

16 Calculus IV Spring 1997

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Texts: Elementary Differential Equations and Boundary Value Problems, by
Boyce and DiPrima, 6th edition, 1997

Lecture Notes in Linear Algebra, by J. Derwent and A Himonas

First order ordinary differential equations. Linear and nonlinear
equations. Separable equations. Applications. Population dynamics. Exact
equations. Integrating factors. Homogeneous equations.

Second order equations. Fundamental solutions of the homogeneous
equation. Reduction of order. Homogeneous equations with constant
coefficients, Undetermined coefficients. Variation of parameters. Free
oscillations.

Series solutions. Review of power series. Series solutions near an
ordinary point. Singular points. Euler equations. Series solutions near a
regular singular point.

Linear algebra. Systems of linear equations. Matrices and matrix
algebra. Systems and matrices. Vector spaces, linear independence, bases,
dimension. Vector spaces and systems. The dot product and Gram-Schmidt
orthogonalization. Linear transformations from \mathbb{R}^n to \mathbb{R}^m . Determinants.
Expansion by cofactors. Expansion by row reduction. The adjoint formula
for the inverse. Cramer's rule. Introduction to eigenvalues and
eigenvectors.

There is written homework for every class, whose aggregate counts the same
as one test.

There were also ten Mathematica demonstrations and eleven short Mathematica
assignments.

Syllabus

Elementary Differential Equations and Boundary Value Problems

Chapter I: Introduction

(Students read:)

- 1 Classification of Differential Equations
- 2 Historical Remarks

Chapter 2: First Order Differential Equations

(10 classes - 1 class period for test:)

- 1 Linear Equations
- 2 Further Discussion of Linear Equations
- 3 Separable Equations
- 4 Differences Between Linear and Nonlinear Equations
- 5 Modeling with Linear Equations
- 6 Population Dynamics and Some Related Problems

- 7 Some Problems in Mechanics
- 8 Exact Equations and Integrating Factors
- 9 Homogeneous Equations
- 10 Miscellaneous Problems and Applications

Chapter 3: Second Order Linear Equations

{ classes:)

- 1 Homogeneous Equations with Constant Coefficients
- 2 Fundamental Solutions of Linear Homogeneous Equations
- 3 Linear Independence and the Wronskian

{ classes:)

- 4 Complex Roots of the Characteristic Equation
- 5 Repeated Roots; Reduction of Order
- 6 Nonhomogeneous Equations; Method of Undetermined
- 7 Coefficients
- 8 Variation of Parameters
- 9 Mechanical and Electrical Vibrations

Chapter 5: Series Solutions of Second Order Linear Equations

{ classes:)

- 1 Review of Power Series
- 2 Series Solutions near an Ordinary Point, Part I
- 3 Series Solutions near an Ordinary Point, Part II
- 4 Regular Singular Points
- 5 Euler Equations

. class period for test; 2 classes:)

- 6 Series Solutions near a Regular Singular Point Part I
- 7 Series Solutions near a Regular Singular Point, Part II

Lecture Notes in Linear Algebra

{.5 classes:)

Systems of Linear Equations

- 1 Introduction to Gaussian Elimination
- 2 General Linear System with m Equations and n Unknowns
- 3 Homogeneous Systems

Matrices

Systems and Matrices

- 1 Systems in Matrix Form
- 2 The Inverse of a Square Matrix
- 3 Homogeneous Systems and the Rank of a Matrix

{ classes:)

Vector Spaces

- 1 The Vector Spaces R^n and C^n
- 2 Vector Spaces
- 3 Subspaces
- 4 Linear Independence, Basis and Dimension

5 The Row Space and Column Space of a Matrix

1.5 class:)

Vector Spaces and Systems

..5 classes:)

The Dot Product

- 1 The Dot Product and its Properties
- 2 Projections and the Gram-Schmidt Process
- 3 Dot Products and Matrix Products

. class period for text; 2 classes:)

Linear Transformations

Determinants

- 1 Definition of the Determinant of a Square Matrix
- 2 Properties of Determinants
- 3 Using Determinants to find A
- 4 Using Determinants to Solve $n \times n$ Systems

! classes:)

Introduction to Eigenvalues and Eigenvectors

- 1 Finding Eigenvalues and Eigenvectors
- 2 Diagonalization of a Matrix