Math 338 Spring 2026
Real Analysis

MWF 10:00-10:50AM (Miller 008)

Professor:	Evan Randles
Email:	erandles@colby.edu
Phone:	(207) 859-5834
Office:	Davis Science Center 209
Office Hours:	2:00-3:00PM Monday & Wednesday;
	10:00-11:00AM Tuesday; & by Appointment

Course Website:	`http://personal.colby.edu/~erandles/M338.html`
Personal Website:	`http://personal.colby.edu/~erandles/`

Teaching Assistants:	Aum Desai	agdesa26@colby.edu
	Jack AbuHaidar	jhabuh27@colby.edu

(TA Office Hours: 7:00-9:00PM & Wednesday in Davis 209A)

The calculus was the first achievement of modern mathematics and it is difficult to overestimate its importance. I think it defines more unequivocally than anything else the inception of modern mathematics; and the system of mathematical analysis, which is its logical development, still constitutes the greatest technical advance in exact thinking. – John von Neumann, 1947[1].

I turn away in fright and horror from this lamentable plauge of functions that do not have derivatives. – Charles Hermite, 1893

Course Description: An exploration of the theory behind calculus, as well as its extension to more general settings. Students will learn to think carefully and clearly about limiting processes such as differentiation, integration, and summation of series and to interpret their knowledge in terms of the topology of metric spaces. They will develop the ability to read and to produce formal mathematical arguments, with particular attention to handling exceptional cases and delicate issues of convergence. Special focus on foundational issues: topology of metric spaces, continuity, differentiation, infinite series, Riemann-Darboux integration.

Prerequisites: Mathematics 160 and 274; or Mathematics 135 and 165.

Textbooks:

- *Principles of Mathematical Analysis* by W. Rudin, 3rd ed.
- *Understanding Analysis* by S. Abbott, 2nd ed.

[1] *The Mathematician:* `https://mathshistory.st-andrews.ac.uk/Extras/Von_Neumann_Part_1/`

I will assign weekly readings from the above excellent texts. These readings should be done carefully, thoroughly, and before you come to class. As you know from Mathematics 274, reading a mathematics textbook means to read with a pencil/pen in hand and work out all details carefully, especially those made within the course of a proof. When creating material for this course (the homework, exams, quizzes etc.), I like to draw from many different sources. In addition to the course textbooks, I will often consult *An Introduction to Analysis* by W. Wade (2nd ed.); *Mathematical Analysis* by Apostol (2nd ed.); Introduction to Real Analysis by R. Bartle and D. Sherbert; and *An Introduction to Analysis* by J. Kirkwood. While you are not required to obtain these texts, you may want to take a look at them, especially if you plan to continue your studies of analysis after this course.

Grading: Your grade will be calculated as follows:

Class participation & Attendance:	10%
Weekly homework assignments:	20%
Minimum of Midterm 1 & 2	20%
Maximum of Midterm 1 & 2	25%
Final Exam:	25%

Exams: This course will have two midterms and one final exam. The exams will be at the following dates, times, and locations:

Midterm 1	**Wednesday, March 18th, 7:00-9:00PM**	**TBA**
Midterm 2	**Wednesday, April 15th, 7:00-9:00PM**	**TBA**
Final Exam	TBA	**TBA**

It is crucial that you reserve these time slots for these exams. In the event that you are unable to attend a midterm exam, you must let me know at least **two weeks** prior to the exam date.

Homework: Homework is the most important part of this course. It is where you will grapple with new ideas, come up with creative solutions and communicate your thoughts and understanding to others. Consequently, it is crucial that you take homework very seriously. You should start homework early and work diligently. If you are having substantial difficulty with a particular exercise, please come talk to me during office hours. I am here to help! You are permitted and encouraged to discuss homework with your classmates (if it is helpful/productive for you), however, when it comes time to write up your solutions, you are required to do so independently and away from your peers (in another room, preferably). If you work with peers, please list the names of all peers with whom you worked; failure to do so is a matter of academic dishonesty and will result in grade penalties and/or reports of academic negligence/dishonesty. Your proofs/solutions should communicate your individual process and understanding of the material. What you turn in must be your own.

The homework for this class will be primarily proof oriented, though we will occasionally have exercises where you are asked to "cook up" examples or perform computations. For the proof-oriented exercises, in general, you are expected to follow the guidelines outlined in Math 274. Of course, writing proofs is a difficult and monumental skill to master and we will work together to build and hone this skill. Please keep in mind the following guidelines while writing and polishing your proofs: 1) Correctness is essential. 2) The longest proof is never the best; the shortest proof is rarely good. 3) Clarity is the ideal.

For your homework write-ups, I expect your solutions to be written out correctly and presented in good mathematical prose. Your grade will depend on the correctness of your solutions and the quality of your writing. This means that your writing should follow a coherent logical structure which makes use of complete sentences (whenever possible) and follows standard rules of grammar. Please do not submit solutions containing incoherent and unstructured calculations. While not necessary (provided that you have very legible handwriting), you are encouraged to typeset your write-ups in LaTeX. If you are interested in using LaTeXand have not used it before, please let me know and I can help get you started (provide instruction, templates, etc.) – just let me know. Overall, you should be proud of the material you turn in!

One word of warning: Solutions for the book exercises are, quite unfortunately, easily found on the internet. Please do not go searching and looking for such solutions; doing so is not only a matter of academic dishonesty (if they are copied and submitted) but it will also hinder your learning. The process of struggling with, working hard, and figuring out solutions to exercises is precisely the method by which you will actually learn the material and be able to perform well on the exams. Of course, we all get stuck from time to time so, if you need help, please come to office hours (mine or the TAs) and, if it is helpful, talk with your peers.

Homework Structure and Schedule: Assignments will be posted to the course website and are due at 10:00AM on Thursdays in the appropriate box outside my office door (Davis209A) It is crucial to keep up with the homework in this course. Therefore, short of the circumstances discussed in the attendance policy below, late homework will not be accepted. I will drop your lowest homework score on the condition that you attend one Mathematics Department colloquium and write a short (one paragraph) summary.

Homework Policies:

1. All write-ups are to be submitted in hard copy. They should be single-sided with no more than one problem per page, i.e., if a homework assignment has 5 problems, you should turn in at least 5 pieces of paper.

2. Each paper you turn in should have your name and the due date printed clearly at the top.

3. Your write-ups should be paper-clipped. You should staple all papers corresponding to a single exercise together, but please paper-clip (not staple) the group of exercises together. It is your responsibility to make sure that your homework is complete and all pages are accounted for.

Attendance and Class Participation: You are required to attend each class session. This means that you need to be on time to class, seated, and ready to learn (take notes, participate, discuss, and engage). To learn mathematics, it is essential to discuss it with others and ask questions. Thus, you will be required to participate in class discussion and you will frequently be called on during lecture. It is for this reason that your on-time attendance is required.

With this being said, I also know that things come up that are outside of your control. To accommodate this, you are allowed 4 'free passes' this semester that can be used for missing class, arriving late, or leaving early. Absences for religious reasons or for official Colby activities do not

count as using a free pass as long as you communicate with me clearly beforehand.

The following rules apply:

1. You are tardy when you arrive t minutes late for $0 < t \leq 5$; here, the minutes start at exactly $10:00$AM.

2. If you arrive more than 5 minutes after the start of the hour, you are considered absent and I ask that you not enter the room so that you do not distract others from their learning.

3. Each instance of tardiness or absence, beyond the four free passes, will count against your final grade (a tardy costs 2% and absence costs 4%). Numerous deductions can result in failing the courses and, if absences/instances of tardiness are particularly egregious, I reserve the right to have the registrar remove you from the course.

In-Class Policies: As discussed above, when you are in class, you are expected to be fully engaged with material and the class discussion. For this reason, you should not have laptops or cell phones out during class; these should be stored away throughout the entirety of the class period. For those students who take notes on digital tablet/notebooks, the tablet/notebooks should always be placed flat on the desk (like a paper notebook) and not propped up like a laptop. Your tablet/notebook screen should always be visible to me. I ask that you stay seated throughout the class period to minimize the distraction of your peers. It is essential for the classroom to be a place where people can focus, learn, and explore mathematics without distraction.

Office Hours: You are strongly encouraged to attend office hours and do so regularly. Office hours are the perfect venue for asking questions, getting help, and having real one-on-one time with me. For my office hours to be most beneficial to you and fair to your peers, my office-hour policies are as follows:

- If you are attending office hours to get help with the homework, you first must first have spent a considerable amount of time ($\geq$ 30 minuets) thinking about/attempting a solution/proof. In particular, you must have parsed through the definitions, read the relevant sections of the textbook(s), compared the problem against what we've done in class and similar examples from the textbook(s), and made an earnest attempt at a solution/proof and be prepared to show me your attempt.

- To be most effective in helping students with homework problems, I will sometimes work with students individually and other times work with students in groups. If you prefer to talk with me individually, please let me know (and be patient).

Open Door Policy: I maintain an "open door policy." This means that, if you find my (inner) office door open and I'm inside, I am likely available to chat and help. In that case, please and ask if I am available. If my door is closed, it's a signal that I am busy (if I am there) and am therefore not able to help. If you see my inner door closed, please do not knock.

My Email Policy: I love talking about mathematics and I always prefer to do it in person. For this reason, I like to, whenever possible, reserve email for logistical things. However, when you are stuck and cannot come see me in person, please feel free to email me. I am here to help!

As my life is busy and I have many responsibilities, I usually only check and respond to email once per day and sometimes not at all on weekends. For this reason, I try to uphold the following 24-48 hour rule: If you send an email Sunday through Thursday, I will do my best to respond within 24 hours. If you send an email on Friday or Saturday, I will do my best to respond within 48 hours. If I do not respond within these windows, feel free to email me again as I may have missed it.

On AI: Colby provides access to professional versions of Google Gemini. Many industries now require their employees to use AI on a regular basis in order to increase efficiency and outsource rote tasks. So by all means, familiarize yourself with AI, including by consulting non-AI sources concerning the enormous ethical, social, and philosophical issues surrounding it. But in this course, efficiency of output is not our objective. Our objective is to learn mathematics and learn how to communicate our understanding as thoroughly as we can. Yes, AI systems "know" differential equations. But in the days before AI, other people knew differential equations too. Indeed the only reason AI systems are at all decent at some mathematics is because humans taught them both by making their intellectual work available online and by directly teaching the AI (aka "reinforcement learning"). This does not change the fact that humans need to know mathematics, even less does it obviate the need to develop mathematical ways of thinking. Indeed, the imperative is even greater. AI systems, above all else, are excellent at sounding convincing. Only by becoming a well educated person yourself, will you be able to tell when it is wrong or be able to think up a more creative solution to some problem than the "common online wisdom" that AI defaults to.

How does one become educated? By working hard both by oneself and in community. "There is no royal road to geometry." (Euclid? 300BCE). The good news is that, if you are doing what you are supposed to, the work will be rewarding and it will pay off.

Academic Integrity: Honesty, integrity, and personal responsibility are cornerstones of a Colby education and provide the foundation for scholarly inquiry, intellectual discourse, and an open and welcoming campus community. These values are articulated in the Colby Affirmation and are central to this course. You are expected to demonstrate academic honesty in all aspects of this course. If you are clear about course expectations, give credit to those whose work you rely on, and submit your best work, you are highly unlikely to commit an act of academic dishonesty.

Academic dishonesty includes, but is not limited to: violating clearly stated rules for taking an exam or completing homework; plagiarism (including material from sources without a citation and quotation marks around any borrowed words); claiming another's work or a modification of another's work as one's own (results from AI, internet searches, or online forums count as "another's work"); buying or attempting to buy papers or projects for a course; fabricating information or citations; knowingly assisting others in acts of academic dishonesty; misrepresentations to faculty within the context of a course; and submitting the same work, including an essay that you wrote, in more than one course without the permission of the instructors.

Academic dishonesty is a serious offense against the college. Sanctions for academic dishonesty are assigned by an academic review board and may include failure on the assignment, failure in the course, or suspension or expulsion from the College.

The Colby Affirmation

Colby College is a community dedicated to learning and committed to the growth and well-being

of all its members.

As a community devoted to intellectual growth, we value academic integrity. We agree to take ownership of our academic work, to submit only work that is our own, to fully acknowledge the research and ideas of others in our work, and to abide by the instructions and regulations governing academic work established by the faculty.

As a community built on respect for ourselves, each other, and our physical environment, we recognize the diversity of people that have gathered here and that genuine inclusivity requires active, honest, and compassionate engagement with one another. We agree to respect each other, to honor community expectations, and to comply with college policies.

As a member of this community, I pledge to hold myself and others accountable to these values.