

Lecture Notes for Math 307: Linear Algebra and Differential Equations

Instructor: Max Hill (Fall 2025)

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About this document

These lecture notes were prepared by Max Hill for a 16-week linear algebra course (MATH 307) at University of Hawaii at Manoa in Fall 2025.

The textbook used is *Linear Algebra and Differential Equations* (2002) by G. Peterson S. Sochacki, in which we cover primarily Chapters 1,2,5, and 6

0 Tentative Course Outline

- **Weeks 1-3: Matrices and determinants.** (*Systems of linear equations, matrices, matrix operations, inverse matrices, special matrices and their properties, and determinants.*)
 - Section 1.1: Systems of Linear Equations
 - Section 1.2: Matrices and Matrix Operations
 - Section 1.3: Inverses of Matrices
 - Section 1.4: Special Matrices and Additional Properties of Matrices
 - Section 1.5: Determinants
 - Section 1.6: Further Properties of Determinants
 - Section 1.7: Proofs of Theorems on Determinants
- **Weeks 4-6: Vector spaces.** (*Vector spaces, subspaces, spanning sets, linear independence, bases, dimension, null space, row and column spaces, Wronskian.*)
 - Section 2.1: Vector Spaces
 - Section 2.2: Subspaces and Spanning Sets
 - Section 2.3: Linear Independence and Bases
 - Section 2.4: Dimension; Nullspace, Row space, and Column Space
 - Section 2.5: Wronskians
- **Weeks 7-11: Linear transformations, spectral theory.** (*Linear transformation, eigenvalues and eigenvectors, algebra of linear transformations, matrices for linear transformations, eigenvalues and eigenvectors, similar matrices, diagonalization, Jordan normal form.*)
 - Section 5.1: Linear Transformations
 - Section 5.2: The Algebra of Linear Transformations
 - Section 5.3: Matrices for Linear Transformations
 - Section 5.4: Eigenvalues and Eigenvectors of Matrices
 - Section 5.5: Similar Matrices, Diagonalization, and Jordan Canonical Form
 - Section 5.6: Eigenvectors and Eigenvalues of Linear Transformations
- **Midterm Exam**
- **Weeks 12-14: Systems of differential equations.** (*Theory of systems of linear differential equations, homogeneous systems with constant coefficients, the diagonalizable case, nondiagonalizable case, nonhomogeneous linear systems, applications to 2×2 and 3×3 systems of nonlinear differential equations.*)
 - Section 6.1: The Theory of Systems of Linear Differential Equations
 - Section 6.2: Homogeneous Systems with Constant Coefficients: The Diagonalizable Case
 - Section 6.3: Homogeneous Systems with Constant Coefficients: The Nondiagonalizable Case
 - Section 6.4: Nonhomogeneous Linear Systems
 - Section 6.6: Applications Involving Systems of Linear Differential Equations
 - Section 6.7: 2×2 Systems of Nonlinear Differential Equations
- **Weeks 14-16: Other stuff if time allows.** (*Converting differential equations to first order systems (section 6.5), linearization of 2×2 nonlinear systems (??), stability and instability (section 6.7), predator-prey equations (section 6.7.1).*)
- **Final Exam**

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This lecture is based on section 1.1 in the textbook.