24-311: Numerical Methods

Spring 2026

Instructor: Professor Levent Burak Kara

Teaching Assistants:

- Vedant Puri, vedantpu@andrew.cmu.edu
- Anuhya Edupuganti, aedupuga@andrew.cmu.edu

Lecture: Monday & Wednesday, 2:00 PM – 3:50 PM, Scaife Hall 105

Recitation: Monday, 7:00 PM – 7:50 PM, Scaife Hall 105

Office Hours:

	Time	**Location / Link**
Burak K	Thursday, 3:30–4:30 PM	Scaife Hall 343
TA + UTA	Wednesday & Thursday, 6:30–8:30 PM	Scaife Hall 309A
Course Assistant	Friday, 4:00–5:00 PM	Zoom link

Required textbook: Applied Numerical Methods with Python for Engineers and Scientists, 1st Edition, Steven Chapra and David Clough, 2022 or later. Digital copy acceptable.

1 Description and Objectives

While the development of a mathematical formulation to study an engineering system can be reasonably straightforward, a closed-form solution of such a formulation (which may be a system of algebraic equations, a differential equation, etc.) only exists in rare cases. To study such systems, numerical methods are required, which, at their most basic level, are a series of simple steps that anyone can perform using a pencil and a piece of paper. Computers are not needed to implement a numerical solution, but are very useful as they can perform the required operations much faster than a person. As engineers, it is our job to tell a computer exactly what it needs to do and understand its limitations, so that meaningful solutions are obtained.

The objective of this course is to expose undergraduate engineering students to the theory behind numerical techniques accessible in computational packages like Python. Students successfully completing this course will be able to:

- Determine the roots and extrema of non-linear functions.
- Solve linear and non-linear systems of equations and perform curve fitting.
- Perform numerical integration.
- Solve ordinary differential equations (initial value problems and boundary value problems).
- Apply Python to perform the required analysis.

Pre-requisites: 21-254: Linear Algebra and Vector Calculus for Engineers & 21-260: Differential Equations.

2 Logistics

2.1 Time

You are responsible for all material discussed in class, whether you attended or not. The course calendar contains the sections of the textbook to be covered in every lecture. You are strongly advised to read the textbook, as it will help you to better understand the materials presented.

There is one recitation per week lasting 50 minutes. The recitations will serve to provide further instruction, test review, discussion about the course project, and TA office hours. You are responsible for all material discussed in recitation, whether you attended or not. The course calendar describes what will be done each week.

Other than for note taking, use of electronic devices (cell phones, laptop computers, etc.) is not permitted. No student may record or tape any classroom activity without the express written consent of the instructor. In the case of a disability that requires recording or taping classroom activities, the student should contact the CMU Office of Disability Resources to request an appropriate accommodation. If such an accommodation has been arranged, the material may not be further copied, distributed, published, or otherwise used without express written consent of the instructor.

2.2 Website

Materials related to the course (e.g., documents and assignments) will be found on Canvas. You are responsible for all posted material.

2.3 Communication

The subject of any email sent to the instructor or TA should start with "24-311:". Do not send the instructor or TAs emails regarding homework (see below).

3 Assessment

Assessment Type	Quantity	Weight
Homework Assignments	11	5% each
Exams	2	Ex1: 20% Ex2: 25%

Homework. Each homework and each exam will have a maximum score of 100 points. Homework will be assigned on a Thursday and is due to Gradescope by 11:59 PM the following Saturday. See the assessment schedule for due dates and the separate Canvas file for submission details. Solutions will be posted to Canvas after grading.

Discussion about the homework will take place on Piazza. Do not email the instructor or TAs with homework questions. The instructor and TAs will regularly check Piazza.

Exams. In-class exams lasting 1 hour and 50 minutes will take place. See course calendar. There is no final exam.

4 Grading

90%–100%	A
80%–90%	B
70%–80%	C
60%–70%	D
0%–60%	R

4.1 Gradescope

All assignments will be submitted on Gradescope and must be fully self-contained. If your work includes images (e.g., photos of handwritten derivations, sketches, or screenshots), you **must embed those images directly into your submitted PDF or notebook**. Do **not** submit links to external images (Google Drive, Imgur, GitHub, etc.), as Gradescope does not allow graders to open clickable links. Any content that is not directly embedded in the submission will be treated as **not submitted** and may not be graded.

4.2 Late Submission Policy

You may submit assignments after the announced deadline according to the policy below. You have a total of 3 days to be late with each assignment. See `assessment_Schedule.pdf` for details.

0–3 hrs	Grade = Nominal grade $\times 0.95$
3–12 hrs	Grade = Nominal grade $\times 0.80$
12–24 hrs	Grade = Nominal grade $\times 0.70$
24–48 hrs	Grade = Nominal grade $\times 0.60$
48–72 hrs	Grade = Nominal grade $\times 0.50$
>72 hrs	Grade = Nominal grade $\times 0.00$

Submissions later than 72 hours receive no credit. This ensures grading and solution posting follow the strict semester timeline. Grace periods must be used carefully. The teaching crew will not honor additional requests for postponement.

4.3 Regrade Requests and Resubmissions

There are two different types of requests:

- **Regrade request (no changes to your submission):** You believe your work was graded incorrectly, but you are not modifying your original PDF.
- **Resubmission request (updated PDF required):** Your original submission needs to be corrected (for example, missing images, broken or inaccessible links, or other formatting issues). In this case, you must upload a revised PDF.

Process:

1. First, submit a regrade request through Gradescope.
2. If you are *not* updating your PDF, no further action is required. Your request will be handled entirely within Gradescope.

3. If you *are* required to upload a revised PDF, complete the Google Form and upload your updated file here:
   https://forms.gle/1SLHStzEMhKZdAX38
4. Do **NOT** resubmit the assignment on Gradescope if the deadline has already passed. All updated files must be submitted through the Google Form only.

5 Collaboration

For your assignments, we encourage collaboration. The parameters of acceptable collaboration are described below.

Guidelines

- Any text or graphics contained in your report should be solely your work.
- Any code you submit should be entirely written by you (excluding provided frameworks).
- You should not cut-and-paste from others, send work via email, or have someone else type your work.

Examples of Good Collaboration

- Discussing implications of results with classmates.
- Asking for help conceptualizing methods.
- Discussing theorems, principles, and equations.
- Debugging code.

If you are unsure whether collaboration is appropriate, talk to a TA. During grading, points may be deducted if cheating is suspected.
Academic Integrity Policy: `https://www.cmu.edu/policies/student-and-student-life/academic-integrity.html`

5.1 A note on AI tools and web sites providing solutions

The landscape of computational tools available to engineers is rapidly evolving. Tools such as ChatGPT, Copilot, Gemini, Claude, and similar AI-based systems are increasingly used in professional engineering practice to assist with coding, debugging, and exploration. Accordingly, this course adopts a **responsible-use policy** rather than a blanket prohibition.

Permitted use. Using AI tools to translate clearly specified algorithmic steps into Python code (e.g., generating function definitions, loop structures, or plotting commands) is permitted, provided the student understands and can explain each line of the resulting code. Hence, students **may use AI tools** as assistive learning aids to:

- Clarifying Python syntax or error messages,
- Exploring numerical algorithms discussed in class,
- Debugging code they have written,
- Reviewing concepts after attempting a problem.

Student responsibility. When using AI tools, students must adhere to the following principles:

- All submitted work must reflect the student's **own understanding**.
- Students must be able to **explain and justify** all aspects of their submitted code, including:
  - choice of numerical method,
  - algorithmic steps,
  - parameter selections (e.g., step size, tolerance, iteration limits),
  - interpretation of results and numerical behavior.
- Submitting code or explanations generated by AI **without understanding them** constitutes inappropriate use.

Students are reminded that homework questions are designed to assess **numerical reasoning and interpretation**, not merely the ability to produce working code. Over-reliance on AI tools will likely hinder performance on exams and conceptual questions.

Prohibited use. The following are **not permitted**:

- Using AI tools to directly obtain complete homework solutions without independent effort,
- Submitting AI-generated explanations or text verbatim as one's own,
- Using AI tools during exams,
- Posting homework questions verbatim to solution-providing services or forums.

Verification of understanding. The instructional team reserves the right to:

- Ask students to explain their submitted work verbally or in writing,
- Deduct credit if a student is unable to demonstrate understanding of their submission,
- Treat misrepresentation of AI-generated work as a violation of academic integrity.

Educational guidance. Homework is intended to be a low-stakes opportunity to develop problem-solving skills. Students are strongly encouraged to:

- Attempt problems independently before consulting AI tools,
- Use office hours and recitations to address conceptual difficulties,
- Treat AI as a supplement to learning, not a replacement for it.

Misuse of AI tools that undermines the learning objectives of the course will be handled in accordance with CMU's Academic Integrity Policy.

5.2 Cheating

In the event of cheating on any assignment or exam, unless extraordinary circumstances prevail, a penalty of failure for the course will be imposed and the incident will be reported to the university.

6 Take Care of Yourself

Do your best to maintain a healthy lifestyle by eating well, exercising, getting enough sleep, and taking time to relax. These steps will help you to achieve your goals and to cope with stress.

All of us benefit from support during times of struggle. There are resources available on campus and an important part of the college experience is learning how to ask for help. Asking sooner rather than later is often better. If you or anyone you know experiences academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. CMU Counseling and Psychological Services (CaPS) is available to help. Call 412 268 2922 or visit their website. Consider reaching out to a friend, faculty, or family member you trust to assist in getting connected to the support that can help.

7 Diversity, Equity, and Inclusion

The following text is that recommended by the CMU Faculty Senate. I fully endorse it.

We must treat every individual with respect. We are diverse in many ways, and this diversity is fundamental to building and maintaining an equitable and inclusive campus community. Diversity can refer to multiple ways that we identify ourselves, including but not limited to race, color, national origin, language, sex, disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Each of these diverse identities, along with many others not mentioned here, shape the perspectives our students, faculty, and staff bring to our campus. We, at CMU, will work to promote diversity, equity and inclusion not only because diversity fuels excellence and innovation, but because we want to pursue justice. We acknowledge our imperfections while we also fully commit to the work, inside and outside of our classrooms, of building and sustaining a campus community that increasingly embraces these core values.

Each of us is responsible for creating a safer, more inclusive environment. Unfortunately, incidents of bias or discrimination do occur, whether intentional or unintentional. They contribute to creating an unwelcoming environment for individuals and groups at the university. Therefore, the university encourages anyone who experiences or observes unfair or hostile treatment on the basis of identity to speak out for justice and support, within the moment of the incident or after the incident has passed. Anyone can share these experiences using the following resources:

- Center for Student Diversity and Inclusion : csdi@andrew.cmu.edu, 412 268 2150.
- Report-It online anonymous reporting platform. username: tartans, password: plaid.

All reports will be documented and deliberated to determine if there should be any following actions. Regardless of incident type, the university will use all shared experiences to transform our campus climate to be more equitable and just.