MATH 6640 Syllabus

Introduction to Numerical Methods for Partial Differential Equations, Section AQ, 3 credit hours

Fall 2026

Instructor Information

Instructor: Prof. Wei Zhu

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General Course Information

Description

Introduction to the implementation and analysis of numerical algorithms for the numerical solution of the classic partial differential equations of science and engineering.

Course Learning Outcomes

Upon successful completion of this course, you should be able to:

- Construct finite-difference discretizations for model elliptic, parabolic, and hyperbolic PDEs, including appropriate explicit and implicit time-stepping methods.
- Analyze the consistency, accuracy, stability, and convergence of numerical PDE schemes using tools such as Fourier analysis, discrete maximum principles, energy estimates, and the CFL condition.
- Evaluate how numerical dissipation, dispersion, boundary treatment, and mesh resolution affect the accuracy and qualitative behavior of computed solutions.
- Characterize weak and entropy solutions of scalar conservation laws and construct conservative shock-capturing methods, including Godunov, monotone, and high-resolution schemes.
- Derive, assemble, and analyze the piecewise-linear finite element method for a one-dimensional elliptic boundary-value problem.

Required Course Materials

- John C. Strikwerda, *Finite Difference Schemes and Partial Differential Equations*, 2nd ed., Society for Industrial and Applied Mathematics (SIAM), 2004.
- Randall J. LeVeque, *Numerical Methods for Conservation Laws*, 2nd ed., Birkhäuser, 1992.

Grading Policy

The final course percentage will be calculated as follows:

- Homework: (30%)
- In-class midterm examination: (30%)
- In-class final examination: (40%)

A: [90%, 100%], B: [80%, 90%), C: [70%, 80%), D: [60%, 70%), F: [0%, 60%). These cutoffs *might* be adjusted, but only in the downward direction (i.e., to make letter grades higher). In the event of a curve, only your final overall percentage grade for the course will be curved. Individual assessments will not be curved as we go along.

Description of Graded Components

- **Homework**: Homework assignments will include analytical problems, proofs, derivations, and computational exercises based on the course material.
- **Examinations**: The in-class midterm will cover material from the first portion of the course, while the in-class final examination will be cumulative. Both examinations will be closed-book and closed-note. No books, notes, calculators, electronic devices, or other outside materials will be permitted unless explicitly stated otherwise.

Course Policies

Attendance and Participation

Synchronous participation in the course is highly encouraged. However, attendance will not be counted towards the student's grade

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.