updated July 2020

MS in Applied Mathematics

Comprehensive Examination Guidelines

Part I for Applied and Computational Math Concentration

The Part I comprehensive examination is a three-hour closed-book exam that is offered on the first Saturday of the autumn and spring quarters. It covers topics from MAT 485 & MAT 486.

MAT 485-486: Numerical Analysis I, II

Students will be examined on the following broad topics:

- Numerical methods for solving equations and systems of equations
- Interpolation methods and least squares
- Numerical differentiation and integration
- Random numbers
- Eigenvalues and singular values

The topics are presented in the required textbook "**Numerical Analysis"** by Timothy Sauer, Pearson 2012 (ISBN 9780321783677). The level of difficulty of the questions on the exam will be similar to that of the book examples or examples done in class.

Specific references to the textbook are given below:

- Chapter 0: *Fundamentals*
  - Section 0.5 (Taylor Approximation): Theorem 0.8 and Example 0.9

- Chapter 1: *Solving Equations*
  - Section 1.1 (Bisection Method): Examples 1.1 and 1.2
  - Section 1.2 (Fixed-Point Iteration): Theorem 1.6, Examples 1.3, 1.4, 1.5
  - Section 1.3 (Limits of accuracy): Examples 1.7, 1.8, 1.9, 1.10
  - Section 1.4 (Newton's Method): Theorems 1.11, 1.12, 1.13; Examples 1.11-1.14

- Chapter 2: *Systems of Equations*
  - Section 2.1 (Operation count for Gaussian elimination): Examples 2.2, 2.3
  - Section 2.2 (LU factorization): Examples 2.5, 2.7, 2.8
  - Section 2.3 (Sources of error): Examples 2.10, 2.11, Theorem 2.6
  - Section 2.5 (Iterative Methods): Examples 2.19-2.23
  - Section 2.7 (Nonlinear Systems of Equations): Examples 2.32, 2.33

- Chapter 3: *Interpolation*
  - Section 3.1 (Polynomial Interpolation): Examples 3.1-3.5
  - Section 3.2 (Interpolation Error): Theorem 3.4, Examples 3.8, 3.9
  - Section 3.3 (Cubic Splines): Examples 3.13, 3.14

- Chapter 4: *Least Squares*
  - Section 4.1 (Least Squares and Normal Equations): Examples 4.1-4.4

- Chapter 5: *Numerical Differentiation and Integration*
  - Section 5.1 (Numerical Differentiation): Examples 5.1, 5.1, 5.3
  - Section 5.2 (Newton-Cotes Formulas): Examples 5.6, 5.8, 5.9, 5.10

- Chapter 9: *Random Numbers and Applications*
  - Section 9.1 (Random Numbers): Examples 9.1 and 9.2

- Chapter 12: *Eigenvalues and Singular Values*
  - Section 12.1 (Power Iteration Methods): Theorem 12.2
  - Section 12.3 (Singular Value Decomposition): Examples 12.4-12.7
  - Section 12.4 (Applications of the SVD): Examples 12.8, 12.9