



# MAT 397 Numerical Methods for Engineers

Summer 2024

**Course Credits:** 4

**Contact Hours:** 56 hours

**Instructor:** TBA

**Email:** TBA

## COURSE OBJECTIVES

Master the fundamental numerical approaches for engineering problem solving. This course, which covers root-finding, iterative approaches, interpolation, differentiation, integration, and error analysis, improves computational abilities that are critical in engineering. Students learn how to solve real-world engineering problems through practical activities, preparing them for higher study and research.

Upon Completion of this Course, students will be able to:

1. Use a variety of root-finding approaches, such as Newton's and bisection, to solve nonlinear equations in engineering applications.
2. Analyse the condition number of linear systems to ensure computational stability and correctness in engineering calculations
3. Use iterative techniques such as Gauss-Seidel and SOR to efficiently solve linear and nonlinear problems.
4. Use interpolation and polynomial approximation to properly estimate functions, which is important for engineering data analysis.
5. Use numerical methods to solve differential equations, which are essential for effectively modeling and evaluating engineering systems.

## PREREQUISITES

N/A

## GRADING

Grades will be determined by accumulating points, with 100 points being the



maximum, as follows:

ITEM	POINTS
Class Participation	10 Points
Quizzes	30 Points
Midterm	20 Points
Final Exam	40 Points
Total	100 Points

Late submissions will be graded at the end of the course. Grades will be assigned according to the following rule:

$$A \geq 90 > B \geq 80 > C \geq 70 > D \geq 60 > F.$$

We reserve the right to make adjustments to the overall grading policy.

## COURSE MATERIALS

### Required Texts:

Steven Chapra, Raymond Canale, *Numerical Methods for Engineers*, 8th Edition, McGraw-Hill, 2021.

### Recommended (Optional) Texts or Other Materials:

None

## COURSE TOPICS

MODULE	TASKS
Module 1	<p><b>Topics:</b>  Topic 1: Modeling, Computers, and Error Analysis  Topic 2: Programming and Software  Topic 3: Approximations and Round-Off Errors  Topic 4: Truncation Errors and the Taylor Series</p> <p><b>Assessments:</b>  Quiz#1</p>



Module 2	<b>Topics:</b> Topic 5: Roots of Equations Topic 6: Linear Algebraic Equations Topic 7: Gauss Elimination Topic 8: LU Decomposition and Matrix Inversion <b>Assessments:</b> Quiz#2
Module 3	<b>Topics:</b> Topic 9: Special Matrices and Gauss-Seidel Topic 10: Least-Squares Regression Topic 11: Interpolation Topic 12: Fourier Approximation <b>Assessments:</b> Midterm
Module 4	<b>Topics:</b> Topic 13: Numerical Differentiation and Integration Topic 14: Newton-Cotes Integration Formulas Topic 15: Integration of Equations Topic 16: Numerical Differentiation <b>Assessments:</b> Quiz#3
Module 5	<b>Topics:</b> Topic 17: Runge-Kutta Methods Topic 18: Boundary-Value and Eigenvalue Problems Topic 19: Finite Difference: Elliptic Equations and Parabolic Equations Topic 20: Finite-Element Method <b>Assessments:</b> Final Exam

## ATTENDANCE

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1) Class attendance is required. Missing classes without permission will lead to decrease in overall grade.

Missing less than two classes: no penalty.

Missing more than two classes: 7% will be taken off from the overall grade.

If the instructor reports a student's frequent missing of class to the Soochow University Academic Administration Office, the student might get a written warning and might be prohibited from attending final exam.

2) Participants in this course are expected to arrive in class promptly and adequately



prepared. The primary objective of this course is to critically engage with the readings and the subject matter. Therefore, course participants are expected to have completed the reading prior to class and prepare thoughtful reflections/commentaries to share with fellow colleagues.

## **LEARNING REQUIREMENTS**

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- 1) Late assignments are not acceptable and are subjected to grade deductions.
- 2) Assignments submitted in the wrong format will be counted as not submitted.
- 3) Failure to submit or fulfill any required course component results in failure of the class.
- 4) Make-up for midterm and final exams only with valid excuses, as defined by the University.
- 5) In order to earn a Certificate of Completion, participants must thoughtfully complete all assignments by stated deadlines and earn an average quiz score of 50% or greater.

## **TECHNOLOGY POLICY**

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The use of electronic devices in class is distracting, both for the user and for the rest of the class. Only non-programmable calculators can be used in the tests and exam. Any attempts to use cell phones and other electronic communication devices will be seemed as cheating. Laptops are discouraged, unless you use them for activities DIRECTLY related to the course (eg., note taking, reading course documents).

## **ACADEMIC INTEGRITY POLICY**

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Soochow University highly values the academic integrity and aims to promote the academic fairness, honesty and responsibility. Any academic dishonesty behaviors and any attempts to cheats and plagiarism will be reported to the university administration office. A written warning and the relevant penalties will be imposed. The record might be shown on the official university transcript.

## **DISABILITY ACCOMMODATION**

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Soochow University is committed to maintaining a barrier-free environment so that



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students with disabilities can fully access programs, courses, services, and activities at Soochow University. Students with disabilities who require accommodations for access to and/or participation in this course are welcome.

Note:

Please contact the University Administrative Office immediately if you have a learning disability, a medical issue, or any other type of problem that prevents professors from seeing you have learned the course material.