

Math 223 - Multivariable Calculus

Spring 2025

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212 Warner Hall

Office Hours: M 1:30-3:00, Tu 12-1:30, Th 11:30-12:30, and by appointment.

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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:

<http://s25.middlebury.edu/MATH0223B>

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

Text

We will cover most of Chapters 1 through 6 in *Vector Calculus, 5th ed.* by Susan Colley.

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.

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 happy to see you there. The CTLR also hosts student-run help sessions for calculus classes on Sunday, Tuesday, and Thursday evenings in the Armstrong 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. If you are unable to hand in your homework during class time, please bring it to my office in Warner Hall. 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

Monday, March 10, 7-9pm

Monday, April 14, 7-9pm

Thursday, May 15, 9am-12pm.

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** so please plan to be on campus until after our exam.

Attendance and Etiquette

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

Your class participation grade will be based on your attentive, active, and respectful contribution to our class. You can miss up to three classes, for whatever reason, without penalty. Further absences will have a negative impact on your class participation grade. If you get sick and need to miss a number of classes as a result, please stay in touch and we will make a plan to accommodate this.

Honor Code

You may (in fact you are encouraged to!) work together in pairs or groups on your homework assignments. However, the final completion of each of your assignments must be your own. The best way to achieve this is to **talk with classmates** about how to decipher a problem, but **write your answer on your own**. You are expected to complete exams on your own. All exams will be closed-book and there will be no calculators required or allowed.

In a similar vein, the use of any resources beyond those given in the class (videos, notes, handouts, textbook, conversations with classmates or me) is not permitted when completing your homework assignments or exams. Our homework and exams are designed to provide you the direct practice

needed to develop your mathematical skills and proficiency, as well as allow you to receive feedback that is appropriate to your particular situation so that you can learn. Since the use of AI tools (e.g. ChatGPT) goes counter to this, they are not allowed in this course. Use of such tools for any assignment or exam in this course 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 in 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:

Homework	15%
Exam 1	25%
Exam 2	25%
Final Exam	25%
Class Participation	10%

Tentative Schedule of Topics

Week Beginning	Topics
Feb 10	Vectors, dot product, cross product
Feb 17	Planes, cylindrical and spherical coordinates, functions of several variables
Feb 24	Limits and continuity, partial derivatives, the total derivative
Mar 3	The total derivative, chain rule
Mar 10	(Exam 1) Directional derivatives and the gradient, space curves
Mar 24	Spring break
Mar 17	Tangent planes to level surfaces, arc length, operators on vector fields
Mar 31	Taylor polynomials, extreme values
Apr 7	Double integrals, changing order of integration (Spring Symposium)
Apr 14	(Exam 2) Triple integrals, change of variables
Apr 21	Polar integration, cylindrical and spherical integration, line integrals
Apr 28	Line integrals continued, Green's theorem
May 5	Alternate forms of Green's theorem, conservative vector fields, FTLI
May 12	Wrap-up