# MATH A285: INTRODUCTION TO LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS

| Item | Value |
|---|---|
| Curriculum Committee Approval Date | 02/23/2022 |
| 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),<br>• Pass/No Pass (B) |
| Associate Arts Local General Education (GE) | • OC Comm/Analytical Thinking - AA (OA2) |
| Associate Science Local General Education (GE) | • OCC Comm/AnalyticalThinking-AS (OAS2)<br>• OCC Mathematics (OMTH) |
| 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

Introduction to linear algebra and differential equations. Topics include matrices, determinants, vector spaces, linear systems of equations, inner product spaces, first and second order differential equations, systems of differential equations, and Laplace transforms. Enrollment Limitation: MATH A285H; students who complete MATH A285 may not enroll in or receive credit for MATH A285H. PREREQUISITE: MATH A185, MATH A185H or MATH A182H. Transfer Credit: CSU; UC.

## Course Level Student Learning Outcome(s)

1. Use matrix algebra and row-reduction methods to solve linear systems.
2. Solve linear systems, including under- and over-determined systems.
3. Prove lemmas and corollaries in linear algebra.
4. Relate linear transformations to their matrices with respect to given bases.
5. Describe linear transformations as functions mapping an n-dimensional space to an m-dimensional space.

## Course Objectives

- 1. Use matrix algebra and row reduction methods to solve linear systems.
- 2. Prove basic properties of linear spaces and linear maps, including spans, independence and basic dimension theorems.
- 3. Compute null spaces and images of linear functions, and apply this to superposition of solutions in applications.
- 4. Compute change of bases.
- 5. Explore consequences of the Rank Nullity Theorem.
- 6. Work with inner product and orthogonality, including abstract Fourier coefficients and the Gramm Schmidt processes.
- 7. Define n.n determinants and explore their elementary properties.
- 8. Use linear theory to solve first and second order ordinary differential equations and linear systems of ordinary differential equations.
- 9. Compute eigenvalues and eigenvectors.
- 10. Use appropriate technology to enhance understanding of differential equations and linear algebra.

## Lecture Content

Row-reduction methods, including elementary row operations, Gauss-Jordan elimination and echelon matrices Matrix algebra including matrix addition, scalar multiplication, multiplication of matrices, identities, inverses and proofs of some of the properties of these operations Using the inverse of a matrix and transpose of a matrix to solve systems of linear equations. Linear spaces with focus on subspaces, spans, independence, bases and dimension theory Linear functions with emphasis on null spaces, images, fundamental theorems including the Rank-Nullity Theorem, and change of basis Introduction to Inner Product Spaces including definitions, examples, norms, orthogonality, Fourier coefficients and the Gramm-Schmidt processes Determinants with emphasis on multilinear functions, elementary properties of determinants, adjoints and Cramers rule First Order Differential Equations Separable Linear Exact Homogeneous Second Order and Higher Order Differential Equations Homogeneous Linear Non-homogeneous Linear Eigenvalues and eigenvectors: definitions, computation and eigenbases Introduction to systems of ordinary differential equations using elimination, eigen methods and the exponential matrix Introduction to Laplace transforms and their use in the solution of linear and non-linear differential equations Numerical methods for solution of ordinary differential equations such as Eulers method, an improved Eulers method or the Runge-Kutta method Series solutions to differential equations Introduction to Fourier series Introduction to Jacobian matrices in the discussion of differentiability of mappings from Euclidean n-space to m-space with extension to a general analysis of the chain rule, implici t function theorem and the inverse function theorem

## Method(s) of Instruction

- Lecture (02)

## Instructional Techniques

Lecture, discussion

## Reading Assignments

Students will spend approximately 1 hour per week reading from assigned text.

## Writing Assignments

Students will spend approximately 1 hour per week on writing assignments, including definitions, theorems, proofs and justifications.

## Out-of-class Assignments

Students will spend approximately 6 hours per week on out-of-class assignments, inclduing reading, written definitions, justifications, and test preparation.

## Demonstration of Critical Thinking

Several written tests, comprehensive final

## Required Writing, Problem Solving, Skills Demonstration

Students will write definitions, theorems, proofs and justifications

## 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. Differential Equations and Linear Algebra. , 4th ed. Pearson, 2017 Rationale: This book covers all the course content.