MERRITT COLLEGE COURSE OUTLINE

COLLEGE:		**STATE APPROVAL DATE:**	08/07/2014
ORIGINATOR:	Tae-Soon Park	**STATE CONTROL NUMBER:**	CCC00055 7398
		BOARD OF TRUSTEES APPROVAL DATE:	06/10/2014
		CURRICULUM COMMITTEE APPROVAL DATE:	04/26/2018
		CURRENT EFFECTIVE DATE:	01/01/2015

DIVISION/DEPARTMENT:

1. REQUESTED CREDIT CLASSIFICATION:

Credit - Degree Applicable
Course is not a basic skills course.
Program Applicable

2. DEPT/COURSE NO:

MATH 003E

3. COURSE TITLE:

Linear Algebra

4. COURSE: MC Course Modification

TOP NO. 1701.00

5. UNITS: 3.000

HRS/WK LEC: 3.00 **Total:** 52.50
HRS/WK LAB:

6. NO. OF TIMES OFFERED AS SELETED TOPIC: AVERAGE ENROLLMENT:

7. JUSTIFICATION FOR COURSE:

Satisfies the General Education Analytical Thinking requirement for Associate Degrees. Provides foundation for more advanced study in mathematics, and related fields such as Physics. Satisfies the Quantitative Reasoning component required for transfer to UC, CSU, and some independent four-year institutions. Acceptable for credit: CSU, UC.

8. COURSE/CATALOG DESCRIPTION

Linear Algebra: Gaussian and Gauss-Jordan elimination, matrices, determinants, vectors in R2 and R3, real and complex vector spaces, inner product spaces, linear transformations, eigenvalues, eigenvectors, and applications. MATH 3E and 3F are equivalent to MATH 3D. Not open for credit to students who have completed or are currently enrolled in MATH 3D.

9. OTHER CATALOG INFORMATION

a. Modular: No If yes, how many modules:
b. Open entry/open exit: No
c. Grading Policy: Letter Grade Only
d. Eligible for credit by Exam: No
e. Repeatable according to state guidelines: No
f. Required for degree/certificate (specify):
Mathematics, Mathematics
g. Meets GE/Transfer requirements (specify):
Acceptable for credit: UC/CSU. AA/AS area 4b CSU area B4. IGETC area 2A.
h. C-ID Number: MATH 250 Expiration Date:

i. Are there prerequisites/corequisites/recommended preparation for this course? Yes
Date of last prereq/coreq validation: 10/21/2014
j. Acceptable for Credit: CSU/UC

10. LIST STUDENT PERFORMANCE OBJECTIVES (EXIT SKILLS): (Objectives must define the exit skills

required of students and include criteria identified in Items 12, 14, and 15 - critical thinking, essay writing, problem solving, written/verbal communications, computational skills, working with others, workplace needs, SCANS competencies, all aspects of the industry, etc.)(See SCANS/All Aspects of Industry Worksheet.)

Students will be able to:

1. Solve systems of linear equations using Gaussian elimination and other methods
2. Determine whether a set, with given operations, is a vector space
3. Use bases and orthonormal bases to solve linear algebra problems
4. Find the dimension of a space such as those associated with matrices and linear transformations
5. Find eigenvalues and eigenvectors and use them in applications
6. Prove basic results in linear algebra using appropriate proof-writing techniques together with concepts such as those of linear independence of vectors, properties of subspaces, linearity, injectivity and surjectivity of functions, and properties of eigenvectors and eigenvalues
7. Apply systems of equations to solving problems from areas such as statistics (curve fitting), physical science (electrical circuits), and business (economic models)

11A. COURSE CONTENT: List major topics to be covered. This section must be more than listing chapter headings from a textbook. Outline the course content, including essential topics, major subdivisions, and supporting details. It should include enough information so that a faculty member from any institution will have a clear understanding of the material taught in the course and the approximate length of time devoted to each. There should be congruence among the catalog description, lecture and/or lab content, student performance objectives, and the student learning outcomes. List percent of time spent on each topic; ensure percentages total 100%.

LECTURE CONTENT:

1. Systems of Linear Equations and Matrices 15 %

a. Techniques for solving systems of linear equations, including Gaussian and Gauss-Jordan elimination
b. Matrix operations, matrix algebra, invertibility and the transpose
c. Inverse matrices and the relationship between coefficient matrix invertibility and solutions to a system of linear equations
d. Elementary matrices
e. Special matrices: diagonal, triangular and symmetric

2. Determinants 5%

a. Evaluating determinants by row reduction
b. Properties of determinants
c. Cramer's rule

3. Vectors in R2 and R3 5%

a. Introduction to vectors (geometric)
b. Norm of a vector; vector arithmetic
c. Dot product; projections
d. Cross product
e. Lines and planes in 3-space

4. Euclidean vector spaces 5%

a. Euclidean n-space
b. Dot product, norm of a vector, angle between vectors, orthogonality of two vectors in Rn
c. Linear transformations from Rn to Rm
d. Properties of linear transformations from Rn to Rm
e. Vector algebra for Rn

5. General vector spaces 10%

a. Real vector spaces and subspaces
b. Linear independence and dependence
c. Basis and dimension of a vector space
d. Matrix-generated spaces: row space, column space, nullspace
e. Rank and nullity

6. Inner product spaces 15%

a. Inner products on real vector spaces
b. Angle and orthogonality in inner product spaces
c. Orthogonal and orthonormal bases
d. Gram-Schmidt process, QR-decomposition
e. Best approximation; least squares
f. Orthogonal matrices
g. Change of basis

7. Eigenvalues, Eigenvectors 15%

a. Eigenvalues and eigenvectors
b. Diagonalization
c. Orthogonal diagnonalization of symmetric matrices
d. Eigenspaces

8. Linear transformations 10%

a. General linear transformations
b. Kernel and range
c. Inverse linear transformations
d. Matrices of general linear transformations
e. Similarity

9. Applications 10%

a. Application to differential equations
b. Geometry of linear operators on R2
c. Least squares fitting to data
d. Approximation problems, Fourier series
e. Diagonalizing quadratic forms
f. Application to conic sections and quadric surfaces

10. Complex vector spaces 10%

a. The complex number system; argument, polar form, De Moivre's Theorem
b. Complex vector spaces
c. Complex inner product spaces
d. Hermitian, unitary and normal matrices

11B. LAB CONTENT:
N/A

12. METHODS OF INSTRUCTION (List methods used to present course content.)

1. Activity
2. Discussion
3. Lecture
4. Threaded Discussions
5. Other (Specify)

Other Methods:
Instructor-focused lecture on theory and the language of calculus. Question and answer periods based on worksheets and in-class examples to encourage class discussion and demonstrations which emphasize alternative approaches to problem solving and their underlying rationales. Video demonstration of tools specific to this level of calculus.

13. ASSIGNMENTS: 0.00 hours/week (List all assignments, including library assignments. Requires two (2) hours of independent work outside of class for each unit/weekly lecture hour. Outside assignments are not required for lab-only courses, although they can be given.)

Out-of-class Assignments:

Out-of-class Assignments: College-level textbook chapter readings that reinforce lecture material. Problem sets including computational problems equivalent in content and level of difficulty to those covered in the lectures. Additional problems that introduce supplemental concepts and formulas and require the synthesis and analysis of various concepts. Graphical representation and analysis specific to the study of linear algebra.

ASSIGNMENTS ARE: (See definition of college level):
Primarily College Level

14. STUDENT ASSESSMENT: (Grades are based on):
SKILL DEMONSTRATION
COMPUTATION SKILLS
NON-COMPUTATIONAL PROBLEM SOLVING (Critical thinking should be demonstrated by solving unfamiliar problems via various strategies.)
ESSAY (Includes "blue book" exams and any written assignment of sufficient length and complexity to require students to select and organize ideas, to explain and support the ideas, and to demonstrate critical thinking skills.)
OTHER (Describe):
Assess essay for understanding and application of concepts presented in classwork and supplemental material. Evaluate computation skills for accurate application of steps and correct answers. Evaluate students' ability to analyze given information and apply it in terms of the question

15. TEXTS, READINGS, AND MATERIALS

A. Textbooks:

Anton, Howard. 2014. *Elementary Linear Algebra* 11th. John Wiley Publishing Company
Rationale: -

*Date is required: Transfer institutions require current publication date(s) within 5 years of outline addition/update.

B. Additional Resources:

Library/LRC Materials and Services:

The instructor, in consultation with a librarian, has reviewed the materials and services of the College Library/LRC in the subject areas related to the proposed new course

Are print materials adequate? Yes

Are nonprint materials adequate? Yes

Are electronic/online resources available? Yes

Are services adequate? Yes

Specific materials and/or services needed have been identified and discussed. Librarian comments: Collection adequate to support course. Department Chair to donate additional texts as needed.

C. Readings listed in A and B above are: (See definition of college level):

Primarily college level

16. DESIGNATE OCCUPATIONAL CODE:
E - Non-Occupational

17. LEVEL BELOW TRANSFER:
Y - Not Applicable

18. CALIFORNIA CLASSIFICATION CODE:
Y - Credit Course

19. NON CREDIT COURSE CATEGORY:
Y - Not Applicable

20. FUNDING AGENCY CATEGORY:
Not Applicable - Not Applicable

SUPPLEMENTAL PAGE

Use only if additional space is needed. (Type the item number which is to be continued, followed by "continued." Show the page number in the blank at the bottom of the page. If the item being continued is on page 2 of the outline, the first supplemental page will be "2a." If additional supplemental pages are required for page 2, they are to be numbered as 2b, 2c, etc.)

1a. Prerequisites/Corequisites/Recommended Preparation:

PREREQUISITE:
- MATH 003A: Calculus I

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STUDENT LEARNING OUTCOMES

1. **Outcome:** Computation: Use appropriate techniques to perform the various computational tasks typically required in linear algebra. Examples of such techniques include: Gaussian or Gauss-Jordan Elimination Applications of Gaussian Elimination Matrix Multiplication Laplace Expansions for Determinants Gram-Schmidt Orthogonalization
   This outcome maps to the following Institution Outcomes:
   • Critical Thinking - Think critically using appropriate methods of reasoning to evaluate ideas and identify and investigate problems and to develop creative and practical solutions to issues that arise in workplaces, institutions, and local and global communities.
   • Quantitive Reasoning - Apply college-level mathematical reasoning to analyze and explain real world issues and to interpret and construct graphs, charts, and tables.

   Assessment: exam, essay, student project, written exercise, skill demonstration

2. **Outcome:** Proofs: Use various elements of deductive reasoning to construct valid proofs of typical statements in linear algebra. Examples of typical statements include: The Invertibility Theorem (some 20+ equivalent characterizations of when a square matrix is invertible) Statements involving general properties of matrices, or properties of special types of matrices Statements involving linear dependence/independence, or bases in a finite-dimensional vector space
   This outcome maps to the following Institution Outcomes:
   • Critical Thinking - Think critically using appropriate methods of reasoning to evaluate ideas and identify and investigate problems and to develop creative and practical solutions to issues that arise in workplaces, institutions, and local and global communities.
   • Quantitive Reasoning - Apply college-level mathematical reasoning to analyze and explain real world issues and to interpret and construct graphs, charts, and tables.

   Assessment: exam, essay, student project, written exercise, skill demonstration

3. **Outcome:** Problem-Solving: Recognize and distinguish the different types of application problems studied in Linear Algebra, translate them into appropriate mathematical form, apply appropriate specific methods and general problem-solving strategies to solve them, verify that their solutions are correct, and document their solution processes in an appropriate, clearly readable style.
   This outcome maps to the following Institution Outcomes:
   • Critical Thinking - Think critically using appropriate methods of reasoning to evaluate ideas and identify and investigate problems and to develop creative and practical solutions to issues that arise in workplaces, institutions, and local and global communities.
   • Quantitive Reasoning - Apply college-level mathematical reasoning to analyze and explain real world issues and to interpret and construct graphs, charts, and tables.

   Assessment: exam, essay, student project, written exercise, skill demonstration

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