A. CATALOG DESCRIPTION
1. Credits: 4
2. Hours/Week: 4
3. Prerequisites (Course discipline/number): Honors program eligibility or Consent of Instructor
4. Co-requisites (Course discipline/number): None
5. MnTC Goals (if any): Goal 2/Critical Thinking, Goal 4/ Mathematics/ Logical Reasoning

This course is an Honors Liberal Arts mathematics course with topics including: Systems of Linear Equations and Matrices, Determinants, Euclidean and General Vector Spaces, Linear Transformations, Eigenvalues, Eigenvectors, diagonalization, matrix decompositions, and real world applications. Students will satisfy Honors COURSE requirements #1, 2, 3, 4, and 5.

B. DATE LAST REVISED (Month, year): September, 2010

C. OUTLINE OF MAJOR CONTENT AREAS:
1. Solving Systems of Equations
   a) Graphical Approximation
   b) Substitution Methods
   c) Gaussian Elimination
   d) Matrix Inversion
   e) Cramer’s Rule
2. Matrix Properties and Operations
   a) Matrix Arithmetic
   b) Determinants
   c) Eigenvalues and Eigenvectors
   d) Diagonalization
3. Vectors and Vector Spaces
   a) Vector Geometry and Arithmetic
   b) Norms, Dot Products, and Cross Products
   c) Vector Space Axioms and Properties
   d) Spanning, Linear Independence, and Basis.
   e) Linear Transformations and Change of Basis.
4. Numerical Methods
   a) LU decompositions
   b) Power Rule
   c) Singular Value Decomposition
5. Applications of Linear Algebra
   a) Statistical and Probability Problems
   b) Numerical Estimation Methods
   c) Social and Natural Science Applications
   d) Graph Theory
   e) Game Theory

D. LEARNING OUTCOMES (GENERAL): The student will be able to:
1. Solve systems of Linear Equations by use of methods such as Graphical Approximation, Substitution, Gaussian
2. Elimination and Matrix Inversion.
3. Read and restate abstract and generalized proofs of key course concepts and ideas constructed using the methods of
4. Direct Proof, Contrapositive Proof, and Mathematical Induction.
5. Evaluate determinants of 2 by 2 and 3 by 3 matrices by hand.
6. Apply the idea of determinants to Cramer’s Rule in order to solve systems of equations
7. Compute matrix inverses by multiple methods.
8. Demonstrate understanding of the basic geometry and arithmetic of vectors in 2 space, 3 space, and n space.
9. Compute dot products and cross products of vectors and understand their meaning.
10. Read and relate the axioms of a general vector space.
11. Read, restate, and apply the concepts of Rank, Nullity, and Dimension for a vector space.
12. Read and relate the concept of Spanning Sets, Linear Independence, and the idea of a Basis for a vector space.
D. LEARNING OUTCOMES (GENERAL): The student will be able to: Continued...
13. Demonstrate the concept of a Matrix as a Linear Transformation.
14. Find the characteristic equation of a matrix and use it to find both Eigenvalues and Eigenvectors.
15. Recognize the diagonalized form of a matrix and compute the matrices used to achieve this form.

Honors Outcomes:
Criteria #1: The inclusion of Numerical Methods and Real World Applications gives greater depth and breadth to this course relative to a non-honors section.
Criteria #2: Academically accessible research papers as well as news articles and items of interest from business and scientific publications are to be worked into the course in order to provide greater real world relevance.
Criteria #3: Students will be expected to work on a short research project, individually or in groups based upon the instructors discretion, expanding upon one of the applications of Linear Algebra toward Business, Statistics, Probability, Natural Science, Social Science, Advanced Mathematics, or any other field chosen with the instructors consent.
Criteria #4: Students will be responsible for an in-class presentation regarding their work from Criteria #3.
Criteria #5: Students will be responsible for meeting with the instructor outside of the classroom for any or all of the following reasons: to discuss a project proposal relating to Criteria #3, to discuss research progress and direction, or to participate in an oral quiz, examination, or final examination.

E. LEARNING OUTCOMES (MNTC):
Goal 2/Critical Thinking: The student will be able to:
1. Gather factual information and apply it to a given problem in a manner that is relevant, clear, comprehensive, and conscious of possible bias in the information selected.
2. Imagine and seek out a variety of possible goals, assumptions, interpretations, or perspectives, which can give alternative meanings or solutions to given situations or problems.
3. Analyze the logical connections among the facts, goals, and implicit assumptions relevant to a problem or claim; generate and evaluate implications that follow from them.
4. Recognize and articulate the value assumptions, which underlie and affect decisions, interpretations, analyses, and evaluations made by ourselves and others.

Goal 4/Mathematics/Symbolic Systems: The student will be able to:
1. Illustrate historical and contemporary applications of mathematics/logical systems.
2. Clearly express mathematical/logical ideas in writing.
3. Explain what constitutes a valid mathematical/logical argument (proof).
4. Apply higher-order problem solving and/or modeling strategies.

F. METHODS FOR EVALUATION OF STUDENT LEARNING:
1. Homework
2. Quizzes
3. Oral Quizzes
4. Group Work
5. Attendance
6. Individual or Group Research
7. Written Examinations
8. Oral or Written Comprehensive Final Exam

G. RRTC CORE OUTCOME(S) ADDRESSED:
- Communication
- Critical Thinking
- Global Awareness/Diversity
- Civic Responsibility
- Personal/Professional Accountability
- Aesthetic Response

H. SPECIAL INFORMATION (if any): None