MATH 131: CALCULUS I - FALL 2025

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Class Meetings:	MWF 8:30am–9:45am, MC 303
Office hours:	MW 3pm–4:30pm; F 11am–12pm; and by appointment

Course information

Course description. Suppose you drove your car from home to school, a distance of 50 miles, and that it took you one hour. Then over that distance, *on average*, you were travelling at a speed of 50 miles per hour. But at any given moment of your journey, your phone's GPS could tell you your speed *at that instant*. What does that even mean? And how does your phone calculate it?

Questions like this can be answered by *differential calculus*, the mathematics of how quantities change. Its central object is the *derivative*, which measures the instantaneous rate of change of a *function*. Calculus's key insight is that instantaneous rates can be understood through *limits*, that is, by examining what happens to average rates of change as the intervals between measurements become arbitrarily small. The resulting theory has applications spanning virtually every quantitive field.

Course textbook. *Calculus* (1^{st} edition) by Laura Taalman and Peter Kohn

Note: The textbook from the bookstore comes bundled with Achieve access for all levels of calculus. If you buy the book elsewhere, it probably **does not** come with Achieve access, which will need to purchased individually from the publisher's website (see Moodle for details).

Course content. The goal of this course is to introduce the fundamental concepts of differential calculus in a way that focuses on gaining a strong intuitive, geometric, and formal understanding of important definitions, theorems, methods, and applications.

After briefly recalling some essential facts about functions of a single real variable and their graphs, this course can be divided into the following three sections:

(i) **Limits and continuity:**

- Understand the concept of a *limit*, and its role in defining the notion of a *continuous function*.
- Understand important properties of continuity, in particular, the *Intermediate Value Theorem*.
- Be able to combine algebraic techniques with standard rules to calculate limits for a wide variety of elementary functions.

(*ii*) **Derivatives:**

- Be able to divine the concept of a *derivative* using limits.
- Understand how the derivative can be interpreted as an instantaneous rate of change.
- Understand the connection between derivatives and tangent lines.
- Be able to use algebraic techniques, and results from the class to calculate derivatives for **all** elementary functions.

(*iii*) **Applications:**

- Understand the applications of differential calculus to fundamental problems in geometry, physics (especially motion), economics (especially marginal quantities), and other disciplines.
- Be able to solve various "word problems" using techniques of calculus, especially "related rates" and optimisation problems.
- Be able to sketch accurate graphs given information about the derivatives.

Moreover, by the end of this course, you should be able to communicate mathematics effectively, using complete sentences which blend the English language with mathematical definitions, notation and accompanying figures.

Course assignments

There will be two kinds of homework assignments:

- Concept check assignments
- Problem sets

Concept check assignments. Most classes, I will assign an online concept check assignment, using the Achieve platform. These assignments are designed to ensure that you have understood the course material, including understanding definitions, and being able to carry out simple computations.

You may complete these assignments as many times as you like before the deadline, and only your highest score will count towards your grade.

Struggling with these assignments is a strong indication you have not understood the material, and you should come to office hours for help.

You may complete these assignments as many times as you like before the deadline, and only your highest score will count towards your grade. Late submissions will not be accepted.

Problem sets. Each week, I will assign a problem set. These assignments are the main focus of the course. Problem sets typically consist of 3-5 questions, and are designed to challenge you and help you to master the course material.

You will be graded both on **mathematical accuracy** and on the **quality of your written communication**. Your homework solutions should be written clearly, legibly, and using appropriate

style. In particular, your solutions should be written in full sentences, using proper grammar, punctuation, and spelling. You should use a fresh, clean, standard size paper (or digital equivalent), in portrait orientation, and leave a margin on all sides.

Problem sets must be submitted electronically using Moodle. Late submissions will not be accepted, except in accordance with the late homwework policy.

Assessment

Exams. There will be three in-class midterm exams and a comprehensive final exam:

- First midterm: Wednesday, October 1
- Second midterm: Wednesday, October 29
- Third midterm: Wednesday, November 19
- Final exam: Monday, December 15, 12pm–2:30pm

Grading. Your grade will be based on the following distribution:

Attendance, participation, and concept check assignments	10%
Problem sets	20%
Midterm 1	15%
Midterm 2	15%
Midterm 3	15%
Final exam	25%

You will be assigned a letter grade based on the following scale:

A	A-	B+	B	B-	C+	C	C-	D	F
[93,100]	[90, 93)	[87, 90)	[83, 87)	[80, 83)	[77,80)	[73,77)	[70,73)	[65,70)	[0,65)

Please note that it is the policy of the mathematics department that the grade of A+ is not awarded in 100-level courses.

Course policies

Expectations. Expect to spend around 8 – 12 hours per week outside of class on reviewing lecture notes, homework, and studying.

You are expected to actively engage in class by asking questions, taking notes, working on in-class exercises, and responding to questions posed by the instructor and your fellow classmates.

If you feel yourself falling behind, please come to office hours and take advantage of the tutoring services, which are available through the Math Tutoring Center.

Office hours. Office hours are a great opportunity to ask questions about lecture and homework material. If you are unable to attend the regularly scheduled office hours and would like to meet, please reach out to me in advance and we can schedule an appointment.

Attendance and participation. Unless otherwise announced, all class meetings will occur in person, and you are expected to attend and participate in each class. *Regular attendance is vital to success in this course,* and repeated absences will impact your ability to keep up with the course material.

If you need to miss a class due to illness, college event, or any other reason, please email ariel.weiss@trincoll.edu to inform me, and I'll do my best to help prevent you from falling behind.

Collaboration. You are strongly encouraged to work with other members of the class to solve homework questions and to understand the course material. However, *your final write-up must be entirely your own.*

Low exam policy. If your grade on the final exam is better than the grade on your lowest midterm exam, your final exam grade will replace your lowest exam grade. In order to benefit from this policy, you must take all three midterm exams.

Late homework policy. You have three grace days for problem sets during the semester. A grace day lets you turn in a problem set up to 24 hours late for any reason, with no explanation needed. You may use these days one at a time or all at once, but once they are gone, no further late work will be accepted without prior approval.

Beyond these three grace days, late homework will only be accepted if you have a valid excuse (e.g. illness, family emergency) that you communicate to me *before the deadline*, and I approve it. Excused late work of this kind does not count against your grace days.

Calculator policy. The use of a graphing calculator on exams is prohibited. You may use any calculator during class, but not any other electronic devices, except for note taking (this includes cell phones, laptops, and MP3 players).

Use of Generative AI. As machine learning tools like ChatGPT become more widespread, it's important to use them thoughtfully and responsibly. The course policy on these tools can be succinctly summarised as follows:

- You are encouraged to use generative AI tools in ways that enhance your learning.
- You should not use generative AI tools in ways that detract from your learning.
- Submitting AI-generated content as your own work is plagiarism and is strictly prohibited.

Examples of uses of AI that are beneficial include generating lists of practice problems, asking for explanations of a concept that you are struggling with, asking for clarification of unfamiliar terminology or reviewing definitions, using AI to help brainstorm questions to ask during office hours or study group sessions, and requesting a worked example of a problem type *after* attempting similar problems yourself.

Note that AI tools may provide information that is wildly incorrect, and that using AI is only beneficial if you are sufficiently sceptical of its output.

Examples of uses of AI that are not beneficial include asking for hints for current homework problems, requesting a worked example of a type of problem *before* you have attempted similar problems yourself, and using generative AI in place of collaborating with your peers.

Examples of uses of AI that reach level of plagiarism include any use of AI that results in you submitting AI-generated material, even if you substantially revise or reword it. This includes copying explanations, computations, or proofs, regardless of how much you edit them.

These categories are necessarily subjective, with many grey areas. If you are in any doubt whether a use case of AI is beneficial, not beneficial, or prohibited, please err on the side of caution and ask me first!

Academic Integrity. Academic honesty is highly valued at Trinity. In accordance with the Trinity College Student Integrity Contract, students are expected to abide by the highest standards of intellectual honesty in all academic exercises. Intellectual honesty assumes that students do their own work and that they credit properly those upon whose work and thought they draw. It is the responsibility of each student to make sure that they are fully aware of what constitutes intellectually honest work in every examination, quiz, paper, laboratory report, homework assignment, or other academic exercise submitted for evaluation in a course at Trinity College.

Academic Accommodations. Trinity College is committed to creating an inclusive and accessible learning environment consistent with the Americans with Disabilities Act. Students with disabilities who may need some accommodation in order to fully participate in this class are urged to contact the Student Accessibility Resource Center, as soon as possible, to explore what arrangements need to be made to assure access.

If you have approval for academic accommodations, please notify me by the end of week two of classes. For those students with accommodations approved after the start of the semester, a minimum of 10 days' notice is required. Please be sure to meet with me privately to discuss implementation.

Student Accessibility Resources can be reached by emailing SARC@trincoll.edu.

Disclaimer. This course syllabus is a general plan for the course, however, deviations may be necessary. If I need to change a course policy, I will make an announcement to the class and give sufficient notice.

Tentative weekly schedule

Week number	Monday of week	Textbook sections	Topics
1	Sep 1	0.1, 0.2	*(LABOR DAY, no class M)* Review of Functions, Piecewise Functions, Domain, Graphs, Transformations, Inverses
2	Sep 8	1.1, 1.4	Idea of Limit, Left & Right Limits, Limits from Table, Limits from Graph, Definition of Continuity, Left & Right Continuity, Discontinuities, Intermediate Value Theorem, Extreme Value Theorem
3	Sep 15	1.4, 1.5	Limit Rules, Cancellation Theorem, Squeeze Theorem
4	Sep 22	1.6, 2.1	Infinite Limits, Limits at Infinity, Vertical/Horizontal Asymptotes, Idea of Derivative, Secant & Tangent Lines, Average & Instantaneous Rates of Change
5	Sep 29	**[[Exam 1]]**, 2.2	**EXAM 1 (0.1-0.2, 1.1, 1.4-1.6),** Definintion of Derivative, Left & Right Derivatives
6	Oct 6	2.2, 2.3	Differentiability Implies Continuity, Second Derivative, Basic Derivative Rules, Product Rule, Quotient Rule
7	Oct 13	2.4	*(TRINITY DAYS, no class M-T)* Chain Rule, Implicit Differentiation
8	Oct 20	2.5, 2.6	Exponential Derivatives, Definition of e (handout), Log Derivatives, Precalculus Review of Trigonometic Functions, Limits and Continuity of Trig and Inverse Trig Derivatives
9	Oct 27	**[[Exam 2]]**, 2.5, 2.6	**EXAM 2 (2.1-2.6),** Logarithmic Differentiation, Inverse Function Theorem
10	Nov 3	3.1, 3.2	Critical Points, Local Extrema, Rolle's Theorem, Mean Value Theorem, Sign Charts, Increasing/Decreasing, First Derivative Test
11	Nov 10	3.2, 3.3, 3.4	Concavity, Inflection Points, Second Derivative Test, Curve Sketching, Finding Global Extrema on Intervals
11*	Nov 17	**[[Exam 3]]**, 3.4	**EXAM 3 (2.5-2.6, 3.1-3.4),** Optimization Word Problems
12	Nov 24	3.4	*(THANKSGIVING BREAK, no class W-F)* Optimization Word Problems
13	Dec 1	3.5, 3.6	Related Rates Word Problems, L'Hopital's Rule, Indeterminate Forms, 0/0, inf/inf, inf-inf, 0*inf, 0^0, 1^inf
13*	Dec 8	Review, **[[Final Exam]]**	*(READING DAYS, no classes T-W)* **FINAL EXAM (cumulative) on MONDAY Dec 15**