

MATH 6640 Syllabus

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

Fall 2026

Instructor Information

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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

- Understand and implement finite difference methods for parabolic and hyperbolic partial differential equations.
- Analyze the stability and accuracy of numerical schemes using tools such as Fourier analysis.
- Apply numerical methods for conservation laws, including upwind and high-resolution schemes.
- Formulate and implement finite element methods for elliptic problems, including handling boundary conditions.
- Solve the resulting linear systems using iterative methods such as conjugate gradient and multigrid.

Prerequisites

MATH 4347 and MATH 4640

Required Course Materials

These are reference books that we will loosely follow. They are not strictly required, as we will use independent lecture notes.

- J. W. Thomas, *Introduction to Numerical Methods for Partial Differential Equations*, Springer, ISBN 0-387-97999-9.
- L. N. Trefethen, *Spectral Methods in Matlab*, SIAM.
- Claes Johnson, *Numerical solution of partial differential equations by the finite element method*. ISBN 0-486-46900-X.
- S. C. Brenner and R. Scott, *The Mathematical Theory of Finite Element Methods*, Second Edition.
- R. J. LeVeque, *Numerical Methods for Conservation Laws*, Birkhauser Verlag, 1992.
- S. V. Patankar, *Numerical Heat Transfer and Fluid Flow*, Hemisphere Publishing Corp., 1980.
- C.-W. Shu, *Essentially non-oscillatory and weighted essentially non-oscillatory schemes for hyperbolic conservation laws*, in *Advanced Numerical Approximation of Nonlinear Hyperbolic Equations*, B. Cockburn, C. Johnson, C.-W. Shu and E. Tadmor (Editor: A. Quarteroni), *Lecture Notes in Mathematics*, volume 1697, Springer, 1998, pp.325-432.

Grading Policy

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.

Assignments

- Homework (50%)
- Final exam (50%)

Description of Graded Components

- Homework assignments will be released approximately every two weeks on Gradescope. No late submissions will be accepted.
- The final exam will be closed notes, closed book, and no external materials are permitted. Calculators are not allowed.

Course Policies

Attendance and Participation

Students are strongly encouraged to attend and engage in class; however, participation will not be factored into the final grade.

Digital Learning Days (DLD)

In cases where campus may be physically closed due to events such as inclement weather, a digital learning day may replace in-person classes. A recording will be posted for students to watch asynchronously (before/on/after the DLD).

Email Policy

All discussion about mathematics should be conducted in person or on Canvas. Please use Piazza to ask questions about the course policies, homework, or projects.

Regrade Requests

After each homework is released on Gradescope, we have a regrade request period. Please keep in mind the following

1. Regrade requests must be made through the appropriate form in Gradescope. We cannot consider regrade requests made in any other fashion. Any regrade requests made after the deadline may be rejected without consideration.
2. The regrade request period will be one week, in order to ensure every student has the opportunity to take a close look at their graded assignments.
3. When making a regrade request, the student must state specifically what they believe was misgraded in the problem. It is inappropriate to submit a request such as "I think I deserve more credit" without additional explanation.
4. **It is possible for a student's grade to decrease as the result of a regrade request.** Occasionally, a regrade request has led a grader to realize they had originally made a grading error in the student's favor. Fixing this error resulted in a decrease in the student's score.

5. Regrade requests may lead the grader to regrade the full problem in question, not just a specific part. For example, a regrade request made for part (a) of a problem may lead the grader to realize that they had accidentally hit the wrong rubric button and had meant to subtract points in part (b). As another example, we have seen cases where a student had a legitimate regrade request for part (a) of a problem, but the request led us to notice that the grader had made an egregious error in the student's favor in part (b) of the problem. The end result was a net decrease in the student's score.
6. Students are responsible for reading the solutions key very carefully before sending a regrade request. Regrade requests are **not** for asking how to do the problem or for asking why your answer was wrong.

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.