Math 104C: Introduction to Numerical Analysis Spring 2021

INSTRUCTOR Paul J. Atzberger Department of Mathematics
http://atzberger.org/ *Office*: 6712 South Hall
Office Hours: Tues 9:15am – 10:00am; Thurs 9:15am - 11:00am.

CLASS TIMES TR 8:00am – 9:15am; 11:00am – 12:15pm.

DESCRIPTION Numerical approaches play an important role in many fields including in scientific research, engineering, finance, machine learning, and data analysis. This class will discuss both mathematical foundations and practical use of modern numerical methods. Examples also will be discussed from related applications areas. More information can be found on the course website.

PREREQUISITES Calculus, Linear Algebra, Differential Equations, and experience programming.

TEXTBOOKS *Numerical Analysis 10th Edition* by R. L. Burden and J. D. Faires.

GRADING

Homework	30%
Midterm	30%
Final Project	40%

POLICIES Assignments will be assigned in class and posted on the course website. Prompt submission of homeworks will be required. While no late homework will be accepted, one missed homework will be allowed without penalty. While it is permissible for you to discuss materials with classmates, the submitted homework must be your own work.

There is a policy of no video or pictures to be taken during lectures. Instead, one should take notes and pay particular attention. There is also a policy of no texting, e-mailing, or social media during the class. It is hoped one is avoiding such distractions to make the most of the class.

EXAMS A midterm exam will be on Thursday, May 13.

TOPICS Sample of topics

- Approximation Theory
  - Discrete Least Squares Approximation
  - Orthogonal Polynomials, Chebyshev Polynomials
  - Power Series, Rational Function Approximation
  - Trigonometric Polynomials
  - Fast Fourier Transforms

- Approximating Eigenvalues
  - Orthogonal Matrices and Similarity Transformations
  - The Power Method, Householder's Method, QR Algorithm

- Singular Value Decomposition (SVD)

- Numerical Solutions of Nonlinear Systems of Equations
  - Fixed Points of Functions of Several Variables
  - Newton-Raphson Method
  - Quasi-Newton Methods
  - Steepest Descent Techniques
  - Homotopy and Continuation Methods

- Boundary-Value Problems for Ordinary Differential Equations
  - Shooting Methods
  - Finite-Difference Methods
  - The Rayleigh-Ritz Method

- Numerical Solutions to Partial Differential Equations
  - Elliptic Partial Differential Equations (PDEs)
  - Parabolic Partial Differential Equations (PDEs)
  - Hyperbolic Partial Differential Equations (PDEs)
  - Finite-Element Method (introduction)

- Application Areas
  - Engineering and the Sciences.
  - Statistical Inference, Machine Learning, Data Science.
  - Computer Graphics and Visualization.
  - Financial Modeling and Economics.

See the website for additional topics and information.

WEBSITE http://teaching.atzberger.org/