

## M 383F/ CS 383D/ CAM 383D

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Prerequisites: 1. Fundamentals of Numerical Methods  
2. Linear Algebra  
3. Introductory Analysis

Assignments: Approximately six

Examinations: Take-home Mid-term and Take-home Final

Grading: 20% Assignments  
35% Mid-Term Examination  
45% Final Examination

Topics: 1. Interpolation  
2. Least Squares Approximation  
3. Numerical Integration  
4. Extrapolation and Remainder Theory  
5. Numerical Solution of Initial Value Ordinary Differential Equations

Some useful texts:

Philip J. Davis: *Interpolation and Approximation* **1975**

Michael T. Heath: *Scientific Computing: An Introductory Survey* **1997**

Anthony Ralston and Philip Rabinowitz: *A First Course in Numerical Analysis* **1978**

**Some of the topics to be covered:**

1. Interpolation

- The General Problem of Finite Interpolation **Davis 2.2**
- Polynomial Interpolation **Davis 2.1**
- Systems Possessing the Interpolation Property **Davis 2.3**
- Unisolvence **Davis 2.4**
- Representation Theorems: The Lagrange Formula **Davis 2.5**
- The Cauchy Remainder for Polynomial Interpolation **Davis 3.1**
- Interpolation at Coincident Points (Generalized Hermite Interpolation) **Davis 3.5**
- Piecewise Polynomial Interpolation **Heath 7.3**

2. Least Squares Approximation

- Best Approximation **Davis 7.1**
- Normed Linear Spaces **Davis 7.2**
- The Fundamental Problem of Linear Interpolation **Davis 7.4**
- Inner product Spaces **Davis 8.1**
- Orthogonal Systems (including Gram Schmidt process) **Davis 8.3**
- Fourier (or Orthogonal) Expansions **Davis 8.4**
- Minimum Properties of Fourier Expansion **Davis 8.5**
- The Normal Equations **Davis 8.6**

3. Numerical Integration

- Numerical Quadrature **Heath 8.1**
- Newton-Cotes Quadrature **Heath 8.2**
- Gaussian Quadrature **Heath 8.3**
- Composite and Adaptive Quadrature **Heath 8.4**
- Romberg Integration **R & B 4.10-2**
- Other Integration Problems **Heath 8.5**

4. Extrapolation and Remainder Theory

- Richardson Extrapolation **Heath 8.8**
- Peano's Theorem and Its Consequences **Davis 3.7**

5. Numerical Solution of Initial Value Ordinary Differential Equations

- Ordinary Differential Equations **Heath 9.1**
- Numerical Solution of ODEs **Heath 9.2**
- Accuracy and Stability **Heath 9.3**
- Implicit Methods **Heath 9.4**
- Stiff Differential Equations **Heath 9.5**
- Survey of Numerical Methods for ODEs **Heath 9.6**