This semester, we'll develop rigorously the concepts of multivariable calculus, including: linear algebra, total derivatives, partial derivatives, integration, multilinear algebra, and differential forms. This course covers essentially the same material as 18.02, but it does so from a conceptual and rigorous point of view, emphasizing careful reasoning and proofs.

**Textbook**

There will be readings from two books:


Loomis and Sternberg. *Advanced Calculus.*

Neither text is required. The latter, which is much more difficult than the former, is available on the website of the author.
Availability

I will be available in my office for an hour each Tuesday and Thursday after class. You may also make an appointment with me through the Contact section of my website. You may also email me with questions; however, it may take me as many as 24 hours to respond.

Evaluation

I must evaluate how successfully you have acquired the skills and knowledge this course is meant to impart, both so that I know I am conveying the material well and so that you know you are mastering what you'll need for your future work in mathematics. To that end, you will be evaluated on the basis of the following four types of work.

Homework (2/3 of your grade)

There will be exercises due each Friday, beginning in week 2. The exercises will be posted on the course website, at least a week before the due date (always Friday). You are asked to complete each exercise carefully and neatly, and to turn the exercises into the appropriate box in the Math Academic Services office (E18-366) by 2 PM on each Friday. They will be returned to you, graded, during recitation.

These exercises form the most important component of the course; you will learn most of the material while completing these exercises.

On average, you may expect to be assigned 10–12 exercises each week, of the following two types. Seven or so of these will be “boilerplate,” meaning that you will not have to have a significantly new idea to perform the exercise; these exercises are intended to demonstrate the utility of the concepts and theorems we have covered, and they will be needed to follow the content of the course. (Note that “boilerplate” does not mean “trivial.”) Approximately 3 of these exercises will be “starred,” meaning that a significantly novel idea will be required to complete the exercise.

The exercises will be sequentially numbered; in all you may expect to be assigned around 120 exercises.

Clarity and neatness do count. Your solutions should be final, coherent, and easy to read. Illegible or sloppy work will not be graded, and you will be granted a 5 percent bonus on your work if it is either typed using the \LaTeX document preparation system or written very carefully and legibly.

You are encouraged to work in groups, but there are three guidelines you should follow:
— *Write the solutions yourself.* Papers with multiple authors will not be accepted, as I need to be able to evaluate your proof-writing abilities individually.

— *Give credit where credit is due.* If the key idea for a proof or a computation is someone else’s, indicate this clearly. For instance, you may write, “This argument is due to G. Jetson,” or “This was explained to me by W. Flintstone.” It is common in research to borrow ideas, but it is important that they be correctly attributed; otherwise this practice is indistinguishable from *charlatanism*.

— *Contribute.* Please do not take advantage of your intelligent but meek friends’ tolerance. Be sure that you are making a genuine contribution to the group’s work. If you are not, please find another group. Sponges cannot learn as much material as those who put forward consistent effort.

**Presentations (1/6 of your grade)**

Many of our Fridays during the semester will be reserved for in-class presentations. There will be six of these throughout the semester. I will ask some of you to present your solution to a recent homework problem. (Eventually everyone in the class will present a number of times.) Your colleagues and I will also ask you various questions during your presentation. The purpose of this is twofold: first, you will learn to present mathematical ideas effectively and comfortably in a public environment, and second, you will have the opportunity to hear other perspectives and approaches toward the material.

**Final exam (1/6 of your grade)**

There will be a final written exam at the end of the semester, during which you will be permitted to use books, class notes, and your homework solutions. The date will be announced later.
Policies

My operating assumption will be that I am working with motivated, intelligent adults who will treat one another with respect and courtesy. This plays out in a variety of ways:

— The difficulty of the material, combined with the differences in skills of your colleagues, can engender frustration. To some extent, this is to be expected. Do not permit that frustration to get in the way of your education, or the education of your colleagues.

— It is impossible to impart the entirety of the knowledge you are expected to acquire in this course during lectures. You should expect the bulk of your learning to result from the reading and from the exercises you will perform.

— Please do not hesitate to provide me with appropriate, timely feedback. My lectures are interactive, and my pace is determined in part by the responses I get from students. If the course is moving at a pace or in a direction with which you are uncomfortable, please do not wait until your head explodes (either from confusion or from boredom) before speaking with me.

Lecture plan for the semester

A lecture plan will be provided on the course website, along with various due dates. This information is only an outline; there may be cause to go faster or slower through the material. I estimate the margin of error for the list of topics to be about two lectures, and there are days scheduled at the end of the semester for this error.