Course Documentation for Spring 2022 Math 325-002

Elementary Analysis

TR 11:00-12:15pm, Burnett Hall 121

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Office:	Avery Hall 306
Office hours:	Tuesdays 12:30-1:30pm after class (and by appointment)
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Overview

Analysis. Analysis is the wellspring of much of modern mathematics. It studies (very carefully) the properties of the real numbers, and of functions taking real values. There are some surprises lurking (enough to trip up several generations of the world's best mathematicians) and the careful resolution of these difficulties was simultaneously one of the crowning mathematical achievements of the 19th century, and the foundation for the 20th century's mathematical flowering.

We will start by developing a clear understanding of the real numbers (which will require us to solidify our understanding of rational numbers also) and then progress to studying the behavior of real-valued functions. Throughout the course we will be working on developing the skills crucial to a young mathematician—those of reading and writing proofs. These activities lie at the heart of mathematics.

Themes. Throughout this course, we will practice:

- Understanding the rigorous foundations of functions, derivatives, and integration
- Connecting visual heuristics with formal argument
- Writing clear, logical, rigorous proofs

Course requirements

Weekly Homework (270 points). This course has regular homework and it will be carefully graded. I expect to collect homework once a week, mostly on Thursdays. There will be two kinds of homework questions. Most will be graded in the usual way, with partial credit for partially correct reasoning.

Homework is typically scored out of 20 points each. If the homework does not total to 270 points, it will be scaled out of that many points (i.e., your total will be multiplied by $\frac{270}{\text{maximum possible weekly homework points}}$).

Mastery Homework (40 points). Other questions on the homework will be graded for mastery. You will not get credit until you have written a correct proof. Responses to these questions can be submitted until you get credit for them, but not exceeding 1 month after it is assigned. The reason for the 1 month deadline is that proof communication is essential for this course (and mathematics), and I would like to provide incentive for you to improve these skills, and for us to work together on them, within an amount of time that you can use these skills for as much of the course as possible.

Mastery homework is typically scored out of 5 points each. If the mastery homework does not total to 40 points, it will be scaled out of that many points (i.e., your total will be multiplied by $\frac{40}{\text{maximum possible mastery homework points}}$).

Midterm 1, 2, 3 and Final Exams (100 + 100 + 100 + 150 points). There will be three midterms and one final exam. They are scheduled as shown below in Course Timeline. The midterms take place in class, and they will typically have a take-home component due the next course meeting. Each take-home component will be worth 20% of the total midterm to which it is associated.

Required Materials

Main Reference. Abbott, S. (2016). *Understanding Analysis.* New York, NY: Springer.

Google Drive. We will have a course Google Drive on which notes and supplemental materials will be posted. Please make sure you can access this drive.

https://tinyurl.com/UNL325Spring2022

(The tinyurl points here: https://drive.google.com/drive/folders/1zZ1x-w7gzjwXi17fcgMoB5AAJWVt-0-M)

Course Timeline (approximate)

Week	Ch.	
W1, Jan 17-21	§1.2	Mathematical statements, quantifiers, and negation; set notation; equivalent statements. Proof techniques; good proof communication. (See: http://www.math.toronto.edu/preparing-for-calculus/3_logic/logic.html)
W2, Jan 24-28	§1.1-1.4	Induction. Archimedean Principle. Existence of square roots. Completeness. Infimums, supremums.
W3, Jan 31-Feb 4	2	Limits and limit theorems of sequences, Monotone and Cauchy sequences.
W4, Feb 7-11	2	Subsequences, lim sup and lim inf. Series. Open and closed sets in $\mathbb{R}$ (§3.2).
Thursday, Feb 11 : Exam 1 : Material from Weeks 1-3		
W5, Feb 14-18	4	Continuous functions and their properties
W6, Feb 21-25	4	Limits of functions, Uniform continuity
W7, Feb 28-Mar 4	5	Derivatives
W8, Mar 7-11	6	Power series, Uniform convergence, Weierstrauss's Approximation Theorem
Thursday, Mar 10 : Exam 2 : Material from Weeks 4-7		
March 13-20, 2022 : Spring Break		
W9, Mar 22-25	6, 7	Mean Value Theorem, Taylor's Theorem
W10, Mar 28-Apr 1	7	The Riemann integral and its properties
W11, Apr 4-8	7	Fundamental Theorem of Calculus
W12, Apr 11-15	8	Improper integrals
(Week 14) **April 14 : Exam 3 : Material from Weeks 8-11**		
W13, Apr 18-22	7	Exponents and Logarithms
W14, Apr 26-29	7	The constant e
W15, May 2-6	7	Continuous nowhere but differentiable functions
Tuesday May 10: Cumulative Final Exam: 3:30-5:30 p.m. Location: Our Regular Classroom		

Departmental and University Policies

Course Evaluations. The Department of Mathematics course evaluation form will be available through Canvas during the last two weeks of class. Evaluations are anonymous and instructors do not see the responses until after final grades have been submitted. Evaluations are important – the department uses them to improve instruction. Please complete the evaluation and take the time to do so thoughtfully.

Academic Honesty Policy. Please see Student Code of Conduct, Section B. Conduct – Rules and Regulations, 1. Acts of Academic Dishonesty.

Accommodations for Students with Disabilities Policy. The University strives to make all learning experiences as accessible as possible. If you anticipate or experience barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can discuss options privately. To establish reasonable accommodations, I may request that you register with Services for Students with Disabilities (SSD). If you are eligible for services and register with their office, make arrangements with me as soon as possible to discuss your accommodations so they can be implemented in a timely manner. SSD contact information: 232 Canfield Admin. Bldg.; 402-472-3787.

Participation in pandemic times. This class builds your knowledge through listening, writing, and speaking mathematics. Given current CDC guidance and the current transmission level of COVID-19 in our community, I respectfully request that you join me in wearing a face covering during our classes, particularly when we are working in close proximity.

Grading Appeals Policy. The Department of Mathematics does not tolerate discrimination or harassment on the basis of race, gender, religion, or sexual orientation. If you believe you have been subject to such discrimination or harassment, in this or any other math course, please contact the department. If, for this or any other reason, you believe your grade was assigned incorrectly or capriciously, then appeals may be made to (in order) the instructor, the vice chair, the Department grading appeals committee, the College of Arts and Sciences grading appeals committee, and the University grading appeals committee.

Assessment Criteria

You have the potential to earn 760 points through the activities of this term.

A course grade of A in this course is likely to result from 93% or higher of these 760 points, an A^- from 90% to 93%, a B^+ from 86% to 89%, B from 83% to 85% etc. An $A+$ is reserved for exceptional, sustained performance. Point potentials are summarized below.

Point potentials for Spring 2022 Math 325-002

Homework		
Weekly homework	270	**310 points**
Mastery homework	40	
Exams		
Midterm exams	100 + 100 + 100	**450 points**
Final exam	150	
Total		**760 points**