Math 223: Vector Calculus
Middlebury College, Fall 2015
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Class  MWF 10:10–11:00, Warner 506

Office hours  MW 3:00–4:30
(or any other time I’m free, preferably by appointment)

Text  Marsden & Tromba, Vector Calculus (Sixth Edition)

Course information

Welcome to Math 223! Our goal this term will be to extend our knowledge of differential and integral calculus of one variable to the more general setting of Euclidean space, starting from very basic objects and building toward the fundamental theorems of vector calculus. The topics that we’ll cover this term include: points, vectors, and vector geometry; shapes; mappings; scalar fields and vector fields; limits, continuity and the derivative; the gradient of a scalar field; divergence and curl of a vector field; integration; the Divergence Theorem, Stokes’ Theorem, and conservative vector fields.

We’ll begin the course with a week or so dedicated to gaining a firm grasp on the concepts of the course, with neither coordinates nor computation playing a significant role. This should be a highly interactive part of the semester—be prepared to spend time thinking about and discussing concepts, both within and outside of class (substituting for written homework during this part of the semester), and to come back to class with questions for further discussion. This time spent sorting out concepts and the big picture will be a crucial preparation for the sometimes intricate computations and proofs that the rest of the course will entail.

Equipped with the big picture, the remainder of the semester will be spent delving into the details of coordinates, computation, and proof regarding the concepts we’ve laid out. Problem sets will often be fairly involved, but with a good grip on the concepts that will allow us to put the details into proper perspective.

Class meets three times per week, and all students are expected to attend each meeting of the class. Homework will be collected en masse at the end of the term, with solutions (as well as additional materials for this course) posted on the course homepage.

http://f15.middlebury.edu/MATH0223A
Our text for this course is Marsden & Tromba’s *Vector Calculus (Sixth Edition)*, of which we aim to cover the vast majority; problems from the text will be assigned throughout the term, with solutions to selected problems posted online.

Class meetings

Class meets thrice per week, as detailed above. Do your best to come to class alert, ready to think and ask questions; class time is the time to clear up concerns from your text readings, flesh out the material with examples, etc. Please do not spend your time in class mindlessly copying down what is written on the board; it is much more important to follow along and think, taking minimal notes on key points, which can later be examined and expanded upon as a means of strengthening and checking your understanding.

Keep in mind that the methods of reasoning that motivate and produce what is discussed and written on the board is what you’re after—thus, the majority of what you see on the board should not be viewed as what it is that you are to learn, but rather as the product of what you are to learn. Handouts and online flashcards (on the course webpage) will supplement and/or summarize many of the key definitions and methods, and your text contains proofs of the major theorems that we’ll discuss in class, so your notes should focus on key ideas, methods, concepts, pictures, observations, and examples, not the details of definitions and proofs that can be found elsewhere.

Examinations and grading

Examinations will target concepts, computation, and proof (when appropriate), and course grades will be based upon the following components: three exams during the term (20% each), the final exam (30%), and homework/quizzes (10%). *The Honor Code* will be in effect for all examinations, in class and/or take-home. Succinctly, the policy is that you may use, exclusively: yourself; writing implements; blank paper; and the examination. Any exceptions to this will be explicitly given before the exam.
## Outline of core topics

### Basic objects
- Euclidean spaces; scalars; vectors; points; shapes; vector and scalar fields

### Vector geometry
- Operations on points and vectors; lines and planes; projection

### Mappings
- Mappings; parametrization and pull-back

### Shapes
- Interior and boundary; smoothness; connectivity; stratification

### Differential calculus
- Limits and continuity; the derivative; the Chain Rule

### Fields and derivatives
- Differentiation of scalar and vector fields

### Integration
- Principles and methods

### Maxima and minima
- Principles and methods

### Major theorems
- The Divergence Theorem; Stokes’ Theorem; conservative fields