C-ID Descriptor
Differential Equations and Linear Algebra

Descriptor Details

- **Descriptor Title**: Differential Equations and Linear Algebra
- **C-ID Number**: 910
- **Suffix**:
  - Sequence (S)
- **Units**: 5.0
- **Date of Last Revision**: 10/12/2017 11:44:05 PM GMT+0000

General Description

First order ordinary differential equations, including separable, linear, homogeneous of degree zero, Bernoulli and exact with applications and numerical methods. Solutions to higher order differential equations using undetermined coefficients, variation of parameters, and power series, with applications. Solutions to linear and non-linear systems of differential equations, including numerical solutions. Matrix algebra, solutions of linear systems of equations, and determinants. Vector spaces, linear independence, basis and dimension, subspace and inner product space, including the Gram-Schmidt procedure. Linear transformations, kernel and range, eigenvalues, eigenvectors, diagonalization and symmetric matrices. Equivalent to the combination of C-ID Descriptors Math 240 and Math 250.

Prerequisites

Single Variable Calculus II (C-ID Math 220 or 221) or Single Variable Sequence (C-ID Math 900S)

Corequisites

No information provided

Advisories

Prior or concurrent course work with vector calculus would be helpful.

Content

1. First order differential equations including separable, homogeneous, exact, and linear;
2. Existence and uniqueness of solutions;
3. Applications of first order differential equations such as circuits, mixture problems, population modeling, orthogonal trajectories, and slope fields;
4. Second order and higher order linear differential equations;
5. Fundamental solutions, independence, Wronskian;
6. Nonhomogeneous equations;
7. Applications of higher order differential equations such as the harmonic oscillator and circuits;
8. Methods of solving differential equations including variation of parameters, Laplace transforms, and series solutions;
9. Systems of ordinary differential equations
10. Techniques for solving systems of linear equations including Gaussian and Gauss-Jordan elimination and inverse matrices;
11. Matrix algebra, invertibility, and the transpose;
12. Relationship between coefficient matrix invertibility and solutions to a system of linear equations and the inverse matrices;
13. Special matrices: diagonal, triangular, and symmetric;
14. Determinants and their properties;
15. Vector algebra for $\mathbf{R}^n$;
16. Real vector spaces and subspaces, linear independence, and basis and dimension of a vector space;
17. Matrix-generated spaces: row space, column space, null space, rank, nullity;
18. Change of basis;
19. Linear transformations, kernel and range, and inverse linear transformations;
20. Matrices of general linear transformations;
21. Eigenvalues, eigenvectors, eigenspace;
22. Diagonalization including orthogonal diagonalization of symmetric matrices;
23. Dot product, norm of a vector, angle between vectors, orthogonality of two vectors in $\mathbf{R}^n$; and

24. Orthogonal and orthonormal bases: Gram-Schmidt process.

Lab Activities

No information provided

Objectives

Upon successful completion of the course, students will be able to:

1. Create and analyze mathematical models using ordinary differential equations;
2. Verify solutions of differential equations;
3. Identify the type of a given differential equation and select and apply the appropriate analytical technique for finding the solution of first order and selected higher order ordinary differential equations;
4. Apply the existence and uniqueness theorems for ordinary differential equations;
5. Find power series solutions to ordinary differential equations;
6. Determine the Laplace Transform and inverse Laplace Transform of functions;
7. Solve Linear Systems of ordinary differential equations.
8. Find solutions of systems of equations using various methods appropriate to lower division linear algebra;
9. Use bases and orthonormal bases to solve problems in linear algebra;
10. Find the dimension of spaces such as those associated with matrices and linear transformations;
11. Find eigenvalues and eigenvectors and use them in applications; and
12. Prove basic results in linear algebra using appropriate proof-writing techniques such as linear independence of vectors; properties of subspaces; linearity, injectivity and surjectivity of functions; and properties of eigenvectors and eigenvalues.

Evaluation Methods

Tests, examinations, homework or projects where students demonstrate their mastery of the learning objectives and their ability to devise, organize and present complete solutions to problems and proofs.

Textbooks

A college level texts designed for science, technology, engineering and math majors, and supporting the learning objectives of this course.