Math 160 Fall 2025
Series and Multivariable Calculus

Section A1: MTWF 10:00-10:50AM Bixler 219
Section C: MTWF 12:00-12:50PM Miller 014

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Office Hours:	2:00-3:30PM Monday, 2:00-4:00PM Wednesday, 2:00-3:00PM Friday, and by appointment
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(Nightly TA sessions will be held from 7-10PM in Olin 001 Sunday, Monday, Tuesday, and Wednesdays)

It is impossible to be a mathematician without being a poet in soul. – Sofia Kovalevskaya

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Course Description: This second-semester course in calculus focuses on two major topics, both connected under the umbrella of approximation. The first major topic, for us, is infinite series. We will first explore an essential and powerful method to approximate functions (of one variable) by polynomials. Through this study, we are led to the concept of power series, that is, functions defined by infinite sums of monomials. There we will confront some delicate questions surrounding what it means to consider infinite sums of functions (and numbers) and study conditions under which these infinite sums make sense; this is the notion of convergence. The second major topic we will study is multivariable calculus, which is an entire subject in its own right. In this study, we will take the ideas of single-variable calculus into a multidimensional setting (e.g., the real world!) and explore familiar notions of limits, continuity, derivatives and integrals for functions of several variables. We will also discuss several real-world applications of multivariable calculus.

Course Objectives:

- Understand what it means for a sequence to converge and be able to calculate limits of common sequences
- Understand what it means for a series to converge (as the limit of partial sums) and be able to determine whether or not certain series converge using several convergence tests
- Be able to calculate the sum of certain convergent series

- Be able to approximate common functions by their Taylor polynomials and determine the accuracy of approximation (via the remainder)
- Be able to compute the Taylor series for common functions and determine their intervals of convergence.
- Understand and perform basic operations on vectors, including the dot product (for vectors in $\mathbb{R}^n$) and cross product (for vectors in $\mathbb{R}^3$).
- Understand the utility of basic vector operations for doing geometry in $\mathbb{R}^n$, e.g., the computations of angles, areas of parallelograms, volumes of parallelepipeds and equations of planes
- Be able to sketch and interpret graphs and contour diagrams of functions mapping from $\mathbb{R}^2$ to $\mathbb{R}$
- Understand (and be able to define) what it means for a function of several variables to be continuous and differentiable
- Understand and calculate partial derivatives, directional derivatives and gradients of functions of several variables
- Understand and be able to apply the chain rule
- Use the tools of multivariable calculus to solve optimization problems (derivative tests and Lagrange multipliers)
- Understand and be able to calculate double and triple integrals using Riemann sums, iterated integrals and change of variables.

Textbooks:

1. Multivariable Calculus[1] by James Stewart, 7th edition.
2. A Short Book on Long Sums: infinite series for calculus students by (our very own) Professor Fernando Gouvêa.

Grading: Your grade will be calculated as follows:

Class participation:	5%
Weekly homework assignments:	25%
Writing assignments:	10%
Quizzes:	10%
Minimum of Midterms 1 and 2:	10%
Maximum of Midterms 1 and 2:	20%
Final Exam:	20%

Exams: This course will have two midterm exams and a final exam. The midterm exams will be cumulative, though they might have a stronger focus on material presented in the several preceding weeks. The final exam will be cumulative. To do well on exams (and quizzes), you will need to understand the material at a conceptual level. Though you will need to be able to calculate quickly and accurately, the exams will test your understanding of the material at a level which goes well beyond simple computation. The exams will be at the following dates and times:

[1]There are several different options for this book listed through the Colby Bookstore. All are sufficient. Also, if you are happy reading digitally, obtaining a PDF copy will suffice.

Exam	Date and Times	Location
Midterm 1	**October 9th from 7:00-9:00PM**	Keyes 105
Midterm 2	**November 5th from 7:00-9:00PM**	Keyes 105
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.

Quizzes: We will have weekly quizzes administered at the beginning of class on certain Fridays. The quizzes will be limited to one or two problems each and they will parallel, in content and style, the problems seen in the homework. While there are **no** make-up quizzes, your lowest quiz score will be dropped.

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 (your peers, your TAs and me). Consequently, it is crucial that you take homework very seriously. You should start homework early, work diligently and talk to your peers and teaching assistants. If you are having substantial difficulty with a particular problem, please email me or come talk to me during office hours. I am here to help! You are permitted and encouraged to discuss homework with your classmates and to consult other textbooks, however, I discourage you from searching for solutions on the internet – such behavior will only hinder your learning experience. What you turn in must be your own.

Homework Structure and Schedule: Assignments will be posted to the course website and are due at noon on Thursday in the approprate box outside my office door (Davis 209A). It is crucial to keep up with the homework in this course. Therefore, short of the circumstances discussed in the attendance policy above, late homework will not be not accepted. To account for one legitimate illness/absence, your lowest homework score will be dropped on the condition that you attend one Mathematics department colloquium (held on Mondays at 3:30) and write a brief summary (which can be submitted to me via email anytime before the last day of classes).

The homework assignments will generally be broken into two distinct parts. The first part of the homework will consist of problems you should do (and I'll expect you to do) but you needn't turn in. This group of problems will generally be computational in nature and mostly consist of odd-numbered textbook problems. As these problems will not be graded, if you would like help with them or just want to make sure you're doing them correctly, you should (always) feel free to come to office hours (mine or those of the TAs). The second part of the homework will be more conceptual in nature. You are expected to solve and write up all of the problems in the second part of the homework. There is an essential difference between writing up a problem and just writing down the answer. I expect your solution to each problem to be written out correctly and your work should follow a coherent logical structure making use of complete sentences whenever possible. Please do not submit solutions containing incoherent and unstructured calculations. You should be proud of the material you turn in!

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.

4. In the case that I've asked you to use technology in the solution of a problem, please provide a complete printout showing all code, inputs and outputs in sequence, and annotate the printout with comments explaining what is being done in each step.

Writing Assignments/Projects:
In addition to homework, there will be a number of writing assignments/Projects assigned throughout the semester. For these assignments, you will practice mathematical writing while attacking longer and more challenging problems - think of them as mathematical essays. As with the homework, I expect the solutions to the writing assignment problems to be correct, well-written, 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 and follows standard rules of grammar. These are different than homework problems in the following ways: You must work on them individually (with the exception of one group project). There are far fewer of them. For each assignment, you will be able to turn in one draft for feedback and a chance to edit and revise before the assignment's official deadline. Finally, more is required for a perfect grade beyond merely a correct answer. After the beginning of the semester, you will be given a specific write-up concerning these writing assignments, including grading policies and a thorough description of my expectations for them.

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. Absence for religious reasons or for official Colby activities does not count as using a free pass as long as you communicate with me clearly beforehand. Beyond the 4 free passes, absences and excessive tardiness will result in a reduction of your final course grade by up to a full letter grade.

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 a "turn in" homework or writing assignment problem, you must first have spent a considerable amount of time ($\geq$ 30 minuets) thinking

about/attempting to solve the problem. In particular, you must have parsed through the definitions (e.g., know the vocabulary), compared the problem against what we've done in class and similar examples from the textbook, and made an earnest attempt at solving the problem 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).

MA160 Help Sessions: For the duration of the semester, there will be large help sessions held in the evenings (Sunday through Wednesday) and dedicated to MA160. The schedule and locations can be found on the class website. In these help sessions, you will find many MA160 TAs who are able to help you with the course material (these TAs may be from your section or from other sections, but all TAs are available to help). You should plan on attending these help sessions regularly and be ready to ask questions and help/collaborate with your peers.

"One-on-one Help/Tutoring Sessions": With regular office hours and nightly TA sessions, you will have plenty of access to help in this course and I strongly encourage you to attend both office hours and TA sessions regularly. Still, some of you might feel that you would like some additional help and have one-on-one help/tutoring-like appointments. For this, we have reserved some times for you to sign up and meet for 15-minute appointments to get help individually.

To be eligible for an individual TA session you must be in active communication with me and putting forth your best effort in the course. This policy may be modified under special circumstances (e.g. extended absence due to major health issue). When in doubt, talk to me first! To request a one-on-one TA session, read and fill out the form linked here[2]. Soon after, you should be contacted by the professor or a TA to set up an individual meeting. You may request these meetings multiple times throughout the semester.

Note: The math department does not support assigning individual tutors to students; if you think you would benefit from a tutor you are strongly encouraged to request an individual TA session. (But you are welcome to request an individual meeting even if you are doing well in the course and just want to talk with a TA.)

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.

Academic Accommodations: I am committed to creating a course that is inclusive in its design. If you encounter barriers, please let me know immediately so we can determine if there is a design adjustment that can be made. I am happy to consider creative solutions as long as they

[2] `https://forms.gle/kExmxRbUUaYNGDZx9`

do not compromise the intent of the assessment or learning activity.

If you are a student with a disability, or think you may have a disability, you are also welcome to initiate this conversation with the Dean of Students Office. The Dean of Students Office works with students with disabilities and faculty members to identify reasonable accommodations. Please visit their website for contact and other information[3]. If you have already been approved for academic accommodations, please connect within the two weeks of the start of the semester so the office can develop an implementation plan.

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 calculus and learn how to communicate our understanding as thoroughly as we can. Yes, AI systems "know" Calculus. But in the days before AI, other people knew Calculus too. Indeed the only reason AI systems are at all decent at Calculus is because humans taught them both by making their intellectual work available online and by directly teaching the AI calculus (aka "reinforcement learning"). This does not change the fact that humans need to know Calculus, 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

[3] `https://www.colby.edu/studentadvising/student-access-and-disability-services/`

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.