ME 2016: COMPUTING TECHNIQUES

Sections B, E, and F, Fall 2026

Credit Hours:	3-0-3
Catalog Description:	An introduction to numerical methods for the solution of mechanical engineering problems. Topics include: sources of errors in computing, mathematical bases of numerical methods, and implementation of numerical techniques using MATLAB.
Class Time and Location:	Section B: TR 11:00a – 12:15p, Instructional Center 109 Section E: TR 2:00p – 3:15p, MRDC 2407 Section F: MW 9:30a – 10:45a, Clough 102
Instructor:	Lena Moller, lmoller3@gatech.edu
Office Hours:	TBD
Graders/TA's:	TBD
Prerequisites:	CS 1371 Introduction to Computing, MATH 1502 Calculus II (C or better), MATH 2403 Differential Equations (Corequisite)
Instruction Mode:	In-person
Textbook:	Steven C. Chapra and Raymond P. Canale, Numerical Methods for Engineers, 6th Edition, McGraw-Hill, 2010.

INTRODUCTION

Welcome to ME 2016: Computing Techniques! This course covers a broad range of numerical analysis techniques for engineering problems, which is a set of topics that will be useful for your entire professional life as an engineer. There are several topics in Mechanical Engineering that you will likely learn and forget because they lack relevance to your specific field – maybe you're a roboticist who has forgotten their fluids or a thermal systems engineer that can't be bothered to remember their dynamics of rigid bodies. ME 2016 is NOT that kind of class. This course is relevant to all fields of engineering and beyond. This class is about making complex problems solvable, even if they might lack a closed-form solution. Numerical Methods are incredibly useful, and even if you don't directly use one, the type of thinking necessary will touch all of your future courses.

As a little disclaimer, this is my first time teaching not just this course, but any course on my own. I graduated in Fall 2025 with my master's degree from Georgia Tech and have been hired on directly into being a lecturer. That means this course will certainly teach us both a lot, and I am going to rely on your feedback! If anything ever in the course is confusing you or isn't working, please do not hesitate to reach out or ask in class. Everything is subject to change, and I am happy to make changes if things aren't working. I also acknowledge that many of my assignments and this syllabus are adapted from Dr. Torello's work.

Topics

1. Introduction to mathematical modeling and the numerical solution of engineering problems.
2. Numerical errors: Accuracy, precision, and round-off error. Taylor series and truncation error.
3. Root finding: Bisection and Newton-Raphson methods. Convergence.
4. Curve fitting: Least-squares regression, polynomial interpolation, piecewise cubic splines.
5. Numerical integration: Trapezoidal rule and Simpson's 1/3 rule. Order of convergence.
6. Ordinary differential equations: Euler's method, Runge-Kutta methods (second and fourth order). Order of convergence. Initial value problems. Boundary value problems.
7. Applications of numerical methods to engineering problems using MATLAB.
8. Additional topics at the discretion of the instructor, such as: advanced topics in root finding, curve fitting, or numerical integration, systems of linear equations, optimization, eigenvalue problems, etc.

Course Structure

The ultimate source for all course knowledge is Canvas, which is where all updates and announcements for the course and corresponding materials (syllabus, schedule, assignments, etc.) will be disseminated to students. It is **STRONGLY** recommended to check that e-mail notifications are enabled, and I encourage you to check for updates at least once a day. I will communicate to the full class through announcements frequently.

The easiest way to reach me for questions is via Email or Microsoft Teams. I will respond to either, so use whichever you prefer. I will try to respond to all emails within 24 hours, but if it has been more than 48 hours and I haven't responded, please send me another message. I am happy to answer any and all questions.

Course Materials

All material required to succeed in the course will be provided via canvas. The course textbook is very useful as a reference, but I will not require that you purchase it or any digital codes associated with the text. There are copies on short-term loans at the library but know that these are extremely limited and require planning to access. All course materials provided, unless from a directly attributed source, are the copyrighted materials of the Georgia Institute of Technology and are for student personal use only. **They may not be distributed outside of normal course usage**. This means Chegg, etc. I have an account there too, and if I see course material pop up there, I will request a takedown and the information of the poster.

Course Software

This course will require extensive use of MathWorks MATLAB. You can download the latest version to your personal computer for free from matlab.gatech.edu. MATLAB can also be accessed through the ME Virtual Lab system from https://mycloud.gatech.edu. Remember that **you are under no obligation to buy any course textbook software**, so PLEASE return this if you purchased it BEFORE you activate the user code, etc.

Homework and Projects

Homework and computer projects will be assigned via Canvas throughout the semester and will be based on material covered in lecture.

Homework is meant to help you develop competency with the material and the algorithms presented in class and help you prepare for the exams and computer projects. It will contain some written work and some MATLAB coding in most cases. More importantly, homework is the time when you get to try stuff out and fail productively towards

course understanding. It is profoundly important that you take homework seriously, as it is the beating heart of learning, and that's what we are here to do.

Computer projects will be more involved and will require you to implement more complicated algorithms and methods to solve authentic and challenging engineering problems using MATLAB. They will require functional code, well-formatted displays, and written explanations. I will provide you with a style guide for submissions that **must** be followed for credit.

All homework and computer projects will be submitted to Canvas by the date and time listed for the assignment on the course page. Late homework and projects will be accepted up to 24 hours after the deadline with a 50% penalty PRE-ASSESSMENT (in other words, an assignment worth 10 points late up to one day will begin the grading process with a 5/10, after which normal deductions will be assessed). This will be gauged entirely by the server clock on which Canvas runs, and anything tagged late by Canvas is considered late, regardless of whether it's 1 second or 1 hour late. **Emailed assignments will not be accepted for any reason**. Do not wait until the last minute as bad things sometimes happen on the internet and on our devices. Start early, plan ahead, and give yourself a submission buffer.

If for some reason you need a short extension on a homework or computer project, please email me in advance. I will not accept any extension requests after the deadline has passed.

EXAMS

There will be two midterm exams and one final exam. All exams will be closed book and closed notes. Two single sided or one double sided 8.5"x11" equation sheet will be allowed for each midterm exam. It may be handwritten or printed, no digital copies allowed. Two such sheets will be allowed for the final exam. The equation sheet must be turned in with each exam. For dates of exams, please refer to the course schedule. Midterms will take place in the course room during course periods, and the final will be conducted at the time listed on the GT exam matrix: https://registrar.gatech.edu/info/final-exam-matrices. Exams can only be rescheduled due to official institute excused absences and will require official documentation.

GRADING

The assignment weights for this course are as follows:

- Homework: 10%
- Projects: 40%
- Exam 1: 12.5%
- Exam 2: 12.5%
- Final Exam: 25%

Any questions on specific assignment grades must be submitted **within one week of the return date** of the assignment. After this has passed, the grade for that assignment is final and will not be changed. I am happy to review any specific assignments with students.

The guaranteed minimum letter breakdown is the standard >90% = A, 89% - 80% = B, etc. This is subject to change at instructor discretion at the end of the semester, but grades will never be "curved down". Changes will only be made to your benefit.

ATTENDANCE

Attendance is not mandatory for lectures, though it is highly recommended. If you cannot commit to coming to class, I highly encourage you to transfer to another section as there is no substitute for coming to class sessions.

Rescheduling of exams and assignments due to official institute excused absences must be arranged with the instructor at least one week in advance of the planned absence and will require official documentation from the Office of the Registrar, the Office of the Dean of Students, or other official campus entity. Students who miss an exam due to illness or family emergency may reschedule only by notifying the instructor as soon as possible and providing verification from the Office of the Dean of Students. This can be attained by filing an absence verification here: https://studentlife.gatech.edu/request-assistance.

If you know that you will be absent due to an important life event or religious observance, you much clear the date in question with the professor during the first week of class. A flight home that "your parents purchased without talking to you" is not a valid excuse to miss the final exam date. I'm serious about this one – you must clear non-emergency reschedules during week 1.

The GT course attendance policy may be found here: http://studentlife.gatech.edu/resources/class-attendance

Academic Honor Code

I expect full compliance with Georgia Tech's Academic Honor Code. Please read and understand this document if you have not already done so here: http://osi.gatech.edu/content/honor-code.. Let me be clear here: **DISCUSSION** of assignments with your peers is highly encouraged. However, **SUBMISSION** of your work and the **PREPARATION** of your work product must be an individual effort. The rough rule is this – if you find yourself looking at someone else's work while preparing your own, even if "just for ideas", you are probably cheating.

Cheating is a broad term but boils down to the inappropriate use of information that student obtains while preparing an assignment or exam for submission. Cheating can include any of the following:

- Direct copying or plagiarism of work (text, computer code, displays, etc.) of others
- Sharing work with other students currently enrolled in the class
- Distributing submitted work, graded and ungraded, to print or electronic repositories for others to copy and submit.

Any cases of cheating or violations of the honor code will be reported to the Office of Student Integrity (OSI). If I suspect you of cheating then you will immediately be referred to OSI, as I refuse to handle the process of cheating disputes without official backup. I will not make any exceptions to this policy.

Generative AI Use

Artificial intelligence (AI) tools such as ChatGPT, Copilot, or similar platforms are becoming increasingly common in engineering practice. In this course, AI may be used to **support your learning**, but never as a substitute for it. Here are my notes on AI use in this course:

- I cannot stop you from using AI. I understand that you are going to use it. I would prefer you didn't, but if you do, you MUST use it intelligently!
- Generated work must always be fully reviewed, verified, and understood by you. If you cannot explain everything you submit, it isn't worth submitting.

- AI should enhance your problem-solving skills, not replace them. It is a tool to assist you. Always maintain ownership of your reasoning and final product.
- Appropriate use of AI: as a study partner/tutor, to clarify concepts, suggest approaches, provide examples, assist with debugging code, generating practice problems, double checking your thinking
- Inappropriate use of AI: submitting an entire assignment page to AI and saying "solve", turning in ANYTHING written by AI, telling AI to write all your code, etc.
- Any use of AI on assignments, projects, or written work must be **explicitly acknowledged**. This includes noting which tools are used, what you prompted AI for, and how you incorporated the output into your work.
- If AI is used to produce code, you are expected to know what each and every line of that code does.

Disability Services and Course Accommodations

The Georgia Institute of Technology has policies regarding disability accommodation, which are administered through the Office of Disability Services (http://disabilityservices.gatech.edu/). If you require special accommodations (ADAPTS), please notify me ASAP.

Additionally, we all need some accommodations in education because we each learn differently. Those accommodations might include video captions, a low distraction place to think during class, or extra time on certain assignments. We are committed to supporting accommodations when it is at all feasible. **Asking for help when you need it is an important life and engineering skill. It is also a skill that we want to help you develop through this course.**

Diversity, Equity, and Inclusion

I expect our classroom and virtual spaces to be places where you, and everyone else, are treated with respect. Our class will welcome individuals of all backgrounds, beliefs, bodies, and identities both visible and invisible. All members of this class are expected to cooperate in the creation of a respectful, welcoming, and inclusive environment for every other member of the course. If there are things I or others have done to degrade that environment we encourage you to bring them to my attention and I will work to correct them. By including this statement, I mean to express my values as your instructor. While many of us are used to entering spaces (physical or otherwise) where we automatically feel welcome, not everyone experiences that. For many reasons, explicitly stating that people are welcome, and how we want to make them feel welcome is valuable to the learning environment we want to create.

I will gladly use an alternate name or gender pronoun of your choice. Please advise us of this preference as early as possible so that we may make appropriate changes to our records. At your preference, I will use preferred names publicly or privately. If I ever get your preferred name or pronouns incorrect, please do not hesitate to correct me publicly or privately.

Course Outcomes

Outcome 1: The student will develop a working knowledge of several numerical methods and their analytical basis.

- The student will demonstrate a basic understanding of several numerical methods.
- The student will demonstrate an ability to use a Taylor series to approximate functions, derivatives, and integrals, and to determine the order of the truncation error.
- The student will demonstrate an understanding of finite-precision arithmetic, round-off error, and relative and absolute errors.

Outcome 2: The student will gain experience in applying numerical methods to practical engineering problems.

- The student will demonstrate the ability to translate a numerical algorithm into an efficient MATLAB program.
- The student will demonstrate the ability to work with simple mathematical models of engineering problems.
- The student will demonstrate an ability to communicate computational results in printed and graphical form using MATLAB and to incorporate those results into written reports.