SOUTHERN CONNECTICUT STATE UNIVERSITY

Mathematics 372
Linear Algebra

I. *Description*

A one-semester course emphasizing matrices, systems of linear equations, vector spaces, elementary properties of linear transformations, eigenvalues, and applications.

II. *Credit*

A. MAT 372 carries three semester-hours of university credit.
B. MAT 372 is required of all Mathematics majors.
C. MAT 372 is required for the mathematics minor.

III. *Prerequisites*

MAT 150 and one additional MAT course numbered 151 or higher.

IV. *Purpose*

The content of MAT 372 forms an important component of many areas of mathematics, both pure and applied. The course itself is a prerequisite for many of the more advanced mathematics courses. For these reasons, the course should be taken early in a student's undergraduate career, preferably upon completion of Calculus II. An important purpose of the course is to help prepare students for the rigor of MAT 375, MAT 480 or MAT 488. Thus, while the course itself is not a theoretical one, it does deal in an introductory way with some of the structure and abstraction inherent to its subject matter.

V. *Format*

Lecture-recitation. Moreover, the use of a computer algebra system (such as Maple or MATLAB) as an accompanying method of instruction is strongly recommended.

VI. *Outline* (We are assuming that 4 classes would be used for tests and review.)

A. Systems of Linear Equations ($\approx$ 29%)
   1. Systems of linear equations, their vector and matrix representations
   2. Solving systems of equations: Gaussian elimination and matrix methods
   3. Linear independence in $\mathbf{R}^n$, span of a finite set of n-tuples

4. Introduction to linear transformations on $\mathbf{R}^n$, standard matrix of a linear transformation
5. At least one application (e.g. electrical networks, elementary difference equations, elementary linear programming, Leontief input-output model, elementary Markov chains, least-squares method, fractals…)

B. Matrix Algebra ($\approx$ 21%)
1. Matrix operations
2. Inverse of a matrix, characterizations of invertible matrices
3. LU-factorization
4. Subspaces of $\mathbf{R}^n$ (including column space and null space of a matrix)

C. Determinants ($\approx$ 7%)
1. Introduction to determinants
2. Properties of determinants
3. Classical adjoint formula for the inverse of a matrix

D. Vector Spaces ($\approx$ 25%)
1. Vector spaces and subspaces
2. Linear transformations (general definition, kernel, range)
3. Linear independence, generating sets, bases, dimension
4. Coordinate systems, change of bases in a vector space
5. Isomorphism

E. Eigenvalues and Eigenvectors ($\approx$ 18%)
1. Eigenvalues and eigenvectors of matrices
2. The characteristic polynomial
3. Diagonalization
4. Eigenvectors and linear transformations
5. (OPTIONAL): Iterative estimates for eigenvalues

F. (OPTIONAL): Time permitting, one could choose to explore inner products, length and orthogonality, orthogonal sets, projections and the Gram-Schmidt process.

VII. Recommended Text

A. Lay, David C.: Linear Algebra and its Applications, 2nd Edition, Addison-Wesley, 1997.

VIII. Date

Prepared by Alain D'Amour, October 2001.

IX. Bibliography

A. Andrilli, S. & Hecker, D.: *Elementary Linear Algebra*, PWS-Kent (ITP), 1993.

B. Anton, H.: *Elementary Linear Algebra*, 3rd Edition, John Wiley, 1981.

C. Campbell, H. G.: *Linear Algebra with Applications*, 2nd Edition, Prentice-Hall, 1980.

D. Curtis, C. W.: *Linear Algebra: An Introductory Approach*, 3rd Edition, Allyn & Bacon, 1974.

E. Damiano D., & Little, J.: *A Course in Linear Algebra*, Harcourt Brace Jovanovich, 1988.

F. Fraleigh, J. & Beauregard, R.: *Linear Algebra*, Addison-Wesley, 1987.

G. Friedberg, S., Insel, A. & Spence, L.: *Linear Algebra*, 2nd Edition, Prentice-Hall, 1989.

H. Grossman, S.: *Elementary Linear Algebra*, 3rd Edition, Wadsworth, 1987.

I. Leon, S. J.: *Linear Algebra with Applications*, 5th Edition, Prentice-Hall, 1998.

J. Nicholson, W. K.: *Linear Algebra with Applications*, 3rd Edition, PWS-Kent (ITP), 1995.

K. Roberts, W.: *Elementary Linear Algebra*, Benjamin-Cummings, 1982.

L. Tucker, A.: *Linear Algebra: An Introduction to the Theory and Use of Vectors and Matrices*, Macmillan, 1993.

M. Venit, S. & Bishop, W.: *Elementary Linear Algebra*, 4th Edition, PWS-Kent (ITP), 1996.

X. Technology manuals

A. Lay, David C.: Instructor's MATLAB Manual, Day, Addison-Wesley, 2000.

B. Herman & Faulkenberry: *ATLAST Computer Exercises for Linear Algebra*, Prentice-Hall, 1997.

C. Hill & Zitarelli: *Linear Algebra Labs with MATLAB*, 2nd Edition, Prentice-Hall, 1996.

D. Herman, Pepe, Moore, & King: *Linear Algebra Modules for Interactive Learning using Maple*, Addison-Wesley, 2000.

E. Bauldry, Evans & Johnson: *Linear Algebra with Maple*, John Wiley, 1995.