# Math 223 - Multivariable Calculus

Fall 2026

Emily Proctor

212 Warner Hall

Office Hours: M 3:30-4:45pm, Tu 1-2pm, Th 12:30-2:00pm, and by appointment

eproctor@middlebury.edu

## Course Description

Multivariable calculus is the translation of the ideas of single variable calculus to functions of more than one variable. We'll begin by becoming familiar with functions of several variables: what they represent and how to visualize them. From there we will generalize differentiation and integration to higher dimensional settings. We will wrap up the course by touching on a number of theorems that generalize the Fundamental Theorem of Calculus and that can be used to simplify integration in higher dimensions.

## Course Website

The website for this course can be found at:

https://f26.middlebury.edu/MATH0223B/

Here you will find course information, handouts, and homework assignments.

## Text

We will cover most of Chapters 12 through 16 in *Calculus, Early Transcendentals, 9th ed.* by James Stewart.

## Course Objectives

The goals of this course are to help you develop:

- familiarity with and understanding of the concepts, notation, and theory of multivariable calculus,
- the ability to apply your understanding to solve straightforward and complex problems,
- increasing fluidity and confidence with the tools of mathematics,
- skills in collaboration and communication, and
- the confidence that comes with taking ownership of your learning process.

## Course Structure and Homework

Homework assignments will be posted on the course website after each class and are due at the beginning of the following class period.

Doing your homework diligently is the best way to succeed in this course. Math is most easily absorbed in small, consistent chunks. By looking at the material for a little while each day and keeping up with the problem sets, over time you will build intuition for the subject. If you keep a steady rhythm with the homework, you will learn the material well.

Please **write neatly** and **staple your work**. The best way to prepare for tests is to take your homework seriously.

I am here to help! If you have problems with an assignment or with some of the material that we cover in class, please come see me during my office hours. I will be very happy to see you there. The CTLR also hosts a student-run help session for our class on Sunday evenings in the Q-Center in BiHall.

Homework problems are graded on a 0-1-2 scale. A 2 is given for a mostly or totally correct answer accompanied by a complete explanation, a 1 is given if the exercise is attempted but isn't quite right or lacks a complete explanation, and a 0 is given for little or no work shown (even if the answer is correct).

**Please note that late homework will not be accepted.** Late homework will receive an overall score of zero. You may however, hand in homework early if a conflict arises. In order to accommodate unexpected circumstances such as illness, when computing your final grade for the course, I will drop your three lowest written homework scores.

## Exams

There will be two midterms and a final exam for this class. The exams are scheduled for

Tuesday, October 13, 7-9pm

Tuesday, November 10, 7-9pm

Friday, December 18, 7-10pm.

If you have a conflict with either midterm exam date, please see me **two weeks** before the scheduled exam date to arrange to take the exam early. If you become sick shortly before the exam, please go to the health center to obtain documentation.

Note that **vacation plans are not a legitimate reason for arranging an early final exam**. Please plan to be on campus for all exams, including the final.

## Attendance and Etiquette

I expect you to attend all classes. Unless you check with me ahead of time, please arrive on time, put your devices in your bag, and stay in the classroom for the full period. This is an active learning class, so your success in this class will depend on your engagement. Your presence in class also makes a significant contribution to class as a whole.

Your class participation grade will be based on your attentive and active contribution to our class. You can miss up to three classes, for whatever reason (including illness), without penalty. Further absences will have a negative impact on your class participation grade. If you become so sick that you need to miss more than one class in a row, please stay in touch and we will make a plan to accommodate this.

## Honor Code

Since collaboration is a major mathematical skill, I strongly encourage you to work together with your classmates to figure out the homework problems. At the same time, it is important that you receive feedback on your work that is appropriate to your own particular situation. Thus, your final write-up of each homework problem must be your own. The best way to achieve this is to **talk** with classmates while you figure out how to do a problem, then **write** your answer on your own.

Our homework and exams are designed to provide you the direct practice needed to develop your mathematical skills and proficiency. Since the use of AI tools goes counter to this, you are strongly

discouraged from using them for your homework. I expect you to complete exams entirely on your own. All exams will be closed-book and the use of any resources beyond those specifically outlined will be considered a breach of the Honor Code.

## Students with Disabilities

Students who have Letters of Accommodation in this class are encouraged to contact me as early in the semester as possible to ensure that such accommodations are implemented in a timely fashion. For those without Letters of Accommodation, assistance is available to eligible students through the Disability Resource Center (DRC). Please contact ADA Coordinators Jodi Litchfield and Peter Ploegman of the DRC at ada@middlebury.edu for more information. All discussions will remain confidential.

## Grading

I will determine final grades according to the following percentages:

| | |
|---|---|
| Exam 1 | 30% |
| Exam 2 | 30% |
| Final Exam | 25% |
| Homework and Class Participation | 15% |

**Tentative Schedule of Topics**

| Week Beginning | Topics |
|---|---|
| Sept 14 | Three-dimensional space, points and vectors |
| Sept 21 | Dot and cross product, lines and planes, surfaces in $\mathbb{R}^3$ |
| Sept 28 | Vector-valued functions and their derivs, arc length, functions of several variables |
| Oct 5 | Limits and continuity, partial derivatives, tangent planes and linear approximation |
| Oct 12 | (Exam 1) The chain rule (Fall Break) |
| Oct 19 | Directional derivatives, the gradient vector |
| Oct 26 | Extreme values, Lagrange multipliers, double integrals |
| Nov 2 | Changing order of integration, polar integration, surface area |
| Nov 9 | (Exam 2) Triple integrals in rectangular and cylindrical coordinates |
| Nov 16 | Spherical integration, change of variables in integration |
| Nov 23 | Thanksgiving break |
| Nov 30 | Vector fields, line integrals |
| Dec 7 | The FTLI, Green's theorem, curl and divergence |
| Dec 14 | Alternate forms for Green's theorem |