PELLISSIPPI STATE TECHNICAL COMMUNITY COLLEGE
MASTER SYLLABUS

MATRIX ALGEBRA
MTH 2510

Class Hours: 3.0 **Credit Hours: 3.0**

Laboratory Hours: 1.0 **Date Revised: Fall 1998**

Catalog Course Description:

Topics include solutions of systems of linear equations and Euclidean vector operations. Concepts of linear independence, basis and dimension, rank and nullity are defined and illustrated. Additional topics include eigensystems and general linear transformations. A computer laboratory component is required.

Entry Level Standards: None

Prerequisite: MTH 1420

Textbook(s) and Other Reference Materials Basic to the Course:

Textbook:
Elementary Linear Algebra. (7th ed.) John Wiley & Sons, Inc.: New York, 1994.
References:
Carlson, David, et al. ed., *Resources for Teaching Linear Algebra*. MAA Notes, The Mathematical Association of America, Cat. Code NTE-42/JR97, 1997.
Personal Equipment:
A calculator with matrix capabilities.

I. Week/Unit/Topic Basis:

Included in the topics listed below are laboratory problems to be completed individually or in groups using the computer aided algebraic system.

Week	Topic
1	Systems of Linear Equations. Gaussian Elimination. Matrices and Matrix Operations. Laboratory #1, Introduction to computer algebra system. Matrix operations.
2	Rules of Matrix Arithmetic, Inverse of Square Matrices. Diagonal, Triangular and Symmetric Matrices. Laboratory #2, Matrix Solution of Linear Systems.
3	Determinants. Evaluation by Row Reduction. Determinant properties. Cramer's Rule. Laboratory #3, Determinants by Row Reduction. Test 1.
4	Geometric Vectors in two-space and three-space. Norm and Vector Arithmetic. Dot Product, Projections. Cross Product. Lines and Planes in three-space. Laboratory #4, Geometry in two-space and three-space.

5	Euclidean N-Space. Linear Transformations from N-space to M-space. Properties of Linear Transformations. Laboratory #4, Linear Transformations Using Matrices. Test 2.
6	Real Vector Spaces. Subspaces. Linear Independence. Laboratory #5, Linear Dependence and Independence.
7	Basis and Dimension. Row Space, Column space, and Nullspace.
8	Inner Products. Angle and Orthogonality. Orthonormal Bases; Gram-Schmidt Orthogonalization. Orthogonal Matrices. Change of Basis. Laboratory #6, Gram-Schmidt Process. Test 3.
9	Eigenvalues and Eigenvectors. Diagonalization. Orthogonal Diagonalization.
10	Applications of Eigenvalues and Eigenvectors. Laboratory #7, Eigenvalue Applications. Test 4.
11	General Linear Transformations. Kernel and Range.
12	Inverse Linear Transformations. Matrices of General Linear Transformations. Similarity. Laboratory #8, Similar Matrices. Test 5.
13	Best Approximation; Least Squares. Laboratory #8, Least Squares Fitting to Data.
14	Iterative Solution of Large Scale Linear Systems. Laboratory #9, Gauss-Seidel Methods.
15	(Full course optional). Numerical Methods for Computing and Estimating Eigenvalues and Eigenvectors. Laboratory #10, Iterative Methods for Computing Eigenvalues and Eigenvectors. **OR** (Full course optional). Recursion Relations for the Direct Solution of Block Tri-diagonal Systems. Laboratory #10, Direct Solution of Block Tri-diagonal Systems.
16	Semester review and final exam.

II. Course Objectives*:

A. Analyze the major aspects of linear systems. I, III, IV

B. Determine if a system of equations has a unique solution, no solution, or multiple solutions. III, IV

C. Calculate the solutions of a consistent linear system of equations. I, III, IV

D. Perform geometry in two-space and three-space. III, V

E. Determine linear independence or dependence of a set of vectors. III, V

F. Form bases and determine dimension of linear spaces and subspaces. III, V

G. Describe the major aspects of inner-product spaces and the Gram-Schmidt process. III, IV, V

H. Consider basic properties and applications of eigenvalues and eigenvectors. III, V

I. Determine a complete set of eigenvectors and eigenvalues for a linear space. III

*Roman numerals after course objectives reference goals of the Math department.

III. Instructional Processes*:

Students will:

1. Use computer software and/or graphing calculator to solve problems involving matrices and determinants. *Technological Literacy Outcome*

2. Actively explore real-world problems through labs and/or projects such as least squares fitting to data. *Numerical Literacy Outcome, Active Learning Strategy, Transitional Strategy*

3. Translate geometry problems in 2- and 3-space into more general vector space problems which can then be solved. *Numerical Literacy Outcome*

4. Learn how to generalize the geometry and vector space language of 2- and 3- space into n-dimensional space. *Numerical Literacy Outcome*

5. Incorporate written descriptions of the mathematical procedures employed and/or the results attained into computer and/or graphing calculator labs. *Communication Outcome*

*Strategies and outcomes listed after instructional processes reference Pellissippi State□s goals for strengthening general education knowledge and skills, connecting coursework to experiences beyond the classroom, and encouraging students to take active and responsible roles in the educational process.

IV. Expectations for Student Performance*:

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

1. Use Gaussian elimination to solve a linear system. C

2. Use echelon or row reduction to find the rank of a linear system. A, B, C

3. Use an advanced calculator and/or a computer algebraic system to perform matrix operations. B, C, E

4. Use row reduction to find the value of a determinant. B, C

5. Use geometric vectors in 2-space and 3-space to find angles, lengths, lines, planes and projections. D

6. Use inner products to find orthogonal bases. E, F

7. Change the basis of a linear system. E

8. Compute eigenvalues and eigenvectors. H

9. Compute the dimensions of the kernel and range of a linear transformation. E

10. Use similar matrices to diagonalize a matrix. A

11. Use numerical methods to find a least-squares fit to data. A

12. Use numerical methods to solve large linear systems. A

*Letters after performance expectations reference the course objectives listed above.

V. Evaluation:

A. Testing Procedures:

Students are evaluated primarily on the basis of tests, laboratories, quizzes, homework and the comprehensive final exam. Six tests are shown in the weekly schedule above. A minimum of five tests is recommended.

B. Laboratory Expectations:

Laboratory experiments/projects will be directly related to specific academic activities and will reflect the theoretical concepts of the course. The design of the laboratory work can be in the form of major projects (a minimum of four is recommended) or shorter weekly "experiments" accompanied by lab reports.

C. Field Work: None

D. Other Evaluation Methods: None

E. Grading Scale:

93	-	100	A
88	-	92	B+
83	-	87	B
78	-	82	C+
70	-	77	C
60	-	69	D
Below 60			F

VI. Policies:

A. Attendance Policy:

Pellissippi State Technical Community College expects students to attend all scheduled instructional activities. As a minimum, students in all courses must be present for at least 75 percent of their scheduled class and laboratory meetings in order to receive credit for the course. Individual departments/programs/disciplines, with the approval of the vice president of Academic and Student Affairs, may have requirements that are more stringent. Excessive absences may lower the final grade.

B. Academic Dishonesty:

Individual instructors must distribute their policy on academic dishonesty during the first week of class.