

**Georgia Institute of Technology**  
**The George W. Woodruff School of Mechanical Engineering**

**ME 2016 – Computing Techniques**  
**Fall 2026**

- Course Objectives:** (i) To learn numerical analysis techniques for solving engineering problems  
(ii) To learn how to implement various numerical methods in Python  
(iii) To understand modeling and simulation methods  
(iv) To develop good programming practices
- Class Timing:** Tue/Thu 3:30 – 4:45 PM
- Instructor:** Prof. Karthik Menon  
Office: Love Building - 115  
Email: [karthik.menon@me.gatech.edu](mailto:karthik.menon@me.gatech.edu)  
Office hours: T.B.A.
- Graders:** T.B.A  
Office hours: T.B.A.
- T.B.A  
Office hours: T.B.A.
- Webpage** Course materials, homework assignments, etc., will be posted to Canvas.
- Textbook:** *Numerical Methods for Engineers (7<sup>th</sup> or 8<sup>th</sup> edition)* by Steven C. Chapra and Raymond P. Canale.
- Pre/Co-requisites:** Calculus, Linear Algebra, Ordinary Differential Equations (co-req), Algorithm Development, Familiarity with Python (preferred) or MATLAB coding.  
**CS1371 or equivalent must be completed before starting this course!**
- Topics:** Modeling and computational methods in mechanical engineering;  
Introduction to Python programming;  
Numerical error analysis;  
Root finding;  
Curve fitting using regression methods;  
Polynomial interpolation;  
Numerical integration;  
Ordinary differential equations;  
Optimization.
- Software:** Python 3 (version 3.9 or newer). The open-source Spyder package is the recommended installation (<https://www.spyder-ide.org>).
- Grading:**
- | <u>Distribution</u>  |     | <u>Final letter grade</u>        |
|----------------------|-----|----------------------------------|
| Homework:            | 45% | A: $90\% \leq$ final grade       |
| Mid-Term 1 Exam:     | 15% | B: $80\% \leq$ final grade < 90% |
| Mid-Term 2 Exam:     | 15% | C: $70\% \leq$ final grade < 80% |
| Final Project:       | 20% | D: $60\% \leq$ final grade < 70% |
| Class participation: | 5%  | F: $60\% >$ final grade          |

**Honor Code and Student-Faculty Expectations:** The members of the Georgia Tech Community believe that the fundamental objective of the Institute is to provide the students with a high-quality education while developing in them a sense of ethics and social responsibility. We believe that trust is an integral part of the learning process, and that self-discipline is necessary in this pursuit. We also believe that any instance of dishonesty hurts the entire community. It is with this in mind that we have set forth the:

1. Student Honor Code: <https://osi.gatech.edu/students/honor-code>.
2. Student-faculty expectations: <https://catalog.gatech.edu/rules/21/>

**Attendance:** Class attendance will foster your learning. If you do miss class, it is your responsibility to make sure that you have all handouts and are aware of all announcements made in class. It is not the responsibility of the instructor to provide individual tutoring for students that miss class. Students who need to miss a deadline or exam date due to official GT activities (e.g., athletics, band) or religious observance will be permitted to make up the missed work within an established timeframe, provided the student provides me with written documentation within the first two weeks of class.

Please, do not come to class if you are feeling ill. In the case of illness and/or family emergencies, it may be necessary for you to delay exams or you may need additional time to complete homework assignments. In these cases, please provide documentation that supports your situation to the Dean of Students. If the illness or family emergency is deemed serious enough, the Dean's office will then contact me and your other instructors with recommendations on how to proceed.

#### **Getting help (outside of the classroom):**

- Your **FIRST** avenue for getting help should be instructor and/or grader **OFFICE HOURS**. This is the most efficient way to get your questions answered. Your graders took the course in previous semesters and did very well – they are an excellent resource.
- If your schedule does not permit attendance of any of the available office hours, or you need an individual meeting for non-homework/exam related discussions, please e-mail the instructor or grader to schedule an appointment.
- The “Discussion” feature on the course Canvas site is also a great resource, but should not replace office hours attendance. “Discussions” should be used for clarifications/questions that could benefit all and can be answered without much back-and-forth. Please reserve questions that require detailed discussions for office hours.
- It is not appropriate to ask the instructor or graders if your homework solution is correct. Instead, indicate why you think your solution might be incorrect, where you think it might have gone wrong, or where any confusion is coming from so that we can better help improve your understanding.
- There is often a Shell tutor for our course. This tutor will not be familiar with your specific assignments but is a good resource for general questions about numerical methods and programming. Please check to see if a Shell tutor is available this semester and find the associated schedule/location here: <https://www.me.gatech.edu/tutoring-0>.

#### **Course materials and announcements:**

- All course notes and *most* Python files used in class will be posted to the course canvas site shortly after the lecture.
- All Homework assignments will be posted on the course Canvas site.
- Homework and Exam solutions will be posted to the course Canvas site shortly after everyone has submitted the assignment or finished the exam.
- Announcements may be posted on Canvas from time to time and may contain critical notifications. I highly recommend setting your Canvas Announcement preferences to “**NOTIFY ME RIGHT AWAY**” to get notified by e-mail.
- I own the copyright to all course materials that I have created for ME 2016. This includes (but is not limited to) my notes, my assignments, my exams, and the solutions to these assignments and exams. Any such material provided to you by me in any form, including posted on Canvas, is for the exclusive use of students enrolled in the course. Students are not allowed to reproduce, distribute, or publicly post my course materials without my express written permission. In particular, marketing, selling or re-

posting of any of these documents on any website is strictly forbidden - it constitutes academic misconduct, is a violation of the Georgia Tech Student Code of Conduct (see section D.9), and it is a copyright violation. If I discover such illicit postings of my intellectual property, I will report these violations to the Office of Legal Affairs and to the Dean of Students.

### Homework Policy:

- An **electronic copy** of the homework is to be turned in to Canvas by **11:59PM on the date it is due**. Your submission should include a report containing all hand calculations, results, and discussion, as well as any Python files used to generate the results. Please use the following naming convention for your files: “HWn\_LastName\_FirstName.zip” (replace n by the number of the homework assignment; LastName and FirstName are your names). For submissions with multiple files, all files should be in a folder and then converted to a .zip file with the above naming convention. For submissions with just one file, there is no need to zip the file.
- Unforeseen exceptions notwithstanding, the written due date/time on the assignments are rigid. After the due date/time, 20% will be deducted from your homework grade for each day late (up to 3 days), where days round up (i.e., if you submit 1 minute late, you will lose the full 20% for a 1-day late submission). Submissions received beyond 3 days of the due date will receive a 0.
- Up to 20% of each homework grade will be based on professional formatting. Specific professionalism requirements will be specified in the homework handout.
- For assignments that involve Python code, the professional formatting requirements include commenting/documenting your code. You are expected to include brief comments that describe the purpose of each major step in your code.
- No make-up homeworks will be given, but your lowest homework grade will not be counted toward your final grade.
- Collaboration is encouraged. Discussing the assignments with your peers will help you to develop a deeper understanding of the material. I encourage you to discuss how to approach the problem, which Python functions to use, or how to interpret the results. However, I do expect each student to turn in a report and Python code that reflect the student’s **individual work**. Do not copy code from another student, from electronic documents, or online robots. To avoid any confusion, each homework solution should explicitly identify the students with whom you collaborated, what the extent of the collaboration was, and any online resources used. Any copying on homework will have severe consequences and be reported to the Dean of Students.
- You are allowed to use Generative AI (e.g. ChatGPT, Google Gemini, etc.) to **assist** in your code-based assignments. However, you should explicitly specify what resources you used to aid in your homework and how/what you used it for. In addition, your code formatting and comments (discussed above) should adequately reflect that you understand the learning material. Note: It is relatively easy to identify simple code snippets that are written by ChatGPT v/s a student.

### Exams:

- There will be 2 Midterm Exams and 1 Final Project.
- All exams will be closed book and closed notes.
- Use of one (2-sided) sheet of formulae (8.5” x 11”) is permitted for each Midterm Exam.
- Any copying on Exams will have severe consequences and be reported to the Dean of Students.
- Absence from any exam without prior consent of instructor will result in zero credit for that exam. There will be no make-up exams, except in the event of a last-minute emergency, for which the student will need to submit appropriate documentation of the emergency (e.g., illness, accident).

**Grading:** Any issues with grading on the Homework should be brought to the attention of the grader(s) within **one week**. Any issues with grading on the Exams should be brought to the attention of the instructor within **one week**.

**Changes:** When appropriate or necessary, the instructor may adjust, amend, or otherwise modify the information presented in the syllabus. Changes will be made in a manner to minimize disruption and in the

interest of fostering learning. Every effort will be made to ensure that all changes are brought to the attention of students – so as to minimize inconvenience.

**Special Accommodations:** If you require special accommodations, please notify me as soon as possible. I will need a copy (paper or electronic) of your Course Accessibility Letter from the Office of Disability Services for my files. Students who receive extra time on tests as part of their accommodations approved by the Office of Disability Services must take the 3 exams at the testing center during a period of time that overlaps with the regularly scheduled exam time. This will apply to the 2 midterm exams and the final exam. Please plan accordingly.

**Mental Health and Wellness:** As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, depression, difficulty concentrating, and/or lack of motivation. These stressful events may compromise mental health and can lead to diminished academic performance and reduce your ability to participate in daily activities. GT offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know is experiencing any of the issues noted above, consider contacting the Center for Mental Health Care & Resources to ask about mental health and well-being services available on campus. Services at the CMHCR are confidential. You may call or walk in to schedule an appointment using the following information:

To schedule an appointment, call (404) 894-2575 or visit us at the Smithgall Student Services (Flag) Building, Suite 238 Mon - Fri 8 a.m.-5 p.m. After hours (nights & weekends), call (404) 894-2575 and select the option to speak to an after-hours counselor. For more information, visit our website, <https://mentalhealth.gatech.edu/>

## Course Schedule

Date	Topic	Homework
<b>Modeling, computers, and error analysis (Part 1)</b>		
08/25	<b>L1:</b> Syllabus, Introduction to numerical methods ( <b>ch. 1</b> )	
08/27	<b>L2:</b> Intro to Python	HW1 assigned
09/01	<b>L3:</b> Intro to Python	
09/03	<b>L4:</b> Computer representation of numbers, error ( <b>ch. 3</b> )	
09/08	<b>L5:</b> Floating point representation, roundoff error ( <b>ch. 3</b> )	HW1 due; HW2 assigned
09/10	<b>L6:</b> Taylor series, truncation error ( <b>ch. 4</b> )	
<b>Roots of equations (Part 2)</b>		
09/15	<b>L7:</b> Bracketing methods (Bisection, False-Position) ( <b>ch. 5</b> )	HW2 due; HW3 assigned
09/17	<b>L8:</b> Open methods (Fixed-point theory) ( <b>ch. 6</b> )	
09/22	<b>L9:</b> Open methods (Newton-Raphson, Secant) ( <b>ch. 6</b> )	HW3 due; HW4 assigned
<b>Curve fitting (Part 5)</b>		
09/24	<b>L10:</b> Straight line linear least-squares regression ( <b>ch. 17</b> )	
09/29	<b>L11:</b> General linear least squares regression ( <b>ch. 17</b> )	HW4 due; HW5 assigned
10/01	<b>L12:</b> Polynomial interpolation (Newton, Lagrange) ( <b>ch. 18</b> )	
10/06	<b>Fall Break – No Lecture</b>	
10/08	<b>L13:</b> Spline Interpolation ( <b>ch. 18</b> )	HW5 due; HW6 assigned
10/13	<b>Review</b>	
10/15	<b>Midterm Exam I (Lectures 1-13)</b>	
<b>Numerical integration (Part 6)</b>		
10/20	<b>L14:</b> Newton-Cotes Integration (Trapezoidal, Simpson's) ( <b>ch. 21</b> )	
10/22	<b>L15:</b> Integration of Equations ( <b>ch. 22</b> )	HW6 due; HW7 assigned
<b>Ordinary Differential Equations (Part 7)</b>		
10/27	<b>L16:</b> Initial Value Problems - Euler and Heun Methods ( <b>ch. 25</b> )	
10/29	<b>L17:</b> Initial Value Problems - Runge-Kutta Methods ( <b>ch. 25, 26.1</b> )	HW7 due; HW8 assigned
11/03	<b>L18:</b> Boundary Value Problems – shooting methods ( <b>ch. 27</b> )	
10/05	<b>L19:</b> Boundary Value Problems – finite difference method ( <b>ch. 27</b> )	HW8 due; HW9 assigned
<b>Optimization (Part 4)</b>		
11/10	<b>L20:</b> One-dimensional unconstrained optimization ( <b>ch.13</b> )	Final project assigned
11/12	<b>L21:</b> Multi-dimensional unconstrained optimization ( <b>ch. 14</b> )	HW9 due; HW10 assigned
11/17	<b>Review</b>	
11/19	<b>Midterm Exam II (Lectures 14-21)</b>	
11/24	<b>L22:</b> Constrained optimization	HW10 due
11/26	<b>Thanksgiving Break – No Lecture</b>	
12/01	<b>Final project review</b>	
12/03	<b>L23:</b> Python built-in functions	
12/08	<b>Final Instructional Day – Practical applications/ML</b>	Final project due
	<b>No Final Exam</b>	