

Course Outline for MATH 2341, Linear Analysis

MATH 2341 Linear Analysis (4 units)

Prerequisite: One of the following: MATH 143, [MATH 1262](#), [MATH 1263](#), or DATA/[MATH 1265](#).

Linear algebra, systems of linear equations, linear transformations, determinants, eigenvalues, eigenvectors, and diagonalization. Differential equations: first-order differential equations, higher order linear differential equations, mechanical and electrical vibrations, systems of differential equations, the Laplace transform. 4 lectures. Cross-listed as HNRS/[MATH 2341](#). Formerly HNRS/MATH 244.

Course Learning Objectives	
1	Solve linear systems using matrices and Gaussian elimination.
2	Classify solution sets of linear systems using the language and ideas of linear independence and dependence, matrix invertibility, rank, nullity, and dimension.
3	Perform operations on matrices to solve problems in linear algebra and applied mathematics.
4	Compute matrix inverses, and use matrix inverses to solve linear systems.
5	Compute determinants and use properties of determinants to solve problems.
6	Compute eigenvalues and eigenvectors of a matrix and use eigenvalues and eigenvectors to diagonalize a matrix.
7	Utilize the language and elementary theory of ordinary differential equations.
8	Solve and analyze first-order separable, linear, and exact differential equations.
9	Solve and analyze second and higher-order linear homogeneous and nonhomogeneous differential equations.
10	Formulate, solve, and analyze the results of mathematical models of elementary physical problems in engineering, physics, and other applied areas.
11	Use the Laplace transform to solve initial value problems, especially problems that arise in engineering involving mechanical or electrical systems with discontinuous or impulsive forcing terms.
12	Solve and analyze systems of first-order linear differential equations.

Expanded Course Content

Textbooks, materials, and/or other resources

Lay, David C., Linear Algebra and its Applications

Boyce, William E. and DiPrima, Richard C., Differential Equations and Boundary Value Problems

Farlow, Hall, McDill, and West, Differential Equations and Linear Algebra (Classic Version, Second Edition), Pearson Modern Classics

Week	Readings	Topics of Discussion
1	Lay 1.1, 1.2, 1.3, 1.4	Systems of Linear Equations, Gaussian Elimination, Row Reduction and Echelon Forms, Vector Equations, The Matrix Equation $Ax=b$, Span
2	Lay 1.5, 1.7, 2.1	Solution Sets of Linear Systems, Linear Independence, Matrix Operations
3	Lay 2.2, 2.3, 2.8	Matrix Inverses, Characterizations of Invertible Matrices, Subspaces of $\mathbb{R}^n$
4	Lay 2.9, 3.1, 3.2	Dimension and Rank Introduction to Determinants, Properties of Determinants
5	Lay 5.1, 5.2	Eigenvectors and Eigenvalues, The Characteristic Equation
6	Lay 5.3, 5.5	Diagonalization, Complex Eigenvalues
7	Boyce and DiPrima Ch. 1, 2.1, 2.2	Introduction to Differential Equations, Linear Differential Equations, Separable Differential Equations
8	Boyce and DiPrima 3.1, 3.2, 3.3	Homogeneous Equations with Constant Coefficients, Solutions of Linear Homogeneous Equations, The Wronskian, Complex Roots of the Characteristic Equation
9	Boyce and DiPrima 3.4, 3.5	Repeated Roots of the Characteristic Equation, Nonhomogeneous Equations

Week	Readings	Topics of Discussion
10	Boyce and DiPrima 3.6, 3.7, 3.8	Variation of Parameters, Mechanical and Electrical Vibrations, Forced Vibrations
11	Boyce and DiPrima 6.1, 6.2, 6.3 Supplemental Notes	Definition of the Laplace Transform, Solution of Initial Value Problems, Step Functions
12	Boyce and DiPrima 6.4, 6.5, 6.6 Supplemental Notes	Differential Equations with Discontinuous Forcing Functions, Impulse Functions, The Convolution Integral
13	Boyce and DiPrima 7.4, 7.5	Systems of First Order Linear Equations, Homogeneous Linear Systems with Constant Coefficients
14	Boyce and DiPrima 7.6, 7.7	Complex Eigenvalues, Fundamental Matrices
15	Boyce and DiPrima 7.8, 7.9	Repeated Eigenvalues, Nonhomogeneous Linear Systems Nonlinear Systems

Method of Assessment

The possible methods of assessment are written individual examinations, quizzes, in-class worksheets, projects, and homework. All exams are to be proctored in-person, and one or more midterms and a cumulative final exam are required.

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Instructional Mode

The instructional mode for this class is face-to-face. This designation means that the essential academic standards of the course require in-class student engagement, and thus remote instruction is not appropriate.

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