a vector along another vector.
   e. Find vectors that belong to a span and interpret geometrically.
   f. Determine whether vectors are linearly independent.
   g. Compute the cross product and use its basic properties.
   h. Use information to write the equation of lines.

2. Learning Activities:

   a. Listen to classroom lecture and participate in discussion.
   b. Read Chapter 1 in text.
   c. Solve problems located in Chapter 1 in text.

3. Unit Outline:

   a. Section 1.1 (Vectors)
   b. Section 1.2 (Length and Direction)
   c. Section 1.3 (Lines, Planes, and the Cross Product of Vectors)
   d. Section 1.4 (Projections)
   e. Section 1.5 (Euclidean n-Space)

B. **Unit Two**: Matrices and Linear Equations

1. Learning Objectives: Upon successful completion of this unit, the student will be able to:

   a. Perform matrix arithmetic.
   b. Know and use properties of matrices.
   c. Relate linear equations and vector equations.
   d. Write a linear system of A**x**.
   e. Find the inverse and transpose of a matrix.
   f. Write the solution to a linear system in the form $x = x_p + x_h$
   g. Find an LU factorization of A and use it to solve A**x** = **b.**

2. Learning Activities:

   a. Listen to classroom lecture and participate in discussion.
   b. Read Sections 2.1, 2.2, 2.3, 2.4, 2.4, and 2.7 in text.
   c. Solve problems located in Chapter 2 in the text.

3. Unit Outline:

a. Section 2.1 (The Algebra of Matrices)
b. Section 2.2 (The Inverse and Transpose of a Matrix)
c. Section 2.3 (Systems of Linear Equations)
d. Section 2.4 (Homogeneous Systems and Linear Independence)
e. Section 2.5 (The LU Factorization of a Matrix)
f. Section 2.7 (Finding the Inverse of a Matrix)

C. **Unit Three**: Determinants. Eigenvalues, Eigenvectors

1. Learning Objectives: Upon successful completion of this unit, the student will be able to:

a. Evaluate the determinant of a square matrix.
b. Know and use the properties of determinants
c. Find the characteristic polynomial of A.
d. Define and compute eigenvalues, eigenvectors, and eigenspaces.
e. Define and use properties of similar matrices.
f. Diagonalize matrices

2. Learning Activities:

a. Listen to classroom lecture and participate in discussion.
b. Read Chapter 3 in text.
c. Solve problems located in Chapter 3 of text.

3. Unit Outline:

a. Section 3.1 (The Determinant of a Matrix)
b. Section 3.2 (Properties of Determinants)
c. Section 3.3 (The Eigenvalues and Eigenvectors of a Matrix)
d. Section 3.4 (Similarity and Diagonalization)

D. **Unit Four**: Vector Spaces

1. Learning Objectives: Upon successful completion of this unit, the student will be able to:

a. Define vector space and subspace.
b. Verify that a given set is a vector space.
c. Determine whether a given set spans another set.
d. Determine whether a given set is linearly independent.
e. Determine whether a given set is a basis of a set.
f. Find the dimension of a set.
g. Find the bases for the null, row, and column spaces of a matrix. (Find the basis for a span of vectors.)

h. Use the rank theorem.

2. Learning Activities:

a. Listen to classroom lecture and participate in discussion.
b. Read sections 4.1, 4.2, 4.3
c. Solve problems located in Chapters 4.

3. Unit Outline:

a. Section 4.1 (The Theory of Linear Equations)
b. Section 4.2 (Basic Terminology)
c. Section 4.3 (Basis and Dimensions; Rank and Nullity)

E. **Unit Five**: Linear Transformations

1. Learning Objectives: Upon successful completion of this unit, the student will be able to:

a. Define a transformation and compute its range.
b. Identify a matrix plane transformation geometrically.
c. Define and test for a linear transformation.
d. Compute the kernel and range of a linear transformation.
e. Identify linear transformations that are one-to-one, onto, and isomorphism.
f. Compute the matrix of a linear transformation.
g. Evaluate a linear transformation from its matrix.
h. Compute the matrix of a linear transformation with respect to a new basis.
i. Relate linear transformations to matrix operations.
j. Define and use properties of an invertible linear transformations.

2. Learning Activities:

a. Listen to classroom lecture and participate in discussion.
b. Read Sections 5
n. Solve problems located in Chapter 5.

3. Unit Outline:

a. Section 5.1 (Linear Transformations
b. Section 5.2 (Matrix Multiplication Revisited)
c. Section 5.3 (The Matrices of a Linear Transformation)
d. Section 5.4 (Changing Coordinates)

F. **Unit Six**: Orthogonality

1. Learning Objectives: Upon successful completion of this unit, the student will be able to:

   a. Define orthogonal and orthogonal sets.
   b. Use basic properties of orthogonal and orthogonal sets.
   c. Find the best (least squares) solution.
   d. Find the projection matrix.
   e. Define orthogonal matrices.
   f. Use basic properties of orthogonal matrices.
   g. Use the properties of an orthogonal projection.
   h. Find an orthogonal basis from a given basis of a subspace.
   i. Use basic properties of orthogonal matrices and orthogonal projections.
   j. Apply the Gram-Schmidt algorithm.
   k. Find a QR factorization.
   l. Define and use properties of the orthogonal complement.

2. Learning Activities:

   a. Listen to classroom lecture and participate in discussion.
   b. Read sections 6.1, 6.2, 6.3
   c. Solve problems located in Chapter 6.

3. Unit Outline:

   a. Section 6.1 (Projection Matrices and Least Squares Approximation)
   b. Section 6.2 (The Gram-Schmidt Algorithm and QR Factorization)
   c. Section 6.3 (Orthogonal Subspaces and Complements)