Prefix, Number and Name of Course: MAT 404   Applications of Linear Algebra

Credit Hours: 3
In Class Instructional Hours: 3   **Labs:** 0   **Field Work:** 0

Catalog Description:
Prerequisites: MAT 202, MAT 263 and MAT 264
Selected applications of linear algebra to diverse fields such as biology, economics and ecology, as well as to other areas of mathematics including curve fitting, geometry and numerical analysis. Theory of eigenvalues/eigenvectors developed and applied to areas such as genetics, population growth, demography, conic sections, differential equations and recursive sequences.

Reasons for Revision:

The newly proposed course MAT 390, Operations Research, incorporates and expands on some of the topics of the "old" MAT 404. This revision addresses and updates current work in other key applications of linear algebra. The course continues to serve the following purposes for our program:
1. To provide a continuation of MAT 202 so that the student has an opportunity to work with some of the many concrete applications of linear algebra
2. To offer the student a deeper and more comprehensive understanding of linear algebra
3. To enable the student to further develop skills, mathematical insights, and approximation techniques with graphing calculators and computer algebra systems.

Student Learning Outcomes: Students will:	**Course Content References:**	**Assessment:**
1. solve eigenvalue problems by hand and (for larger problems) by use of current technology.	II	1. Individual homework assignments, projects, exams.
2. apply linear algebra to formulating and solving problems in diverse real-life fields.	I, III	2. Group work in class, individual homework assignments, projects, exams.
3. apply linear algebra to solving problems in other fields of mathematics.	I, III	3. Group work in class, individual homework assignments, projects, exams.

Course Content:

I.   Selected Applications in Linear Algebra
      A. Equations through specified points
      B. Markov chains
      C. Polygonal areas
      D. Least squares fitting to data
      E. Geometry of linear operators
      F. Cubic spline interpolation
      G. Graph theory
      H. Leontief economic models
      I. Forest management
      J. Computer graphics
      K. Cryptography

II.   Eigenvalues/Eigenvectors
      A. Computing eigenvalues and eigenvectors
      B. Diagonalizing matrices
      C. Triangularizing matrices
      D. Orthogonal Diagonalization
      E. Scaled power method

III.   Selected Applications of Eigenvalues/Eigenvectors
      A. Conic sections, quadric surfaces
      B. Genetics
      C. Age-specific population growth
      D. Harvesting animal populations
      E. Recursive sequences
      F. Linear systems of first-order differential equations

Resources

Classic Scholarship in the Field:

Agnew, J. L., and Knapp, R. C. (1989). Linear Algebra with Applications, 3rd edition. New York: Brooks/Cole Publishing

Anton, H., and Rorres, C. (2000). Elementary Linear Algebra, Applications Version, 8th edition. New York: John Wiley & Sons

Bretscher, O. (1997). Linear Algebra with Applications. Upper Saddle River, NJ: Prentice Hall

Cullen, C. G. (1994). An Introduction to Numerical Linear Algebra. Boston, MA: PWS Publishing

Cullen, C. G. (1997). Linear Algebra with Applications, 2nd edition. New York: Addison-Wesley

Daniel, J. W., and Noble, B. (1977). Applied Linear Algebra, 2nd edition. Englewood Cliffs, NJ: Prentice Hall

Goldberg, J. L. (1991). Matrix Theory with Applications. New York: McGraw-Hill

Golub, G. H., and van Loan, C. F. (1996). Matrix Computations, 3rd edition. Baltimore, MD: The Johns Hopkins University Press

Hager, W. (1988). Applied Numerical Linear Algebra. Englewood Cliffs, NJ: Prentice Hall

Hill, D. R. (1988). Experiments in Computational Matrix Algebra (The MathWorks Inc.). New York: Random House

Johnson, E. (1995). Linear Algebra with Mathematica. New York: Brooks/Cole.

Kolman, B. (1995). Introductory Linear Algebra with Applications. Englewood Cliffs, NJ: Prentice Hall

Lay, D. C. (1997). Linear Algebra and Its Applications, 2nd edition. New York: Addison-Wesley

Nakos, G., and Joyner, D. (1998). Linear Algebra with Applications. Pacific Grove, CA: Brooks/Cole Publishing

Nicholson, W. K. (1995). Linear Algebra with Applications, 3rd edition. Boston, MA: PWS Publishing

Penney, R. C. (1998). Linear Algebra: Ideas and Applications. New York: John Wiley & Sons

Strang, G. (1988). Linear Algebra and its Applications. San Diego, CA: Harcourt Brace Jovanovich

Tucker, A. (1988). A Unified Introduction to Linear Algebra: Models, Methods and Theory. New York: Macmillan

Williams, G. (2000). Linear Algebra with Applications, 4th edition. Boston, MA: Jones and Bartlett

Current Scholarship in the Field:

Hill, D. R., and Kolman, B. (2001). Modern Matrix Algebra. Upper Saddle River, NJ: Prentice-Hall

Kolman, B., and Hill, D. R. (2005). Introductory Linear Algebra: An Applied First Course, 8th edition. Upper Saddle River, NJ: Pearson Prentice Hall

Leon, S. J. (2006). Linear Algebra with Applications, 7th edition. Upper Saddle River, NJ: Pearson Prentice Hall

Olver, P. J., and Shakiban, C. (2006). Applied Linear Algebra. Upper Saddle River, NJ: Pearson Prentice Hall

Poole, D. (2006). Linear Algebra: A Modern Introduction, 2nd edition. Belmont, CA: Brooks/Cole

Sadun, L. (2001). Applied Linear Algebra: The Decoupling Principle. Upper Saddle River, NJ: Prentice Hall

Periodicals:

College Mathematics Journal
The American Mathematical Monthly
Mathematics Magazine
The Journal of Undergraduate Mathematics and Its Applications (COMAP)

Electronic and/or Audiovisual Resources:

Linear Algebra and Its Applications, Science Direct Elsevier Science Journals (http://www.sciencedirect.com/science/Journal/00243795)

Linear Algebra toolkit for students: http://www.math.odu.edu/~bogacki/cgi-bin/lat.cgi