ECE 6380 Syllabus

Introduction to Computational Electromagnetics, Section A, 3 hours credit

Fall 2026

Instructor Information

Instructor: Andrew F. Peterson

Email: afpeterson@gatech.edu

Registered students may find additional instructor contact information and the current schedule of instructor in-person and Zoom office hours on the GT Canvas site.

General Course Information

Description

ECE 6380 is an introductory graduate-level course on computational techniques for solving electromagnetic (EM) field problems, including electrostatic applications such as determining capacitance, frequency-domain situations for modeling antennas, waveguiding, or resonant cavities, and time-domain applications for general, transient excitations. Numerical techniques for the solution of linear systems and eigenvalue equations, as well as numerical integration using quadrature, will also be discussed. Students will be required to implement simple approaches in computer programs.

Pre- &/or Co-Requisites

Graduate Standing.

Mode of Instruction

ECE 6380 is taught in an in-person format, and regular attendance is strongly encouraged. Video recordings are available as a back-up for all lecture content. In the event of a campus emergency or instructor absence, these videos will replace in-person classes on the same schedule. Weekly homework assignments will be collected through Canvas.

Course Learning Outcomes

Upon successful completion of the course students should be able to

(1) create finite difference and finite element discretizations of differential equations and implement the results in computer codes
(2) quantify the error associated with various numerical techniques and describe ways to improve the accuracy of numerical results
(3) understand the computational costs associated with various techniques and with the solution of matrix and eigenvalue equations
(4) be able to explain the differences between the scalar Helmholtz operator and the vector Helmholtz operator and describe the benefits of using mixed-order vector expansion functions with the latter
(5) be able to explain the properties of the vector Helmholtz operator and understand techniques for the proper treatment of its nullspace
(6) be able to generate 2D meshes that will yield numerical solutions with required accuracy for problems such as cavity resonators or sources in a waveguide
(7) be familiar with the most popular method-of-moments approach for treating the electric field integral equation

Required Course Textbook

Notes prepared by the instructor are available through Canvas as pdf files and cover all class lectures.

There is no required course text; students who benefit from supplemental reading are encouraged to consider any of the following optional texts:

J.-M. Jin, *The Finite Element Method in Electromagnetics*. Wiley, 2014.
A. Taflove, *Computational Electrodynamics: The Finite-Difference Time-Domain Method*, Artech House, 2005.
S. D. Gedney, *Introduction to the Finite-Difference Time-Domain (FDTD) Method for Electromagnetics* Springer/Nature Synthesis Lectures, 2011.
J. E. Houle and D. M. Sullivan, *Electromagnetic Simulation Using the FDTD Method with Python*. Wiley/IEEE Press, 2020.
Peterson, Ray, Mittra, *Computational Methods for Electromagnetics*, Wiley/IEEE Press, 1998.
Graglia & Peterson, *Higher-order Techniques in Computational Electromagnetics*. IET, 2015.

(Some of these texts are available as a free download through the GT library, as explained on the Canvas site)

Course Website and Other Classroom Management Tools

All required course materials (class notes, supplementary videos, assignments) will be distributed through the GT Canvas system. Homework assignments must be uploaded through the Canvas system.

Detailed Course Schedule

Registered students may find a detailed course schedule on the Canvas site, including dates of the MidTerm Quiz and the Final Exam.

Grading Policy:

The weighting of various components of the course grade is as follows:

Weekly MiniQuizzes: 10%
Weekly homework and programming assignments: 40%
MidTerm Quiz: 20%
Final Exam: 30%

Description of Graded Components

The MiniQuizzes are administered through Canvas and involve a completion grade only.

The homework and programming assignments will be assigned and collected through Canvas. It is recommended that the MATLAB language be used for all programming assignments.

The MidTerm Quiz and the Final Exam will be administered in class. The Final Exam will be comprehensive.

There may be a MiniQuiz and a Homework Assignment due during the final class days.

Course grades will follow a nominal A = 90%/B = 80%/C = 70% definition, which may be curved to lower breakpoints.

Course Policies

Attendance and/or Participation

ECE 6380 is taught in person. Students are encouraged to attend the in-person classes.

Extensions, Late Assignments, & Rescheduled/Missed Exams

Students requiring an extension due to an approved institute activity or illness, or other legitimate reasons, should contact the instructor as early as possible to arrange an extension or makeup.

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.

Students in this class are expected to abide by the Georgia Tech Honor Code and avoid any instance of academic misconduct, including but not limited to:

- *Possessing, using, or exchanging improperly acquired oral or written information in the preparation of a quiz or exam.*
- *Submission of material that is substantially identical to that created or published by another individual, except as noted below.*
- *False claims of performance or work that has been submitted by the student.*

As the instructor, I will make available previous quiz problems so that all students have an equal opportunity to prepare and know what to expect. (Old quizzes will be posted the Canvas site.)

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.

Collaboration and Group Work

Students are encouraged to work in groups of 2-3 in the preparation of homework assignments, provided that each student makes a "good faith" effort to contribute to the group effort and turns in their own writeup of the assignment

Use of Generative Artificial Intelligence

The use of AI generated work for homework assignments or quizzes/exams is not permitted.

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.

Campus Resources for Students

The Canvas system has an up-to-date link to "GT Student Resources" that includes a range of available resources. These include Emergency Resources, Mental & Physical Health Resources, Financial Assistance, Academic Support, Professional Enrichment, etc.
Please explore these!