

15 Differential Equations, Spring 1997

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Syllabus

Texts: Boyce & DiPrima, Elementary Differential Equations and Boundary Value Problems, Sixth Edition
Coombes, et al, Differential Equations with Maple

Comments

Differential Equations with Maple is an excellent supplement. The problems require serious use of the computer to solve problems, plot solutions, etc., in combination with a good understanding of the concepts in order to interpret the output from Maple and sometimes in order to see how to use Maple on the problem. There is now a second edition, designed for use with Maple VR 4. The authors have also written Differential Equations with Mathematica.

I have never been happy with the treatment of systems of differential equations in Boyce and DiPrima. A minor comment is that the Chapter on numerical methods is between the two chapters on systems. The treatment of repeated eigenvalues is ad hoc (§ 7.7). There is enormous duplication between § 9.1P9.2 and parts of Chapter 7, with no acknowledgment in Chapter 9 that there is duplication.

Some students find the material on partial differential equations and Fourier series very difficult and cannot absorb it in two or three weeks. I don't think this material belongs in the course. The whole concept of Fourier series is totally new to students; it is a very deep and difficult concept. Attempting to reduce it to a few cookbook formulas doesn't work. The proper place to learn the material is in an undergraduate course on partial differential equations, such as Math 436.

The chapter on higher order equations is a good place to start because it reinforces what students have already learned. However, most textbooks on ODE do not have such a chapter, since higher order equations are easily converted into first order systems and so are covered (in principle) once first order linear systems have been covered.

Syllabus

Elementary Differential Equations & Boundary Value Problems
Chapter 4 Higher Order Linear Equations
4.1 General Theory of n th Order Linear Equations
4.2 Homogeneous Equations with Constant Coefficients
4.3 The Method of Undetermined Coefficients
Chapter 6 The Laplace Transform
6.1 Definition of the Laplace Transform

- 5.2 Solution of Initial Value Problems
- 5.3 Step Functions
- 5.4 Differential Equations with Discontinuous Forcing Functions
- 5.5 Impulse Functions
- 5.6 The Convolution Integral
- Chapter 7 Systems of First Order Linear Equations
 - 7.1 Introduction
 - 7.2 Review of Matrices
 - 7.3 Systems of Linear Algebraic Equations; Linear Independence, Eigenvalues, Eigenvectors
 - 7.4 Basic Theory of Systems of First Order Linear Equations
 - 7.5 Homogeneous Linear Systems with Constant Coefficients
 - 7.6 Complex Eigenvalues
 - 7.7 Repeated Eigenvalues
 - 7.8 Fundamental Matrices
 - 7.9 Nonhomogeneous Linear Systems
- Chapter 8 Numerical Methods
 - 8.1 The Euler or Tangent Line Method
 - 8.2 Errors in Numerical Procedures
 - 8.3 Improvements on the Euler Method
 - 8.4 The RungeKuta Method
 - 8.6 More on Errors; Stability
- Chapter 9 Nonlinear Differential Equations and Stability
 - 9.1 The Phase Plane; Linear Systems
 - 9.2 Autonomous Systems and Stability
 - 9.3 Almost Linear Systems
- Chapter 10 Partial Differential Equations and Fourier Series
 - 10.1 Separation of Variables; Heat Conduction
 - 10.2 Fourier Series
 - 10.3 The Fourier Convergence Theorem
 - 10.4 Even and Odd Functions
 - 10.5 Other Heat Conduction Problems
 - 10.6 The Wave Equation; Vibrations of an Elastic String
- Differential Equations with Maple
 - Introduction
 - Guiding Philosophy
 - Student User's Guide
 - Instructor's Guide
 - Getting Started with Maple
 - Maple in Windows
 - Maple on a Macintosh
 - Maple in the X Window System
 - Doing Mathematics with Maple
 - Problem Set A: Practice with Maple
 - Using Maple Worksheets
 - Solutions of Differential Equations
 - Numerical Methods
 - Features of Maple
 - Troubleshooting
 - Problem Set C: Numerical Solutions of Differential Equations

.. Laplace Transforms

Problem Set E: Series Solutions and Laplace Transforms

!. Higher Order Equations and Systems of First Order Equations

!. Qualitative Theory for Systems of Differential Equations

Problem Set F: Systems of Equations