Numerical Analysis
MATH 4721/6721
Dept Math Sciences
University of Memphis

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Text: An Introduction to Numerical Analysis, K. E. Atkinson (Univ. Iowa)
second edition (1989), Wiley & Sons, ISBN 0-471-62489-6, QA.297.A84

There are a few websites where you can download this textbook for free.
One such is at https://archive.org/details/an_introduction_to_numerical_analysis.
(Note: my url window includes the period at the end of this web address.)

Chapter One. Error: Sources, Propagation, and Analysis
- 1.1. Preliminaries
- 1.2. Floating-Point Numbers
- 1.3. Definition and Sources of Error
- 1.4. Propagation of Errors
- 1.5. Error Analysis
- 1.6. Stability Theory

Chapter Two. Finding Roots of Equations and Nonlinear Systems
- 2.1. The Bisection Method
- 2.2. Newton's Method
- 2.3. The Secant Method
- 2.4. Muller's Method
- 2.5. One-Point Iteration: General Theory
- 2.6. Aitken's Method
- 2.7. Multiple Roots
- 2.8. Brent's Algorithm
- 2.9. Roots of Polynomials
- 2.10. Systems of Nonlinear Equations
- 2.11. Newton's Method for Nonlinear Systems
- 2.12. Unconstrained Optimization

Chapter Three. Interpolation Theory
- 3.1. Polynomial Interpolation (Splines)
- 3.2. Divided Differences
- 3.3. Finite Difference Tables
- 3.4. Forward Differences, Error Propagation
- 3.5. Interpolation Error Analysis
- 3.6. Hermite Interpolation
- 3.7. Spline Theory
- 3.8. Trigonometric Splines

Chapter Four. Functional Analysis: Approximation Theory

- 4.1. From Taylor to Weierstrass
- 4.2. The Minimax Problem
- 4.3. The Least Squares Problem
- 4.4. Orthogonal Polynomials
- 4.5. L2 Approximation of Functions
- 4.6. Minimax Approximations
- 4.7. Near-Minimax Approximation

Chapter Five. Numerical Integration

- 5.1. What was covered in Calc II
- 5.2. Spline Integration (Newton-Cotes Method)
- 5.3. Gaussian Quadrature
- 5.4. Error Analysis
- 5.5. Automatic (?) Numerical Integration
- 5.6. Improper Integrals
- 5.7. Numerical Differentiation

Chapter Six. Numerical Solutions for Differential Equations

- 6.1. Existence, Uniqueness, and Stability
- 6.2. Euler's Method
- 6.3. Multistep Methods
- 6.4. Midpoint Method
- 6.5. Trapezoidal Method
- 6.6-11 = other topics (6.10 = Runge-Kutta, 6.11 = BVP's)

Chapter Seven. Linear Algebra

- 7.1. Linear Spaces and Systems of Equations
- 7.2. Eigenvalues and Eigenvectors
- 7.3. Vector Norms and Matrix Norms
- 7.4. Convergence and Perturbation

Chapter Eight. Matrix Methods

- 8.1. Gaussian Elimination
- 8.2. Pivoting and Scaling
- 8.3. Other ways to improve Gaussian Elimination
- 8.4. Error Analysis
- 8.5. Residual Method
- 8.6. Iteration Methods
- 8.7. Error Propagation
- 8.8-9 = other topics

Chapter Nine. Numerical Analysis of Eigenvalues

9.1. Error and Stability

9.2-4 = special cases (symmetric tridiagonal systems)

9.5-7 = other stuff (QR Method)

Professor Atkinson designed his textbook for a two-semester course, so we will not be able to cover every section, and we probably won't get to Chapter Nine at all.

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