

THE COURSE

Advanced Calculus

Meets in VinH 207 for 2 hours on TuTh (11:15-1:10)? and for 1 hour MWF (12:20-1:10)?.

INSTRUCTOR

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Office Hours: 12:20 - 1:05 MWF; "on demand": just after class TTh.

TEXT

The Way of Analysis, by Robert S. Strichartz, (revised edition)
paperback; Jones and Bartlett, 2000; ISBN 0763714976

MATERIAL COVERED Chapters 1 – 10, hopefully some of Chapters 12 and 13.

We'll begin with some symbolic logic – it gives us our basic language for definitions, for stating theorems, and for analyzing mathematical statements. We will continue with basic ideas about sets, set operations, and mathematical logic & sets, which involves variables and quantifiers. Most of this material is in sections 1.1–1.2. Section 1.3 is very important – I suggest you keep rereading it.

Then we'll quickly (and lightly) cover Chapter 2 of the text, on Real Numbers. I'll post Real Number Axioms on the Web. They're not exactly the same as the ones in the text, but they are all in one place. The text does not need the Completeness Axiom because it is actually a Theorem (Theorem 2.3.1) there. We will *assume* completeness, and then we can prove Theorem 2.3.1, based on our assumption.

The stuff on Completeness, together with proofs, is the big difference between Calculus and Advanced Calculus. The course might be sub-titled "The Rôle of Completeness in Calculus." A more colloquial version: "getting used to *sup* and *inf*."

By the time we're done with Chapter 2 you should be getting familiar with the structure of "proving."

Chapter 3 will be partly review and partly new. The new material will make use of Completeness.

Chapters 4 thru 6 don't use Completeness explicitly as often as the earlier chapters do. That's because in those chapters we can use Theorems proved earlier to get our results. So Completeness is still used, but often indirectly. These chapters redo many Theorems you're familiar with.

Chapter 7 quickly reviews sequences and series of numbers – and introduces Complex Numbers. Series are really sequences of partial sums. Then series of functions (this might be new to you) extend these ideas to functions, the most important case being power series. We may not cover all of Chapter 7.

Chapter 8 is about the important Calculus functions *exp*, *log*, *sine* and *cosine* (and related functions derived from them). They all come in some way from the complex exponential function.

I will try to sneak stuff from Chapter 9 into the class as we go, so we won't have to spend a lot of time there. Maybe we can approach Chapter 10 the same way. We'll see.

The point of this course is to bring you from "where you are," mathematically (possibly somewhere in the seventeenth or the eighteenth century) to the early twentieth century. The seventeenth and eighteenth centuries saw the invention and much of the development of Calculus and its applications. The idea of *proof*, and thus a deeper understanding, was developed in the next two centuries. We will be working on extending your knowledge of Calculus so that you can understand proofs in Calculus, and produce proofs yourself. This will require getting to know the Real Numbers. I hope you will learn a lot, and enjoy doing so!

GRADING

Your grade will be based on frequent 25-minute Quizzes (at least one per week), Homework Problems (from the text, scored by a papergrader), Special problems (scored by me) and a Final Exam. Assignemnts will be posted on the Web, in PDF format.

Each Quiz may involve material covered in lectures up to the Quiz. Thus, you are responsible for material covered in the lectures!

Your grade in this course will reflect what you did in it, not your ability or potential. It is very important, then, for you to be able to put your work on paper, under time pressure. If you have problems taking tests, there are people on campus who might be able to help you overcome them. Ask about it at an office hour!

You'll have a GPA grade for each Quiz, your total Homework score, your total Special Problem score, and the Final. The weighting of the grades, though subject to change, is, at present: 30% for Quizzes, 20% for homework, 15% for Special Problems, and 35% for the Final. Grades will perhaps amount to 80–85% for A, 65–70% for B, 50–55% for C, 40–45% for D.

Each grading item will have “Gradelines” assigned to it. For example, if the B gradeline is 70, the A gradeline is 85, and your score is 80, then your GPA grade, G , for that item is $G := 3 + \frac{80 - 70}{85 - 70} = 3.67$ (rounded to 2 places). In other words, your GPA grade is B, plus $2/3$ of the way between B and A. Your GPA grade, G , on any grading item is computed using your score on it, and numbers g (the grade corresponding to the highest gradeline smaller or equal to your score), glb (the highest gradeline smaller than or equal to your score), gla (the lowest gradeline greater than your score):

$$G = g + \frac{\text{your score} - glb}{gla - glb}$$

where glb is the gradeline just below your score,

gla is the next gradeline - above your score,

and g is the grade number: 5 for a 100% score, 4 for the A gradeline, 3 for B, etc.

If your score falls on a gradeline, then $G = g$. If your score is 100% on a Quiz, etc., your $G = 5$.

When the G are combined, multiplied by weights, and added, the result is your GPA grade for the course. If your total is within 0.025 of one of the University of Minnesota's official GPA numbers that define one of the valid letter or letter-plus-or-minus grades, your grade is “borderline.” Case-by-case decisions are made then, whether to award the higher or the lower grade. One important factor is the direction your grades have taken at the course's end.

Be sure to talk to me in advance if you have to miss a Quiz! If you do miss a Quiz, and you don't make arrangements in advance, your G for that Quiz is zero! **You need documentation for makeups!**

If, for **documented** reasons beyond your control, you're passing and you can't complete the course, your grade up to that point may “stay with you” as part of an Incomplete; all I's must be issued according to department guidelines.

SCHOLASTIC CONDUCT

Please read the (appropriate for you) notices in the IT Bulletin, the CLA Bulletin, and so on. You are encouraged to work with others in understanding what problems say, setting up solutions, and so on. If you get ideas from a reference *or from someone else*, GIVE CREDIT! You must submit as YOUR work only what YOU have written up yourself: DON'T COPY! Graders will be asked to bring answers that look alike to my attention. If I encounter identical answers, I give the points to the first paper I encounter, and zero to the others.