Advanced Calculus of One Variable (Math 317)

Spring 2017

Technicalities

Instructor: Dr. Clayton Shonkwiler (clay@shonkwiler.org)
Office: Weber 216
Course web page: http://shonkwiler.org/317
Text: *Elementary Analysis: The Theory of Calculus*, by Kenneth A. Ross
Time/Location: 2:00–2:50 MTWF, Engineering E205.
Office Hours: Tuesday 1:00–2:00, Wednesday 1:00–2:00 and 3:00–4:00, Thursday 2:00–3:00, and by appointment.

Summary of the Course

The goal of this course is to develop the theory of real numbers, limits, continuity, differentiation and integration. These are the same concepts that a typical calculus course (like Math 160/161) deals with, so hopefully you already have an intuitive understanding of them. However, in this course we want to get a little more serious and replace intuitive notions with rigorous definitions, give careful proofs of theorems that get taken for granted in calculus classes, and develop an abstract framework for understanding it all.

In particular, we will try to make sense of the following:

- What are the real numbers?
- What is the limit of an infinite sequence? How can we make sense of infinite series?
- What is the structure (i.e. topology) of the space of real numbers and how can we use that structure to understand functions?
- What does it mean for a function to be continuous? What properties do continuous functions have (e.g. Extreme Value Theorem, Intermediate Value Theorem)?
- What is a derivative? What is an integral? What's the relationship between them (e.g. the Fundamental Theorem of Calculus)?

In order to address these issues with precision, you will need to develop a better understanding of and a greater facility with mathematical language. Internalizing this language and learning to write correct and convincing proofs will be a major focus of this course. To that end, we will discuss how to make sense of mathematical definitions and statements and work through strategies and techniques for analyzing and constructing proofs.

If you skimmed the above, please make note of the following: **this is a proofs-based course intended for mathematics majors and others with a serious interest in understanding the *why?* of mathematics, not just the *what?***

Homework

Homework will be collected on an approximately weekly basis. Assignments will be posted to the course webpage as well as to Canvas.

Some problems on each assignment will be graded for completeness: if you made a serious attempt at the problem, you will receive full credit. The rest of the problems will be graded for

correctness, on the following basis: each problem graded for correctness is worth 5 points, with the points divided between content (4 points) and exposition (1 point). Any problem with a score of 3 or below may be re-written and re-submitted *with your original solution* within one week of the original due date. The average score will be recorded. The grading scale for content points is:

4 points: A completely correct solution.
3 points: A solution demonstrating a good understanding of the problem, but with some minor mistakes or omissions.
2 points: An attempted solution which is incorrect due to a significant error, but which employs a reasonable strategy.
1 point: An attempted solution which contains the beginnings of some good ideas.
0 points: Not a serious attempt at a solution.

The point for exposition will be awarded for solutions which exhibit both clear writing and clear organization. You should write each solution so that a fellow-student can understand it.

Homework must be stapled with your name clearly written at the top. What you turn in should be a final copy: it should be neat, legible, and well-organized. If I can't read or understand your work you won't receive any credit.

Late homework will not be accepted, so you should turn in whatever you have completed on the due date in order to get credit for it.

I strongly encourage you to work on solving homework problems with your fellow classmates. However, the work you turn in must reflect your own knowledge and understanding and not that of anyone else. Therefore, you *must* write up your solutions by yourself.

Exams

There will be two midterm exams and a final. The midterms will be 50 minute in-class exams and are tentatively scheduled for **February 17** and **March 31**. The final exam will occur in Engineering E205 (our regular classroom) from **11:50–1:50 on Tuesday, May 9**.

Make-up examinations will only be given under extraordinary circumstances, which must be appropriately documented (by, e.g., a medical or legal professional). Please let me know as soon as possible if participation in a university-sanctioned event will cause a conflict with one of the exam dates.

Grading

Your final grade in the course will be determined by:

Homework and Class Participation: 30%
Exams: 20% each
Final Exam (comprehensive): 30%

Here's how the grading process works. First, I compute an overall course grade for you on a scale of 0–100 by combining your exam and homework grades using the weights above. For example, if you have scores of 75% and 80% on the two midterms, 85% on the final, and 90% on the homework and class participation, I would compute this score as

$$\underbrace{0.75 \times 20 + 0.80 \times 20}_{\text{midterm exams}} + \underbrace{0.85 \times 30}_{\text{final}} + \underbrace{0.90 \times 30}_{\text{homework}} = 83.5.$$

After computing the above score score, I rank everybody in the class in order by their score and assign cutoffs for 'A', 'B', 'C', and 'D'. Generally these are somewhat lower than the traditional 90, 80, 70, and 60. When setting the cutoff I consider the students immediately above and below the line and try to take into account improvement and other circumstances. That being said, the list is never, ever reordered. Regardless of other circumstances, a better score in the class should always earn at least as good a letter grade. Ultimately, I can only grade the course based on what's in your written work.

Scores will be maintained on Canvas (`http://canvas.colostate.edu/`); please check occasionally to make sure your scores have been entered correctly.

Attendance

You are expected to attend class every day, to participate in class, to read the textbook, and to do the homework.

Academic Integrity

As a Colorado State University student, you have agreed to abide by the University Policy on Academic Integrity (see University Policies → Students' Responsibilities → Academic Integrity/Misconduct in the General Catalog `http://catalog.colostate.edu/general-catalog/`) and by the Student Conduct Code. Please see `http://tilt.colostate.edu/integrity/` for more on academic integrity at CSU. All academic work must meet the standards described in the Academic Integrity Policy. At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services.

Lack of knowledge of the academic honesty policy is *not* a viable explanation for a violation. Questions related to coursework and the academic integrity policy should be discussed with the instructor.

You are encouraged to *discuss* homework problems with your classmates, but the work you turn in must be your own, and in particular you should write up your final solutions independently. Remember that for all work in this course, the CSU honor pledge applies: "I have not given, received, or used any unauthorized assistance."

Additional help

If I were a perfect teacher, you could learn everything you need to know just by going to class and doing the assignments. Unfortunately, I am not a perfect teacher, so there's a good chance that, at some point, you'll find yourself confused, stuck or otherwise frustrated by the material or the course. If you do, ask for help! Office hours are, of course, an excellent venue for this, but if you feel uncomfortable asking my help or if you find that my teaching style and your learning style simply don't mesh, there are many other resources available to you.

First and foremost, your fellow classmates are a great resource. Odds are that, for any question you have, there's someone in the class who can answer it, so don't be afraid to ask. Even the simple process of explaining why you're stuck to someone who is just as confused as you is often enough to make things clearer. Just be sure to return the favor when you get the chance to help someone else.

Also, the math department maintains its own list of recommended private tutors (typically graduate students): `http://www.math.colostate.edu/courses/Tutoring/tutoring.shtml`.

If none of the above is suitable or practical, please let me know and I'll be happy to help you find additional resources.

Accommodations

If you think you may need accommodations in this course due to the impact of a disability please meet with me privately during the first week of class. You should also contact the Resources for Disabled Students office (`http://rds.colostate.edu`) to confirm your eligibility for appropriate accommodations. Doing so early in the semester will help prevent unnecessary inconvenience.

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Disclaimer

The course syllabus is a general plan for the course; deviations announced in class may be necessary.

Anticipated Schedule

Week	**Subjects (Sections from the text)**
01.17–01.20	The real number system (§1–5)
01.23–01.27	Limits of sequences (§7-9)
01.30–02.03	Monotonicity and subsequences (§9–11)
02.06–02.10	Subsequences (§11–12)
02.13–02.17	Series (§14–15) **MIDTERM #1**
02.20–02.24	Continuity (§15, 17)
02.27–03.03	Uniform continuity (§18–19)
03.06–03.10	Functional limits and power series (§20, 23)
03.13–03.17	SPRING BREAK
03.20–03.24	Convergences of power series (§24–25)
03.27–03.31	Differentiation (§26, 28) **MIDTERM #2**
04.03–04.07	Differentiation Theorems (§28–29)
04.10–04.14	Approximation and the Riemann integral (§30–32)
04.17–04.21	Integration (§32–33)
04.24–04.28	The Fundamental Theorem of Calculus (§33–34)
05.01–05.05	Applications and Conclusion
05.09	**FINAL EXAM at 11:50 AM**