

Midterm Exam Outline

Math 104B: Numerical Analysis Professor: Paul J. Atzberger

- Integration
  - Newton-Cotes Methods (open and closed).
  - Newton-Cotes order of accuracy (odd and even cases).
  - Trapezoidal Quadrature, Simpson's Quadrature.
  - Composite Quadrature.
  - Gaussian Quadrature.
  - $\circ~$  Gaussian Quadrature order of accuracy.
- Theory of Ordinary Differential Equations (ODEs)
  - Lipschitz continuity both scalar and vector-valued functions.
  - Definition of well-posedness.
  - Sufficient criteria for well-posedness.
  - Uniqueness, existence, robustness to perturbations.
- Numerical Approximation of ODEs
  - o Euler's Method
    - Truncation error.
    - Error bound.
    - Stability.
  - Taylor Methods.
  - Runge-Kutta Methods
    - Explicit / implicit methods.
    - Second order methods.
    - Fourth order methods.
  - Multistep Methods
    - Adams-Moulton Methods.
    - Adams-Bashforth Methods.
    - Truncation error.
    - Stability.
- Convergence of Methods, Stability, and Stiffness
  - Consistency of methods.
  - Definition of A-stable method.
  - Stability region.
  - Stability of One-step Methods.
  - Stability of Multi-step Methods
    - Root conditions.
  - Convergence theory for One-step Methods.
  - Convergence theory for Multi-step Methods.
  - Stiff ODEs and performance of implicit vs explicit methods.