

CEE 6513 Syllabus

Computational Methods in Mechanics, Section 1, 3 Credits

Fall 2026

Instructor Information

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General Course Information

Description

This is a graduate course for students interested in learning computational methods in mechanics. The topics to be covered include:

- Partial Differential Equations: Elliptic equations; Parabolic equations; Hyperbolic equations; Eigenvalue problems
- Methods of Weighted Residuals: Galerkin methods; Collocation methods; Least-squares methods; Composite methods
- Variational Methods: Introduction to variational principles; Weak forms; Rayleigh-Ritz method
- Finite-Element Methods: Finite-element approximations; Error estimates – rates of convergence; Numerical integration – quadrature; Spectral finite elements; h- and p-adaptivity
- Finite-Difference Methods: Finite-difference approximations; Accuracy, stability, and convergence; Runge-Kutta methods; Linear multistep methods
- Spectral Methods: Differentiation matrices; Discrete Fourier Transform and Fast Fourier Transform; Smoothness and spectral accuracy; Polynomial interpolation and clustered grids
- Numerical Methods for Linear and Nonlinear Systems: Direct methods for linear systems; Iterative methods for linear systems; Nonlinear solvers; Eigensolvers; Symmetry: application to lattice structures
- Machine Learning: Data-driven computational mechanics
- Parallel Programming: MPI; GPU acceleration

Course Learning Outcomes

Upon successful completion of this course, the student will:

- Understand the method of weighted residuals and variational methods.
- Develop a theoretical understanding of finite-element, finite-difference, and spectral methods.
- Solve ordinary and partial differential equations using these methods.
- Evaluate the applicability and limitations of these computational methods.
- Implement these methods in MATLAB, Python, and C++.

Required Course Materials

None

Grading Policy:

Letter grade: A (90 and above), B (80-90), C(70-80), D (60-70), and F (below 60)

Assignments

- Homework 1: 10%
- Homework 2: 10%
- Homework 3: 10%
- Homework 4: 10%
- Homework 5: 10%
- Homework 6: 10%
- Homework 7: 10%
- Final Exam: 30%

Description of Graded Components

- Homework: 1-3 problems each.
- Final Project: Formulation and implementation of the various methods learned in the course to a single problem.

Course Policies

Attendance and/or Participation

This will be an active classroom, where you will be expected to participate. Attendance will be taken into account in determining letter grades, particularly for students whose final grades fall near a grade boundary.

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.

Core IMPACTS

[Core IMPACTS](#) is the University System of Georgia's General Education curriculum. If you are teaching a course that counts towards Core IMPACTS, you should include a syllabus statement about the Core area and associated [career competencies](#). [This resource](#) developed by the Center for Excellence in Teaching and Learning and Online Education at Georgia State University includes template syllabus statements for each of the Core IMPACTS areas that you may adapt for your course.

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.

Pre- &/or Co-Requisite

None

Collaboration, Group Work, and Use of Generative AI

You are allowed to work in groups on all homeworks and the project, but any work you turn in must be written in your own hand.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Late homeworks and project will be penalized accordingly.