

- Preface p. xi
- Acknowledgments p. xv
- 1 Introduction to Differential Equations p. 1
 - 1.1 Definitions and Terminology p. 2
 - 1.2 Initial-Value Problems p. 15
 - 1.3 Differential Equations as Mathematical Models p. 22
- Chapter 1 in Review p. 37
- 2 First-Order Differential Equations p. 39
 - 2.1 Solution Curves Without the Solution p. 40
 - 2.2 Separable Variables p. 51
 - 2.3 Linear Equations p. 60
 - 2.4 Exact Equations p. 72
 - 2.5 Solutions by Substitutions p. 80
 - 2.6 A Numerical Solution p. 86
- Chapter 2 in Review p. 92
- 3 Modeling with First-Order Differential Equations p. 95
 - 3.1 Linear Equations p. 96
 - 3.2 Nonlinear Equations p. 109
 - 3.3 Systems of Linear and Nonlinear Differential Equations p. 121
- Chapter 3 in Review p. 130
- Project Module: Harvesting of Renewable Natural Resources Gilbert N. Lewis p. 133
- 4 Higher-Order Differential Equations p. 138
 - 4.1 Preliminary Theory: Linear Equations p. 139
 - 4.1.1 Initial-Value and Boundary-Value Problems p. 139
 - 4.1.2 Homogeneous Equations p. 142
 - 4.1.3 Nonhomogeneous Equations p. 148
 - 4.2 Reduction of Order p. 154
 - 4.3 Homogeneous Linear Equations with Constant Coefficients p. 158
 - 4.4 Undetermined Coefficients--Superposition Approach p. 167
 - 4.5 Undetermined Coefficients--Annihilator Approach p. 178
 - 4.6 Variation of Parameters p. 188
 - 4.7 Cauchy-Euler Equation p. 193
 - 4.8 Solving Systems of Linear Equations by Elimination p. 201
 - 4.9 Nonlinear Equations p. 207
- Chapter 4 in Review p. 212
- 5 Modeling with Higher-Order Differential Equations p. 215
 - 5.1 Linear Equations: Initial-Value Problems p. 216
 - 5.1.1 Spring/Mass Systems: Free Undamped Motion p. 216
 - 5.1.2 Spring/Mass Systems: Free Damped Motion p. 220
 - 5.1.3 Spring/Mass Systems: Driven Motion p. 224
 - 5.1.4 Series Circuit Analogue p. 227
 - 5.2 Linear Equations: Boundary-Value Problems p. 237
 - 5.3 Nonlinear Equations p. 247
- Chapter 5 in Review p. 259

- Project Module: The Collapse of the Tacoma Narrows Suspension Bridge Gilbert N. Lewis p. 263
- 6 Series Solutions of Linear Equations p. 267
- 6.1 Solutions About Ordinary Points p. 268
- 6.1.1 Review of Power Series p. 268
- 6.1.2 Power Series Solutions p. 271
- 6.2 Solutions About Singular Points p. 280
- 6.3 Two Special Equations p. 292
- Chapter 6 in Review p. 304
- 7 The Laplace Transform p. 306
- 7.1 Definition of the Laplace Transform p. 307
- 7.2 Inverse Transform and Transforms of Derivatives p. 314
- 7.3 Translation Theorems p. 324
- 7.3.1 Translation on the s-Axis p. 324
- 7.3.2 Translation on the t-Axis p. 328
- 7.4 Additional Operational Properties p. 338
- 7.5 Dirac Delta Function p. 351
- 7.6 Systems of Linear Equations p. 354
- Chapter 7 in Review p. 361
- 8 Systems of Linear First-Order Differential Equations p. 364
- 8.1 Preliminary Theory p. 365
- 8.2 Homogeneous Linear Systems with Constant Coefficients p. 375
- 8.2.1 Distinct Real Eigenvalues p. 376
- 8.2.2 Repeated Eigenvalues p. 380
- 8.2.3 Complex Eigenvalues p. 384
- 8.3 Variation of Parameters p. 393
- 8.4 Matrix Exponential p. 399
- Chapter 8 in Review p. 404
- Project Module: Earthquake Shaking of Multistory Buildings Gilbert N. Lewis p. 406
- 9 Numerical Solutions of Ordinary Differential Equations p. 410
- 9.1 Euler Methods and Error Analysis p. 411
- 9.2 Runge-Kutta Methods p. 417
- 9.3 Multistep Methods p. 424
- 9.4 Higher-Order Equations and Systems p. 427
- 9.5 Second-Order Boundary-Value Problems p. 433
- Chapter 9 in Review p. 438
- 10 Plane Autonomous Systems and Stability p. 439
- 10.1 Autonomous Systems, Critical Points, and Periodic Solutions p. 440
- 10.2 Stability of Linear Systems p. 448
- 10.3 Linearization and Local Stability p. 458
- 10.4 Modeling Using Autonomous Systems p. 470
- Chapter 10 in Review p. 480
- 11 Orthogonal Functions and Fourier Series p. 483
- 11.1 Orthogonal Functions p. 484

- 11.2 Fourier Series p. 489
- 11.3 Fourier Cosine and Sine Series p. 495
- 11.4 Sturm-Liouville Problem p. 504
- 11.5 Bessel and Legendre Series p. 511
- 11.5.1 Fourier-Bessel Series p. 512
- 11.5.2 Fourier-Legendre Series p. 515
- Chapter 11 in Review p. 519
- 12 Partial Differential Equations and Boundary-Value Problems in Rectangular Coordinates p. 521
- 12.1 Separable Partial Differential Equations p. 522
- 12.2 Classical Equations and Boundary-Value Problems p. 527
- 12.3 Heat Equation p. 533
- 12.4 Wave Equation p. 536
- 12.5 Laplace's Equation p. 542
- 12.6 Nonhomogeneous Equations and Boundary Conditions p. 547
- 12.7 Orthogonal Series Expansions p. 551
- 12.8 Boundary-Value Problems Involving Fourier Series in Two Variables p. 555
- Chapter 12 in Review p. 559
- 13 Boundary-Value Problems in other Coordinate Systems p. 561
- 13.1 Problems Involving Laplace's Equation in Polar Coordinates p. 562
- 13.2 Problems in Polar and Cylindrical Coordinates: Bessel Functions p. 567
- 13.3 Problems in Spherical Coordinates: Legendre Polynomials p. 575
- Chapter 13 in Review p. 578
- 14 Integral Transform Method p. 581
- 14.1 Error Function p. 582
- 14.2 Applications of the Laplace Transform p. 584
- 14.3 Fourier Integral p. 595
- 14.4 Fourier Transforms p. 601
- Chapter 14 in Review p. 607
- 15 Numerical Solutions of Partial Differential Equations p. 610
- 15.1 Elliptic Equations p. 611
- 15.2 Parabolic Equations p. 617
- 15.3 Hyperbolic Equations p. 625
- Chapter 15 in Review p. 630
- Appendixes p. 1
- I Gamma Function p. 1
- II Introduction to Matrices p. 3
- III Laplace Transforms p. 25
- Selected Answers for Odd-Numbered Problems p. 1
- Index p. 1