

Exercises from the final edition of a popular engineering math text. A collection of 1332 mostly odd-numbered exercises. Worked at a mediocre skill level in Mathematica 10. Browse PDFs on the locally hosted site, then come back and download anything interesting.

The chapter contents:

CHAPTER 1 First-Order ODEs

- 1.1 Basic Concepts. Modeling
- 1.2 Geometric Meaning of $y' = f(x, y)$. Direction Fields, Euler's Method
- 1.3 Separable ODEs. Modeling
- 1.4 Exact ODEs. Integrating Factors
- 1.5 Linear ODEs. Bernoulli Equation. Population Dynamics
- 1.6 Orthogonal Trajectories.
- 1.7 Existence and Uniqueness of Solutions for Initial Value Problems

CHAPTER 2 Second-Order Linear ODEs

- 2.1 Homogeneous Linear ODEs of Second Order
- 2.2 Homogeneous Linear ODEs with Constant Coefficients
- 2.3 Differential Operators. Optional
- 2.4 Modeling of Free Oscillations of a Mass-Spring System
- 2.5 Euler-Cauchy Equations
- 2.6 Existence and Uniqueness of Solutions. Wronskian
- 2.7 Nonhomogeneous ODEs
- 2.8 Modeling- Forced Oscillations. Resonance
- 2.9 Modeling- Electric Circuits
- 2.10 Solution by Variation of Parameters

CHAPTER 3 Higher Order Linear ODEs

- 3.1 Homogeneous Linear ODEs
- 3.2 Homogeneous Linear ODEs with Constant Coefficients
- 3.3 Nonhomogeneous Linear ODEs

CHAPTER 4 Systems of ODEs. Phase Plane. Qualitative Methods

- 4.1 Systems of ODEs as Models in Engineering Applications
- 4.3 Constant-Coefficient Systems. Phase Plane Method
- 4.4 Criteria for Critical Points. Stability
- 4.5 Qualitative Methods for Nonlinear Systems
- 4.6 Nonhomogeneous Linear Systems of ODEs

CHAPTER 5 Series Solutions of ODEs. Special Functions

- 5.1 Power Series Method
- 5.2 Legendre's Equation. Legendre Polynomials $P_n(x)$
- 5.3 Extended Power Series Method- Frobenius Method
- 5.4 Bessel's Equation. Bessel Functions $J_\nu(x)$
- 5.5 Bessel Functions of the $Y_\nu(x)$. General Solution

CHAPTER 6 Laplace Transforms

- 6.1 Laplace Transform. Linearity. First Shifting Theorem (s-Shifting)
- 6.2 Transforms of Derivatives and Integrals. ODEs
- 6.3 Unit Step Function (Heaviside Function). Second Shifting Theorem (t-Shifting)
- 6.4 Short Impulses. Dirac's Delta Function. Partial Fractions
- 6.5 Convolution. Integral Equations
- 6.6 Differentiation and Integration of Transforms. ODEs with Variable Coefficients
- 6.7 Systems of ODEs

CHAPTER 7 Linear Algebra-- Matrices, Vectors, Dets.

- 7.1 Matrices, Vectors - Addition and Scalar Multiplication
- 7.2 Matrix Multiplication
- 7.3 Linear Systems of Equations. Gauss Elimination
- 7.4 Linear Independence. Rank of a Matrix. Vector Space
- 7.7 Determinants. Cramer's Rule
- 7.8 Inverse of a Matrix. Gauss-Jordan Elimination
- 7.9 Vector Spaces, Inner Product Spaces. Linear Transformations. Optional

CHAPTER 8 Linear Algebra - Matrix Eigenvalue Problems

- 8.1 The Matrix Eigenvalue Problem. Determining Eigenvalues and Eigenvectors
- 8.2 Some Applications of Eigenvalue Problems
- 8.3 Symmetric, Skew-Symmetric, and Orthogonal Matrices
- 8.4 Eigenbases. Diagonalization. Quadratic Forms
- 8.5 Complex Matrices and Forms. Optional

CHAPTER 9 Vector Differential Calculus. Grad, Div, Curl

- 9.1 Vectors in 2-Space and 3-Space
- 9.2 Inner Product (Dot Product)
- 9.3 Vector Product (Cross Product)
- 9.4 Vector and Scalar Functions and Their Fields. Vector Calculus- Derivatives
- 9.5 Curves. Arc Length. Curvature. Torsion
- 9.7 Gradient of a Scalar Field. Directional Derivative
- 9.8 Divergence of a Vector Field
- 9.9 Curl of a Vector Field

CHAPTER 10 Vector Integral Calculus. Integral Theorems

- 10.1 Line Integrals
- 10.2 Path Independence of Line Integrals
- 10.3 Calculus Review- Double Integrals.
- 10.4 Green's Theorem in the Plane
- 10.5 Surfaces for Surface Integrals
- 10.6 Surface Integrals
- 10.7 Triple Integrals. Divergence Theorem of Gauss
- 10.8 Further Applications of the Divergence Theorem
- 10.9 Stokes's Theorem

CHAPTER 11 Fourier Analysis

- 11.1 Fourier Series
- 11.2 Arbitrary Period. Even and Odd Functions. Half-Range Expansions
- 11.3 Forced Oscillations
- 11.4 Approximation by Trigonometric Polynomials
- 11.5 Sturm-Liouville Problems. Orthogonal Functions
- 11.6 Orthogonal Series. Generalized Fourier Series
- 11.7 Fourier Integral
- 11.8 Fourier Cosine and Sine Transforms
- 11.9 Fourier Transform. Discrete and Fast Fourier Transforms

CHAPTER 12 Partial Differential Equations (PDEs)

- 12.1 Basic Concepts of PDEs
- 12.3 Solution by Separating Variables. Use of Fourier Series
- 12.4 D'Alembert's Solution of the Wave Equation. Characteristics
- 12.6 Heat Equation- Sol'n by Fourier Series. Steady 2D Heat, Dirichlet Problems
- 12.7 Heat Equation- Modeling Long Bars. Sol'n by Fourier Integrals and Transforms
- 12.9 Rectangular Membrane. Double Fourier Series
- 12.10 Laplacian in Polar Coordinates. Circular Membrane. Fourier-Bessel Series
- 12.11 Laplace's Equation in Cylindrical and Spherical Coordinates. Potential
- 12.12 Solution of PDEs by Laplace Transforms

CHAPTER 13 Complex Numbers and Functions. Complex Differentiation

- 13.1 Complex Numbers and Their Geometric Representation
- 13.2 Polar Form of Complex Numbers. Powers and Roots
- 13.3 Derivative. Analytic Function
- 13.4 Cauchy-Riemann Equations. Laplace's Equation
- 13.5 Exponential Function
- 13.6 Trigonometric and Hyperbolic Functions. Euler's Formula
- 13.7 Logarithm. General Power. Principal Value

CHAPTER 14 Complex Integration

- 14.1 Line Integral in the Complex Plane
- 14.2 Cauchy's Integral Theorem
- 14.3 Cauchy's Integral Formula
- 14.4 Derivatives of Analytic Functions

CHAPTER 15 Power Series, Taylor Series

- 15.1 Sequences, Series, Convergence Tests
- 15.2 Power Series
- 15.3 Functions Given by Power Series
- 15.4 Taylor and Maclaurin Series
- 15.5 Uniform Convergence. Optional

CHAPTER 16 Laurent Series. Residue Integration

- 16.1 Laurent Series
- 16.2 Singularities and Zeros. Infinity
- 16.3 Residue Integration Method
- 16.4 Residue Integration of Real Integrals

CHAPTER 17 Conformal Mapping

- 17.1 Geometry of Analytic Functions- Conformal Mapping
- 17.2 Linear Fractional Transformations (Möbius Transformations)
- 17.3 Special Linear Fractional Transformations
- 17.4 Conformal Mapping by Other Functions
- 17.5 Riemann Surfaces.

CHAPTER 18 Complex Analysis and Potential Theory

- 18.1 Electrostatic Fields
- 18.2 Use of Conformal Mapping. Modeling
- 18.3 Heat Problems
- 18.4 Fluid Flow
- 18.5 Poisson's Integral Formula for Potentials
- 18.6 Harmonic Functions. Uniqueness for Dirichlet Problem

CHAPTER 19 Numerics in General

- 19.1 Introduction
- 19.2 Solution of Equations by Iteration
- 19.3 Interpolation
- 19.4 Spline Interpolation
- 19.5 Numeric Integration and Differentiation

CHAPTER 20 Numeric Linear Algebra

- 20.1 Linear Systems- Gauss Elimination
- 20.2 Linear Systems- LU-Factorization, Matrix Inversion
- 20.3 Linear Systems- Solution by Iteration
- 20.4 Linear Systems- Ill-Conditioning, Norms
- 20.5 Least Squares Method
- 20.7 Inclusion of Matrix Eigenvalues
- 20.8 Power Method for Eigenvalues
- 20.9 Tridiagonalization and QR-Factorization

CHAPTER 21 Numerics for ODEs and PDEs

- 21.1 Methods for First-Order ODEs
- 21.2 Multistep Methods
- 21.3 Methods for Systems and Higher Order ODEs
- 21.4 Methods for Elliptic PDEs
- 21.5 Neumann and Mixed Problems. Irregular Boundary
- 21.6 Methods for Parabolic PDEs
- 21.7 Method for Hyperbolic PDEs

CHAPTER 22 Linear Programming
22.1 Unconstrained Optimization. Method of Steepest Descent
22.2 Linear Programming
22.3 Simplex Method
22.4 Simplex Method -- Difficulties

CHAPTER 23 Graphs, Optimization
23.1 Graphs and Digraphs
23.2 Shortest Path Problems. Complexity
23.3 Bellman's Principle. Dijkstra's Algorithm
23.4 Shortest Spanning Trees -- Greedy Algorithm
23.5 Shortest Spanning Trees -- Prim's Algorithm
23.6 Flows in Networks
23.7 Maximum Flow -- Ford-Fulkerson Algorithm
23.8 Bipartite Graphs. Assignment Problems

CHAPTER 24 Probability, Statistics
24.1 Data Representation. Average. Spread
24.2 Experiments, Outcomes, Events
24.3 Probability
24.4 Permutations and Combinations
24.5 Random Variables. Probability Distributions
24.6 Mean and Variance of a Distribution
24.7 Binomial, Poisson, and Hypergeometric Distributions
24.8 Normal Distribution
24.9 Distributions of Several Random Variables

CHAPTER 25 Mathematical Statistics
25.1 Introduction. Random Sampling
25.2 Point Estimation of Parameters
25.3 Confidence Intervals
25.4 Testing Hypotheses. Decisions
25.5 Quality Control
25.6 Acceptance Sampling
25.7 Goodness of Fit. Chi-squared Test
25.8 Nonparametric Tests
25.9 Regression. Fitting Straight Lines. Correlation