MATH G285: INTRODUCTION TO LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS

Item	Value
Curriculum Committee Approval Date	11/03/2020
Top Code	170100 - Mathematics, General
Units	5 Total Units
Hours	90 Total Hours (Lecture Hours 90)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Grading Policy	Standard Letter (S)
Local General Education (GE)	• GWC Mathematic Competency (GB2)
California General Education Transfer Curriculum (Cal-GETC)	• Cal-GETC 2A Math Concepts (2A)
Intersegmental General Education Transfer Curriculum (IGETC)	• IGETC 2A Math Concepts (2A)
California State University General Education Breadth (CSU GE-Breadth)	• CSU B4 Math/Quant.Reasoning (B4)

Course Description

Formerly: Ordinary Differential Equations. This course is designed to introduce students to the fields of Linear Algebra and Differential Equations. Topics include 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. PREREQUISITE: MATH G185. Transfer Credit: CSU; UC. C-ID: MATH 910S, MATH 240. **C-ID:** MATH 910S, MATH 240.

Course Level Student Learning Outcome(s)

1. Course Outcomes
2. Find bases and othonormal bases associated with matrices and linear transformations to solve problems in Linear Algebra.
3. Find the subspaces and dimensions of spaces associated with matrices and linear transformations.
4. Find eigenvalues and eigenvectors and use them to solve systems of differential equations and in applications.
5. Identify the type of a given differential equation and select and apply the appropriate analytical
6. technique for finding the solution of first order and selected higher order ordinary differential equations.
7. Use Laplace transforms and inverse Laplace transforms to solve differential equations or systems of differential equations.

Course Objectives

- 1. Create and analyze mathematical models using ordinary differential equations
- 2. Verify solutions of differential equations
- 3. Identify the type of given differential equation and select and apply the appropriate analytical technique for finding tthe 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
- 12. Prove basic results in linear algebra using appropriate proof-writing techniques such as linear independence of vectors; properties of vector spaces or subspaces; linearity, injectivity and surjectivity of functions; and properties of eigenvalues and eigenvectors

Lecture Content

First order differential equations including separable, homogeneous, exact, and linear; Existence and uniqueness of solutions; Applications of first order differential equations such as circuits, mixture problems, population modeling, orthogonal trajectories, and slope fields; Second order and higher order linear differential equations; Fundamental solutions, independence, Wronskian; Nonhomogeneous equations; Applications of higher order differential equations such as the harmonic oscillator and circuits; Methods of solving differential equations including variation of parameters, Laplace transforms, and series solutions; Systems of ordinary differential equations Techniques for solving systems of linear equations including Gaussian and Gauss-Jordan elimination and inverse matrices; Matrix algebra, invertibility, and the transpose; Relationship between coefficient matrix invertibility and solutions to a system of linear equations and the inverse matrices; Special matrices: diagonal, triangular, and symmetric; Determinants and their properties; Vector algebra for Rn; Real vector spaces and subspaces, linear independence, and basis and dimension of a vector space; Matrix-generated spaces: row space, column space, null space, rank, nullity; Change of basis; Linear transformations, kernel and range, and inverse linear transformations; Matrices of general linear transformations; Eigenvalues, eigenvectors, eigenspace; Diagonalization including orthogonal diagonalization of symmetric matrices; Dot product, norm of a vector, angle between vectors, orthogonality of two vectors in Rn; and Orthogonal and orthonormal bases: Gram-Schmidt process.

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- DE Online Lecture (02X)

Reading Assignments

Textbook on ordinary differential equations and their applications.

Writing Assignments

1. Tests and quizzes.2. Homework assignments consisting mainly of problems from the textbook.

Out-of-class Assignments

Utilizing online solving applications for numerical analysis.

Demonstration of Critical Thinking

Students will demonstrate critical thinking and problem-solving skills by using logic, in conjunction with past mathematical solving techniques, to solve and interpret a variety of applications not previously seen. Demonstrations will be shown by completing assignments, participating in discussions, and completing required exams and quizzes.

Required Writing, Problem Solving, Skills Demonstration

Test and quizzes with written solutions. Homework and classroom assignment. Skills demonstration can be shown through indivisual/group projects.

Eligible Disciplines

Mathematics: Masters degree in mathematics or applied mathematics OR bachelors degree in either of the above AND masters degree in statistics, physics, or mathematics education OR the equivalent. Masters degree required.

Textbooks Resources

1. Required Goode, Stephen W., Annin, Scott A.. Differential Equations and Linear Algebra, 4th ed. Prentice Hall, 2016