# Math 104B: Introduction to Numerical Analysis Spring 2018


INSTRUCTOR Paul J. Atzberger
http://atzberger.org/teaching
*Office Hours*: TR 9:15am – 10:45am

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CLASS TIMES TR 8:00am – 9:15am.
Phelps 1160

DESCRIPTION Computational approaches play an important role in many fields ranging from basic scientific research to engineering to finance to machine learning and data science. This class will discuss both the mathematical foundations and the practical implementation 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

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|---|---|
| Homework | 30% |
| Midterm | 30% |
| Final Exam / 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 or 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 lectures.

EXAMS A midterm exam will be on Tuesday, May 8th.
Final exam/project.

TOPICS

- Initial-Value Problems for Ordinary Differential Equations
  - Well-posedness of initial-value problems.
  - Euler's Method of Approximation.
  - Taylor Methods for Higher-order Approximation.
  - Runge-Kutta Methods.
  - Multistep Methods.
  - Convergence Analysis.
  - Order of Accuracy and Stability.
  - Stiff Differential Equations.

- Solving Linear Systems and Matrix Algebra
  - Linear Algebra Review.
  - Linear Equations.
  - Direct Methods.
  - Gaussian Elimination and Pivoting Strategies.
  - Matrix Factorizations.
  - Iterative Methods.
  - Eigenvalues and Eigenvectors.
  - Power Method.
  - Approximate Solution of Linear Systems.
  - Jacobi Iteration and Gauss-Siedel Iteration.
  - Rates of Convergence.
  - Conjugate Gradient Method.
  - Preconditioners.
  - Multigrid Methods.

- Application Areas
  - Statistical Inference and Machine Learning.
  - Approaches in the Data Sciences.
  - Computer Graphics and Visualization.
  - Financial Modeling and Economics.
  - Simulation in Engineering and the Sciences.

WEBSITE http://atzberger.org/teaching