

**Math 331-01 Analysis I**  
SPRING 2024

**Professor:** M. Sandoval, Nutt MECC 277, 297-2062, email: msandova@trincoll.edu (The best way to contact me!)

**Time and Location:** MWF 12:00 - 12:50pm, Location: McCook 213.

**Course Website:** We have a Moodle Website in the usual place.

	Monday	1:30pm–3pm
	Tuesday	none, except by appointment
<b>Office Hours:</b>	Wednesday	1:30pm–3pm
	Thursday	none, no appointments
	Friday	1:30pm–2:30pm

Or by appointment. Please allow 48 hours to find a mutually agreeable time.

**About this course:** Analysis is one of the three essential branches of pure mathematics. Furthermore, it is essential for the proper grounding of applied mathematics. It is a rich subject which has deep connections to many areas of pure and applied mathematics, as well as statistics.

This course serves three purposes: (1) it provides a complete exposition of the theory of behind differential calculus; (2) it provides an opportunity to deepen students' ability to think abstractly; (3) it is designed to help students further develop their proof-writing skills, which are essential for mathematics majors.

**Course Learning Objectives: General Mathematical Abstract Reasoning Skills:**

By the end of this course, successful students will be able to:

- prove that a particular mathematical object satisfies a given definition.
- determine if an example is a counterexample to some proposition.
- analyze the hypotheses of a given problem.
- closely read definitions, arguments, identify common structures, apply abstract criteria to determine if particular examples meet the abstract hypotheses or criteria, and be able to explain the logical relationship between theorems and definitions in this course.
- closely read proofs, identify logical structures, and identify commonly used techniques.
- reflect on an argument, assess its validity, analyze its structure, comparing it to similarly structured arguments, and revise it as needed.
- construct correct, concise arguments (proofs), making well-justified rigorous statements, sometimes from first principles, and write them up clearly, using good style, exposition, and form.

**Course Learning Objectives: Content Specific Reasoning Skills:** More specifically, in terms of subject matter, successful students will be able to

- understand the difference between real numbers, rational numbers, and integers.
- exploit the properties and axioms of the real line to prove results.
- be able to make arguments about the convergence/divergence of sequences and subsequences of real numbers.

- understand and be able to use basic topological properties such as openness, closedness, compactness, and connectedness.
- be able to understand and use the definition of continuity and the properties of continuous functions.
- understand the connection between continuity and convergence of sequences.
- understand and be able to use the definition and properties of differentiable functions.
- understand and be able to appreciate the proofs of the basic foundations of differential calculus, including the major theorem.

**Textbook:** *Understanding Analysis*, Second Edition by Stephen Abbot.

This textbook is available **FREE** from the publisher when accessed through the following link:

<http://link.springer.com.ezproxy.trincoll.edu/>

You may also purchase a hard copy online as I have not ordered it for the bookstore.

**To access a free PDF version:**

- Click on the link above to take you to the Springer website as a validated Trinity user.
- Go to the website for each text:  
<https://link-springer-com.ezproxy.trincoll.edu/book/10.1007/978-0-387-21506-8>
- On the right side you will see a link that says, **Download Book PDF**.
- Clicking on the link will open the book on your computer. BE SURE AND SAVE IT OR YOU WILL HAVE TO GO THRU THIS PROCEDURE EVERY TIME!

As an additional resource for writing proofs, we also have the following free text : *Writing Proofs in Analysis*, by J. Kane, available in a similar fashion to the above via

<https://link-springer-com.ezproxy.trincoll.edu/book/10.1007/978-3-319-30967-5>

**Material:** Chapters 1 through 5 of *Understanding Analysis*, most sections.

**Grading:** This course is about learning how to prove mathematical facts.

Video Reflection Activities,	10%
Attendance and Class Participation (includes group work and warm up exercises)	10%
Weekly Proof Sets	30%
Exam I	15%
Exam II	15%)
Final on Friday, May 10th, 3pm	20%

Extra credit is not available. All assignments must be turned in on time. Late assignments will not be accepted. Missing class is not a valid reason for turning in late assignments.

The letter grade in this course is based on a straight scale, with the exceptions (1) that I do not decorate D grades with plusses or minuses; and (2) the grade of A+ is reserved for the truly

remarkable students—someone whom I would rate in the top 1 percent of all the students I have encountered in my career at Trinity (this is consistent with the policy of the Dean of the Faculty’s latest policy)—consequently, a grade that is a 90 percent but below a 95 percent is an A- and a grade above 95 percent is an A.

**Expectations:** Analysis is a VERY CHALLENGING subject and requires a substantial effort in order to be successful. This is a flipped class and the expectations are a little bit different than you may be used to.

- Successful students attend class. Attendance will be taken and will be taken into account in the calculation of the final grade. To receive full credit attendance you must attend class for the full class period **and be engaged in class activities**. We will be using a work-shop model to actively work on the assignments during a portion of the class period.
- You are expected to closely follow the videos and take notes, on the handouts with gaps if you wish. If you do not understand something, make note of the time stamp in the video and ask questions during class in the portion of class allotted for that purpose.
- You are expected to actively participate in all class activities, including group work, proof strategy brainstorming activities, et cetera.
- You are expected to use office hours are for handling any overflow of unanswered questions from class. I have many students who also have equal access to my office hours
- You are expected to start on assignments immediately, and work on assignments every class period and in whatever time is needed outside of class. Class activities are designed to get you started on this work. You should expect to work on this class (including watching the videos) for at least 9 hours per week.

**Video Reflection Activities/Attendance/Class Participation/In-class Activities:** This is a flipped class, which means that portions of the class time will be spent working on the proof sets. In addition we will have regular in-class activities in the form of worksheets, warm-up activities, proof strategy brainstorming activities, groupwork, mock quizzes, et cetera. Some items may be posted before class for you to complete on moodle. If you are absent, you may not make up the class activities except under extraordinary circumstances that can be documented via the Dean of Students Office. Every class period, I will assign a participation grade based on my observations of your participation and engagement.

**Proof Sets:** You should start these as soon as they are assigned. Writing proofs is the main focus of the course. Problem Sets will usually consist of 3-5 problems. All assignments must be turned in. Assignments are due at the beginning of class on the day announced on the assignment. Electronic submission as a single pdf are preferred. Late homework will receive a zero, and will not be graded. Electronic submissions of your proof-writing homework as a single pdf are required through moodle. Proof sets do not need to be typeset with a program; hand-written work is fine as long as it is organized and legible. You should start each problem on a new page. Sets are due on Mondays, and each Monday’s class will consist of a workshop for you to address remaining questions/issues with your work. Proof Sets will be due at midnight on Mondays via moodle.

**Exams:** There will be two exams and a cumulative final exam. There will be no make-up exams. If you suffer from a sudden illness or emergency that prevents you from taking an exam, then you must notify me and the Dean of Students by email, telephone message, or other means of communication prior to or during that exam. If your emergency is deemed sufficient to excuse you

from the exam, you will not be given a make-up exam—your final exam will simply be lengthened and rescaled to make up for the lost points. A missed exam that has not been excused will result in a zero score. The dates of the two exams are as follows:

Wednesday, February 21st  
Wednesday, March 27th

**The Final:** The final exam is scheduled for May 10th, at 3pm.

**Academic Honesty:** 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. In this course, you may not draw upon internet solutions or the work of others. It is the responsibility of each student to make sure that he or she is 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.

**Students with Academic Accommodations:** Trinity College is committed to creating an inclusive and accessible learning environment consistent with the Americans with Disabilities Act. If you have approval for academic accommodations, please notify faculty during the first two weeks of the semester or a minimum of 10 days prior to needing your accommodations. Please be sure to meet with me privately to discuss implementation. If you do not have approval for academic accommodations, but have questions about applying for academic accommodations, please contact the Student Accessibility Resource Center, by emailing: [SARC@trincoll.edu](mailto:SARC@trincoll.edu). The website is <https://www.trincoll.edu/sarc/students/>. Academic accommodations are available ONLY to students who have approval for academic accommodations.

**Finally:** Unless stated otherwise, all other matters of course policy are subject to the instructor's discretion and may be changed with suitable notice.

Tentative schedule: (for a current version, look at the moodle schedule)

1	M	Jan 22	1	Introduction
1	W	Jan 24	2	Preliminaries 1
1	F	Jan 26	3	Preliminaries 2
2	M	Jan 29		Workshop 1
2	W	Jan 31	4	The Axiom of Completeness
2	F	Feb 2	5	Consequences of Axiom of Completeness
3	M	Feb 5		Workshop 2
3	W	Feb 7	6	Cardinality of Sets
3	F	Feb 9	7	Sequences
4	M	Feb 12		Workshop 3
4	W	Feb 14	8	Limit Properties
4	F	Feb 16	9	Order Limit Properties
5	M	Feb 19	10	Workshop 4
5	W	Feb 21		<b>Exam 1</b>
	F	Feb 23		<b>Trinity Days-no class</b>
5	M	Feb 26		The Cantor Set
	W	Feb 28		<b>Bicentennial Day-no class</b>
6	F	Mar 1	11	The Cauchy Criterion
6	M	Mar 4		Workshop 5
6	W	Mar 6	12	Open and Closed Sets
7	F	Mar 8	12	Open and Closed Sets

	M	Mar 11		spring break - no class
	W	Mar 13		spring break - no class
	F	Mar 15		spring break - no class
7	M	Mar 18		Workshop 6
7	W	Mar 20	13	Compact Sets
8	F	Mar 22	14	Functional Limits
8	M	Mar 25		Workshop 7
8	W	Mar 27		<b>Exam 2</b>
9	F	Mar 29	15	Continuity
9	M	Apr 1		Workshop 8
9	W	Apr 3	16	Continuous Functions
10	F	Apr 5	17	The Intermediate Value Theorem
10	M	Apr 8		Workshop 9
10	W	Apr 10	18	Sets of Discontinuity
11	F	Apr 12	19	Derivatives
11	M	Apr 15		Workshop 10
11	W	Apr 17	20	Derivatives and their Properties
12	F	Apr 19	20	Derivatives and their Properties
12	M	Apr 22	21	The MVT
12	W	Apr 24	21	The MVT
13	F	Apr 26		Workshop 11
13	M	Apr 29		Catch up Day
13	W	May 1		Review
	F	May 10		Final Exam noon-2:30pm