Math 381: Real Analysis **2020**
Real Analysis with Real Applications, Davidson and Donsig
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Course Objectives: *Continue to learn how to do mathematics!* Mathematics is a problem-solving discipline, and we all have room to improve. To develop as problem-solvers, we must focus on technique and not on memorization. In this course, we focus on the basics of calculus, this time with an emphasis on precise details. How can we prove that the techniques we use in calculus are correct? More importantly, when are these techniques not valid? We will look at some very unusual functions that we can analyze but that defy intuition and the basic techniques learned previously. We take a step into the world of mathematics, where definitions and logic rule!

Intended Learning Outcomes: At the end of the course, successful students will be able to

- Use definitions of calculus terms to solve problems and contrast with other terms
- State important calculus theorems and know when they are not valid
- Use proof techniques to progress from one calculus result to the next
- Apply calculus definitions to complicated functions of theoretical interest

Attendance Policy: Attendance and attention in class is essential! Work hard in class and you will have little need for studying the night before a test. You are responsible for everything done in class, through attendance and sharing class notes with classmates. If you miss a class, e-mail or call me before class is over and explain why. With the first unexplained absence, you and your advisor and the registrar will be warned that another unexplained absence will result in removal from the course. **If you have two unexplained absences, you will be dropped from the course.**

Equipment: We will use Mathematica for some messy calculations, but mostly you will be using your brain and lots of pen and paper to work and rework problems. When working on a proof, it is very hard to tweak a mistake – start over and make sure the logic is correct.

Individual and Group Homework: There will be nine homework sets, typically due on a Monday. Work each of the "individual" problems. Fridays are typically reserved to work on problems – ask questions of me and each other, but write up the problems on your own. The group problems will either be done in pairs or individually with groups assigned. Each group will work one of the group problems – problems will be "drafted" in class. Turn in one problem with both names on it.

Quizzes: Every class, other than test days, will start with a brief 5-minute quiz. The quiz ends at 1:15, so get to class on time! Quiz topics will typically be statements of definitions or named theorems. These are the basic elements of understanding Real Analysis, so commit to learning these like you would a calculus derivative formula. Given the precise nature of mathematics, a small change in language can change the meaning of a statement, so be careful if you paraphrase a definition or theorem. You will be graded on a scale of 0 (not turned in) to 3 (perfect).

Applications: Although the focus in this course is on definitions and proofs, there are a number of accessible "applications" of real analysis to explore. Choose your group of two or three and then choose your topic from a small list that will be provided (or propose your own topic). The application should be nicely developed in a paper and brief class presentation.

I expect you to spend at least 12 hours of work each week inside and outside of class.

Co-Curricular: During the course of the semester, you must attend at least three co-curricular events approved by the MCSP department. For each, write a two-paragraph reflection paper, giving a brief summary of the talk and expanding on some aspect of particular interest to you. Reports are due within a week of the talk. One report must be turned in before fall break.

Tests: There will be three tests and a final exam. Each test will have an in-class portion and a couple of take-home problems. Test dates are F 2/7, F 3/13 and W 4/8. The final exam is Monday, 4/27, at 2:00.

Make-ups: In case of sickness or scheduling conflicts, get in touch with me ASAP.

Academic Integrity: The college policy is fully supported. Tests are closed notes, closed book unless noted. Electronic devices other than computers are not allowed in test situations, and computers may only be used for computation purposes in Mathematica.

Grading:

Quizzes: 10%	Homework: 24%
Application: 12%	Participation: 6%
Tests: 36%	Exam: 12%

Grades may be curved up based on extenuating circumstances, including improvement as the semester goes on.

A: 93-100 A-: 90-92
B+: 87-89 B : 83-86 B-: 80-82
C+: 77-79 C: 73-76 C-: 70-72
D+: 67-69 D: 63-67 D-: 60-62
F: 59 and below

Community: Welcome back to the mathematics community! I hope you will take advantage of the opportunities available in our department. You may get to know us and other students in the MCSP Study Room (Trexler 271) which is near most of the faculty offices. There is an active Math Club and there is a weekly department tea, which is an informal time to chat, play games, and eat cookies (and drink tea, if you like). Ask me for more information on these and other opportunities such as Stat Crew.

Math 381 Schedule

Date	Sections	Topics	Individual	Group
M 1/13	**2.3**	**Limits of Sequences**	**Abe, C, Ea**	**D, F**
W 1/15	**2.4**	**Basic Properties**	**A, Bb**	**C, D, I**
M 1/20	**2.5**	**Bounds**	**A, B**	**G, H**
W 1/22	**2.6**	**Subsequences**	**A, D**	**G, J, K**
M 1/27	**2.7**	**Cauchy Sequences**	**A, D**	**G, H**
W 1/29	**2.8**	**Cardinality**	**A, C**	**B, E, F**
M 2/3	**3.1**	**Convergent Series**	**A, B, D**	
F 2/7	**TEST**			
M 2/10	**3.4**	**Conditional Convergence**	**A(5&5), C**	**E, I**
W 2/12	**4.1**	**n-Dimensional**	**A, C**	**D, F, I**
M 2/17	**4.2**	**Convergence**	**A, B**	**C, H**
W 2/19	**5.1**	**Continuity**	**A, C, M**	**G (n=m=1), H**
M 2/24	**5.1**	**Continuity**	**handout**	
W 2/26	**5.2**	**Discontinuous**	**C, handout**	

SPRING BREAK

Math 381 Schedule

Date	Sections	Topics	Individual	Group
M 3/9	5.4	Extreme Values	A, B, F	H, I
F 3/13	TEST			
M 3/16	5.5	Uniform Continuity	Handout	A, F
W 3/18	5.6	Intermediate Value	A, D	G
M 3/23	6.1	Differentiability	A, B, C	D, E, O
W 3/25	6.2	Mean Value Thm	A, B, D	Iab, L
M 3/30	6.3	Integration	B, C, D	G, I, M
W 4/1	6.4	Fundamental Thm	Handout	B, Ca
W 4/8	TEST			
M 4/13	Applications			
W 4/15	Applications			
F 4/17	Applications			
M 4/20	Group Presentations			
M 4/27	Exam 2:00			

Math 381 Information Sheet

Name:

Email:

Cell phone:

Major(s):

Hometown:

List the math/stat course(s) you took last year.

How hard do you expect real analysis to be? How interesting?

Why is calculus important?

What are some of the co-curricular or other campus activities you would like to participate in this year?

Group Schedule

	TB	AD	JJ	JL	RL	OL	BP	SP	SR
TB	3	6	5	8	7	9	2	1	4
AD	6	5	8	7	9	2	1	4	3
JJ	5	8	7	9	2	1	4	3	6
JL	8	7	9	2	1	4	3	6	5
RL	7	9	2	1	4	3	6	5	8
OL	9	2	1	4	3	6	5	8	7
BP	2	1	4	3	6	5	8	7	9
SP	1	4	3	6	5	8	7	9	2
SR	4	3	6	5	8	7	9	2	1