**1. COURSE TITLE\*:** Linear Algebra

2. **CATALOG – PREFIX/COURSE NUMBER/COURSE SECTION\*: MATH 2250**

**3. PREREQUISITE\*:** MATH 2222 or Math 223, or the equivalent

**COREQUISITE(S)\*: None**

**4. COURSE TIME/LOCATION/MODALITY: (*Course Syllabus – Individual Instructor Specific*)**

**5. CREDIT HOURS\*:** 4 **LECTURE HOURS\*:** 4

**LABORATORY HOURS\*:** 0 **OBSERVATION HOURS\*:** 0

**6. FACULTY CONTACT INFORMATION: *(Course Syllabus – Individual Instructor Specific)***

**7. COURSE DESCRIPTION\*:**

This course serves as a standard introduction to linear algebra. Topics include matrix, operations, vector spaces, inner product spaces, linear transformations, determinants, eigenvalues, and eigenvectors.

**8. LEARNING OUTCOMES\*:**

At the completion of this course the student will:

* 1. Understand algebraic and geometric representations of vectors in *Rn* and their operations, including addition, scalar multiplication and dot product. understand how to determine the angle between vectors and the orthogonality of vectors. (OMT019 – Outcome 1)
  2. Solve systems of linear equations using Gauss-Jordan elimination to reduce to echelon form. Solve systems of linear equations using the inverse of the coefficient matrix when possible. Interpret existence and uniqueness of solutions geometrically. (OMT019 – Outcome 2)
  3. Perform common matrix operations such as addition, scalar multiplication, multiplication, and transposition. Discuss associativity and noncommutativity of matrix multiplication. (OMT019 – Outcome 3)
  4. Discuss spanning sets and linear independence for vectors in *Rn*. For a subspace of *Rn*, prove all bases have the same number of elements and define the dimension. Prove elementary theorems concerning rank of a matrix and the relationship between rank and nullity. (OMT019 – Outcome 4)
  5. Interpret a matrix as a linear transformation from *Rn* to *Rm*. Discuss the transformation’s kernel and image in terms of nullity and rank of the matrix. Understand the relationship between a linear transformation and its matrix representation, and explore some geometric transformations in the plane. Interpret a matrix product as a composition of linear transformations. (OMT019 – Outcome 5)
  6. Use determinants and their interpretation as volumes. Describe how row operations affect the determinant. Analyze the determinant of a product algebraically and geometrically. (OMT019 – Outcome 7)
  7. Define eigenvalues and eigenvectors geometrically. Use characteristic polynomials to compute eigenvalues and eigenvectors. Use eigenspaces of matrices, when possible, to diagonalize a matrix.
  8. Use axioms for abstract vector spaces (over the real or complex fields) to discuss examples (and non-examples) of abstract vector spaces such as subspaces of the space of all polynomials. (OMT019 – Outcome 8)
  9. Discuss the existence of a basis of an abstract vector space. Describe coordinates of a vector relative to a given basis. For a linear transformation between vector spaces, discuss its matrix relative to given bases. Discuss how those matrices changes when the bases are changed. (OMT019 – Outcome 9)
  10. Discuss orthogonal and orthonormal bases, Gram-Schmidt orthogonalization, orthogonal complements and projections.  Discuss rigid motions and orthogonal matrices. (OMT019 – Outcome 10)
  11. Explain how orthogonal projections relate to least square approximations. (OMT019 – Outcome 11)

**9.       ADOPTED TEXT(S)\*:**

## Elementary Linear Algebra

9th edition

Kolman & Hill

Pearson/Prentice-Hall, 2018

ISBN 13: 9780134718538

**9a: SUPPLEMENTAL TEXTS APPROVED BY FULL TIME DEPARTMENTAL FACULTY (INSTRUCTOR MUST NOTIFY THE BOOKSTORE BEFORE THE TEXTBOOK ORDERING DEADLINE DATE PRIOR TO ADOPTION) \*\*\*.**

**10. OTHER REQUIRED MATERIALS: (SEE APPENDIX C FOR TECHNOLOGY REQUEST FORM.)\*\***

A graphing calculator capable of matrix operations is required.

**11. GRADING SCALE\*\*\*:**

Grading will follow the policy in the catalog. The scale is as follows:

A: 90 – 100

B: 80 – 89

C: 70 – 79

D: 60 – 69

F: 0 – 59

**12. GRADING PROCEDURES OR ASSESSMENTS: (*Course Syllabus – Individual Instructor Specific)***

|  |
| --- |
| *Example 1 - By Percent* |
| Homework 10%  Quizzes/Tests 90%  Total 100% |

|  |  |  |
| --- | --- | --- |
| *Example 2* | | |
| *Category* | *By Total Points* | *% of Grade* |
| Homework (20x10) | 200 | 10% |
| Quizzes/Tests  (5x360) | 1800 | 90% |
| Total | 2000 | 100% |

|  |  |  |
| --- | --- | --- |
| *Example 3* | | |
| *Category* | *By Total Points* | *% of Grade* |
| Online Quizzes | 400 | 100% |
| Online Tests  (6x100) | 600 | 15% |
| Notebook  (2x500) | 1000 | 25% |
| Midterm | 1000 | 25% |
| Final | 1000 | 25% |
| Total | 4000 | 100% |

**13. COURSE METHODOLOGY: *(Course Syllabus – Individual Instructor Specific)***

The course design provides instruction and materials to support the course objectives.  Classes may consist of a variety of means to accomplish this including but not limiting to: lectures, class discussions, small group projects, supplemental materials, and outside assignments.  Practice is an important part of the learning process.  For every one hour of class time, two additional hours of study time should be expected.

**14. COURSE OUTLINE: *(Course Syllabus – Individual Instructor Specific)***

**Chapter 1 - Linear Equations and Matrices**

1.1 Systems of Linear Equations (Review as needed)

1.2 Matrices (OMT019 – Outcome 3)

1.3 Matrix Multiplication (OMT019 – Outcome 3)

1.4 Algebraic Properties of Matrix Operations (OMT019 – Outcome 3)

1.5 Special Types of Matrices and Partitioned Matrices

1.6 Matrix Transformations

1.7 Computer Graphics (Optional)

1.8 Correlation Coefficient

**Chapter 2 - Solving Linear Systems**

2.1 Echelon Form of a Matrix (OMT019 – Outcome 2)

* 1. Solving Linear Systems (OMT019 – Outcome 2)
  2. Elementary Matrices; Finding *A*– 1 (OMT019 – Outcome 2)
  3. Equivalent Matrices
  4. LU–Factorization (Optional)

**Chapter 3 – Determinants**

3.1 Definition (OMT019 – Outcome 6)

3.2 Properties of Determinants (OMT019 – Outcome 6)

3.3 Cofactor Expansion (OMT019 – Outcome 6)

3.4 Inverse of a Matrix

3.5 Other Applications of Determinants (OMT019 – Outcome 6)

3.6 Determinants from a Computational Point of View

**Chapter 4 - Real Vector Spaces**

4.1 Vectors in the Plane and in 3—Space (OMT019 – Outcome 1)

4.2 Vector Spaces (OMT019 – Outcome 4)

4.3 Subspaces (OMT019 – Outcome 4)

4.4 Span (OMT019 – Outcome 4)

4.5 Linear Independence (OMT019 – Outcome 4)

4.6 Basis and Dimension (OMT019 – Outcome 4)

4.7 Homogeneous Systems (OMT019 – Outcome 8)

4.8 Coordinates and Isomorphisms (OMT019 – Outcome 9)

4.9 Rank of a Matrix (OMT019 – Outcome 4)

**Chapter 5 - Inner Product Spaces**

5.1 Length and Direction in *R*2 and *R*3 (OMT019 – Outcome 1)

5.2 Cross product in *R*3 (Optional)

5.3 Inner Product Spaces (OMT019 – Outcome 10)

5.4 Gram—Schmidt Process (OMT019 – Outcome 10)

5.5 Orthogonal Complements (OMT019 – Outcome 10)

5.6 Least Squares (OMT019 – Outcome 11–partly)

**Chapter 6 - Linear Transformations and Matrices**

6.1 Definition and Examples (OMT019 – Outcome 5)

6.2 Kernel and Range of a Linear Transformation (OMT019 – Outcome 5)

6.3 Matrix of a Linear Transformation (OMT019 – Outcome 5)

6.4 Vector Spaces of Matrices and Vector Space of Linear Transformations

(OMT019 – Outcome 5)

6.5 Similarity

6.6 Introduction to Homogeneous Coordinates

**Chapter 7 - Eigenvalues and Eigenvectors**

7.1 Eigenvalues and Eigenvectors (OMT019 – Outcome 7)

* 1. Diagonalization of Similar Matrices (OMT019 – Outcome 7)
  2. Diagonalization of Symmetric Matrices (OMT019 – Outcome 7)

**15. SPECIFIC MANAGEMENT REQUIREMENTS\*\*\*:**

Suggested pace for the course by section numbers:

Week 1: 1.2, 1.3, 1.4

Week 2: 1.5, 1.6, 1.8

Week 3: 2.1, 2.2

Week 4: 2.3, 2.4

Week 5: 3.1, 3.2

Week 6: 3.3, 3.4

Week 7: 3.5, 3.6, 4.1

Week 8: 4.2, 4.3

Week 9: 4.4, 4.5, 4.6

Week 10: 4.7, 4.8

Week 11: 4.9, 5.1, 5.3

Week 12: 5.4, 5.5, 5.6

Week 13: 6.1, 6.2, 6.3

Week 14: 6.4, 6.5, 6.6

Week 15: 7.1, 7.2, 7.3

Week 16: **Finals**

**16. FERPA:\***

Students need to understand that your work may be seen by others. Others may see your work when being distributed, during group project work, or if it is chosen for demonstration purposes. Students also need to know that there is a strong possibility that your work may be submitted to other entities for the purpose of plagiarism checks.

**17. DISABILITIES:\***

Students with disabilities may contact the Disability Services Office, Central Campus, at 800-628-7722 or 937-393-3431.

**18. OTHER INFORMATION\*\*\*:**

**SYLLABUS TEMPLATE KEY**

**\*** Item cannot be altered from that which is included in the master syllabus approved by the Curriculum Committee.

**\*\*** Any alteration or addition must be approved by the Curriculum Committee

\*\*\*Item should begin with language as approved in the master syllabus but may be added to at the discretion of the faculty member.