I. GENERAL DESCRIPTION
   A. Approval Date: April 2012
   B. Department: Mathematics
   C. Course Number: MATH 130
   D. Course Title: Linear Algebra and Differential Equations
   E. Course Outline Preparer(s): T. B. Lee and G. Ling
   F. Department Chair: Dennis Piontkowski
   G. Dean: David Yee

II. COURSE SPECIFICS
   A. Hours: Lecture: 5 weekly (87.5 total)
   B. Units: 5
   C. Prerequisites: None
   D. Course Justification: This course is intended for students majoring in Mathematics, Computer Science, Engineering, or Physical Sciences. It satisfies both the CSU and UC Quantitative Reasoning transfer requirements.
   E. Field Trips: No
   F. Method of Grading: Letter
   G. Repeatability: 0

III. CATALOG DESCRIPTION

IV. MAJOR LEARNING OUTCOMES
   Upon completion of this course a student will be able to:
   A. Solve linear algebra problems involving subspaces, linear dependence, span, basis, or dimension.
   B. Read and write proofs of basic linear algebra results.
   C. Use a variety of methods to solve differential equations.
   D. Describe the linear structure, existence, and uniqueness of solutions to differential equations.
V. CONTENTS
A. Real Vector Spaces
   1. Definition and Examples
   2. Subspaces
   3. Linear Dependence and Span
   4. Basis and Dimension
   5. Vectors, Coordinates of Vectors, and Coordinate Vectors
B. Matrices and Determinants
   1. Matrix Algebra
      a. Sums and Products
      b. Inverses
   2. Matrices and Linear Systems
      a. Row-echelon Form
      b. Gaussian Elimination
   3. Rank of a Matrix
      a. Row Space and Column Space
      b. Orthogonal Complements of Row Space and Column Space
   4. Determinants
      a. Definition
      b. Computation and Properties
C. Inner Product Spaces
   1. Inner Products and Norms
   2. Orthogonal Projection
   3. Gram-Schmidt Orthogonalization
D. Linear Transformations
   1. Definition and Examples
   2. Kernel, Image, and the Dimension Theorem
   3. Compositions
   4. Inverse Linear Transformations
   5. Matrix Representations
   6. Change of Basis
   7. Similarity
   8. Eigenvalues and Eigenvectors
   9. Diagonalization
E. Proofs of Selected Results: for example, the Unique Representation Theorem, the
   Cauchy-Schwarz Inequality, the Dimension Theorem, and the Change of Basis Theorem
F. First-Order Differential Equations
   1. Basic Concepts of Differential Equations
   2. Methods of Solution
   3. Qualitative Methods
   4. Theoretical Concepts
   5. Applications
G. Second-Order Differential Equations
   1. Linear Second-Order Differential Equations
   2. Constant Coefficient Second-Order Differential Equations
   3. Methods of Solution
4. Applications

H. Systems of First-Order Constant Coefficient Differential Equations

I. Series Solutions
   1. Review of Power Series
   2. Constructing Series Solutions
   3. Distinguishing Ordinary and Regular Singular Points and their Effects on the Series Solution Method

J. Laplace Transform
   1. Basic Idea of the Laplace Transform
   2. Solving Constant Coefficient Differential Equations
   3. Discontinuous Forcing Functions

K. Fourier Series and Partial Differential Equations
   1. Fourier Series, Sine Series, and Cosine Series
   2. Convergence Behavior
   3. Separation of Variables and Fundamental Solutions to the Heat Equation, the Wave Equation, and Laplace’s Equation
   4. Solution of Initial Value and Boundary Value Problems

L. Linear Structure, Existence, and Uniqueness of Solutions to Differential Equations

VI. INSTRUCTIONAL METHODOLOGY

A. Assignments
   1. In-class assignments: discussion, individualized work, or small group work appropriate to the day’s lesson
   2. Out-of-class assignments
      a. Regular reading assignments from class notes or the textbook
      b. Regular homework problems either from the textbook or posed by the instructor: for example, determining whether a subset of a vector space is a subspace, determining whether a set of vectors is linearly independent or spans a vector space, constructing an orthonormal basis for an inner product space, finding bases for the kernel and image of a linear transformation, or computing the eigenvalues and eigenvectors for a square matrix; solving a first- or second-order differential equation, solving a first-order system of differential equations, computing a series solution for a differential equation, using the Laplace transform to solve a differential equation, constructing a Fourier series solution for a partial differential equation

B. Evaluation
   1. Assignments as described above
   2. Periodic exams consisting of problems similar to those on the assignments intended to measure conceptual understanding and computational competency
   3. A comprehensive final exam consisting of problems similar to those on the assignments and periodic exams intended to measure overall mastery of the course material

C. Textbooks and other instructional materials

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3. The Mathematics Department’s textbook list indicates the current textbooks.
4. A graphing calculator may be required.

VII. TITLE 5 CLASSIFICATION
CREDIT/DEGREE APPLICABLE (meets all standards of Title 5. Section 55002(a)).