Syllabus for ACMS 40390: Numerical Analysis
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The material covered will include the following (sometimes in a slightly different order) sections from Burden, Faires, and Burden Numerical Analysis (tenth edition).

Chapter 1: Preliminaries
1.1: Review of Calculus
1.2: Roundoff Errors and Computer Arithmetic
1.3: Algorithms and Convergence

Chapter 2: Solutions of Equations in One Variable
2.1: The Bisection Method
2.2: Fixed Point Iteration
2.3: The Newton-Raphson Method
2.4: Error Analysis for Iterative Methods
   : Basics on roots of polynomials

Chapter 3: Interpolation and Polynomial Approximation
3.1: Interpolation and the Lagrange Polynomial
3.3: Divided Differences
3.4: Hermite Interpolation
3.5: Cubic Spline Interpolation

Chapter 4: Numerical Differentiation and Integration
4.1: Numerical Differentiation
4.2: Richardson’s Extrapolation
4.3: Elements of Numerical Integration
4.4: Composite Numerical Integration
4.5: Romberg Integration
4.6: Adaptive Quadrature Methods
   : Brief Discussion of Randomness and Monte Carlo Integration

Chapter 5: Initial-Value Problems for Ordinary Differential Equations
5.1: The Elementary Theory of Initial-Value Problems
5.2: Euler’s Method
5.3: Higher Order Taylor Methods
5.4: Runge-Kutta Methods
5.5: Error Control and the Runge-Kutta-Fehlberg Method
5.6: Multistep Methods
5.9: Higher-Order Equations and Systems of Differential Equations

Chapter 6: Direct Methods for Solving Linear Systems
6.1: Linear Systems of Equations
6.3: Linear Algebra and Matrix Inversion
6.5: Matrix Factorization
6.6: Special Types of Matrices

Chapter 7: Iterative Techniques in Matrix Algebra
7.1: Norms of Vectors and Matrices
7.3: Iterative Techniques for Solving Linear Systems
7.4: Error Estimates and Iterative Refinement

Chapter 8: Approximation Theory
8.1: Discrete Least Squares Approximation
8.2: Orthogonal Polynomials and Least Squares Approximation
8.3: Chebyshev Polynomials

Chapter 9: Approximating Eigenvalues
9.1: Linear Algebra and Eigenvalues
    : The Power Method, the QR Algorithm, and the Singular Value De-
    composition

Chapter 10: Numerical Solutions of Nonlinear Systems of Equations
10.1: Fixed Points for Functions of Several Variables
10.2: Newton’s Method
10.5: Homotopy and Continuation Methods

Chapter 11: Boundary-Value Problems for Ordinary Differential Equations
11.1: The Linear Shooting Method
11.2: The Shooting Method for Nonlinear Problems
11.3: The Finite-Difference Method for Linear Problems
11.4: The Finite-Difference Method for Nonlinear Problems

Chapter 12: Numerical Solutions of Partial-Differential Equations
12.1: Elliptic Partial-Differential Equations