Course Syllabus: Math 3500A
Analysis I
Department of Mathematics and Computer Science
University of Lethbridge, Fall 2014

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Office: UHall C530 **Course website:** via moodle.uleth.ca
Office hours: M 3:30-4:30 pm, TR 2:00-3:00 pm, WF 10:30-11:30 am
Lectures: MWF, 2:00-2:50 pm in UHall D634

Course Description

From the calendar:

> Rigorous treatment of the notions of calculus of a single variable, emphasizing epsilon-delta proofs. Completeness of the real numbers. Upper and lower limits. Continuity. Differentiability. Riemann integrability.

Basically, this course represents a return to the material introduced in Calculus I and II. However, in the Calculus sequence, the knowledge and skills obtained are mostly procedural - these courses are concerned with answering how: how to take a derivative using the chain rule, how to do integration by parts, etc. In Analysis, we're more concerned with the reasoning underlying the procedures: what is the precise definition of the limit, and why is it necessary (or correct)? What is special about the real number system, and why does it make calculus possible? A physicist or an engineer might consider the procedures of calculus justified because they produce the right results. For a mathematician, the justification is more abstract: we want to ensure that the rules of calculus are logically consistent and follow rigorously from our basic assumptions about the real number system.

Course Objectives

This course is intended to provide you with a deeper understanding of the theory of calculus. For those of you majoring in the sciences (especially math, stats, and physics) this course provides your first encounter with some of the essential tools needed to analyze problems, prove theorems, and understand highly technical results. Much of analysis is concerned with obtaining rigorous error estimates, which is a useful skill in many areas. For education students in the course, the assumption is that many of you will find yourselves teaching high school mathematics, including calculus. The goal for this course is for you to get a feel for what is going on "under the hood", placing your curriculum in a broader context and allowing you to have answers ready whenever you run into a smart-ass kid who thinks they already know all the answers.

Required Textbook:

Analysis With an Introduction to Proof, 5^{th} ed. by Stephen Lay.

Note: This is a decent textbook, especially for those of you who are a bit unsure of your ability to write a good proof (in particular, of the ϵ-δ variety) but it's really expensive. In my defense, the book had already been ordered before I was assigned to the course. If you want to save some money by getting an older edition, feel free. I will write out assignment problems rather than providing textbook references, so you won't need the book to do assignments. On the other hand, I will be more or less following the outline of the book, so you'll probably at least want occasional access to a friend's copy. If you want to take your chances and go it alone without the text, I'll provide a list of alternatives on Moodle, including a few books available as free e-resources through the library. Note however that most other analysis texts, even "introductory" ones, assume a certain amount of mathematical sophistication on the part of the reader; in other words, they expect you to be able to figure out a fair bit on your own.

Evaluation

Your grade will be determined according to the following table (see below for explanations of each component):

Component	Assignments	Papers	Tests	Final
Weight	30	10	20	40

Exceptions: The current weighting is 60% coursework, 40% final. If you do better on the final than on your coursework, I'll reverse this weighting (40% term, 60% final).

Assignments:

Assignments will be due on the Friday of every week in which there is no term test or paper due. I will post the assigned problems to Moodle at least one week in advance. There will be 9 assignments in total, and your grade will be based on the best 6 out of 9 assignments. **Note:** Since you get to drop your three worst assignments, I will not grant extensions or makeups for assignments.

Term tests:

There will two in-class term tests, written on **Monday, the 6$^{\text{th}}$ of October** and **Monday, the 10$^{\text{th}}$ of November**. There will not be any make-up tests. If you miss a test due to illness or athletics, I will add the value of the test to the final exam.

Papers:

I will be assigning two writing projects, worth 5% each. The first will be on a set topic, with specific guidelines, and is due on Friday, the 26$^{\text{th}}$ of September. (Essentially, it'll be an extended assignment, but you'll have to focus on using complete sentences.) The second will be on a topic of your choice, as long as it's related to the course. (Historical and applied topics are acceptable.) The second paper will be due on Wednesday, the 3$^{\text{rd}}$ of December (the last day of class).

Participation:

Participation is not required in this course, but is strongly recommended. I will provide two different ways to interact online:

1. Piazza. Piazza is a Q&A forum, which we're using because it integrates with Moodle, has great support for math symbols, and if you're shy about posting a question or answer, you have the option of doing so anonymously (to your classmates). Piazza can be used to discuss any problem, but please post only hints for problems that are assigned for credit.

2. PeerWise. I'm adding this site with education students in mind, to get you thinking about creating good questions. PeerWise lets you collaborate on creating multiple choice questions. You get to create your own questions and comment/vote on existing ones. The idea here is for you to think about the course material, and decide on what would make a good question, as well as what likely wrong answers might be. Apparently you can earn badges and stuff for good questions. As added incentive, I might choose a few of my favourite questions for inclusion on the term tests.

Letter grade conversions:

The percentage grades earned in this class will be converted to letter grades according to the following table:

Letter grade:	A^+	A	A^-	B^+	B	B^-	C^+	C	C^-	D^+	D	F
Minimum % required:	95	85	80	77	73	70	67	63	60	55	50	0

Course policies

Lecture:

For our Monday and Friday classes I will follow a fairly standard lecture format. I've included a tentative schedule of topics at the end of the syllabus as a guideline for keeping up with the readings. I strongly recommend reading the relevant section *before* each lecture. Wednesday classes (except for the first one) will be reserved for further discussion and problem solving, except in a few cases where we need more than one class to cover a topic.

Homework:

Like most math courses, the only way to really learn the material is to do as many practice problems as possible. I recommend doing as many of the problems in your textbook as you have time for, in addition to the assignment problems. If you have trouble with any problems that are not on the assignments, consider posting the question on Piazza. You'll usually get an answer from myself or a classmate within a few hours.

Communication:

Communication between students and myself can take place in several ways:

- Announcements on Moodle. Any updates and reminders will be posted on Moodle. These announcements will be sent to your uleth.ca email address by default, so be sure to monitor that account. It is also highly recommended that you log into Moodle on a regular basis to keep up to date on the course.
- In person, during office hours. (Recommended, especially if you are having trouble with a concept.)
- Online discussion forum, via Piazza.com.
- Email. You are welcome to email me with questions about the course, and I will do my best to answer as soon as I can. I do, however, have a few email etiquette rules:
  - Include the course number in your subject heading, and your full name in the message text. Since I teach several classes at once, this will help to ensure a prompt reply. (For example, if your email consists only of "Yo prof, when's the test?" I won't be able to give you an answer since my courses have tests at different times.)
  - Questions about how to solve a particular homework problem should be directed to the discussion forum rather than email: the discussion forum can properly display math symbols, and it's usually the case that several students will have the same question.
  - Questions that can be answered by reading this syllabus (e.g. "When's the test?") will usually not be answered in a timely fashion, and the replies will generally be grumpy/sarcastic in nature.

Special arrangements:

If you are a student who has registered for accommodations with the Accommodated Learning Centre, please ensure that I am informed of the necessary arrangements as soon as possible, and please feel free to meet with me if there are any adjustments I can make to improve your learning experience.

Academic honesty:

Students are expected to be familiar with, and abide by, the rules laid out in the Academic Calendar regarding academic honesty, cheating, etc. and the penalties assessed for disregarding those rules. In particular, collaboration on assignments is acceptable, but copying is not. If you're not sure what the difference is, see me.

Tentative course schedule (subject to change)

Date	Topic	Assigned Reading
Sept. 3rd	Course outline and introduction	Ch. 1 and 2
Sept. 5th	Number systems	§§3.1-3.2
Sept. 8th	Completeness of $\mathbb{R}$	§3.3
Sept. 10th	Least upper bounds	Discussion
Sept. 12th	Topology of $\mathbb{R}$	§§3.4-3.5
Sept. 15th	Metric spaces	§3.6
Sept. 17th	Chapter 3 Review	Discussion
Sept. 19th	Convergence of sequences	§4.1
Sept. 22nd	Limit theorems	§4.2
Sept. 24th	ϵ-δ proofs	Discussion
Sept. 26th	Cauchy sequences	§4.3
Sept. 29th	Subsequences	§4.4
Oct. 1st	Sequences and the topoogy of $\mathbb{R}$	Discussion
Oct. 3rd	Review	Ch. 1-4
Oct. 6th	Term test 1	
Oct. 8th	Test results	Discussion
Oct. 10th	Limits of functions	§5.1
Oct. 13th	Thanksgiving holiday	No class
Oct. 15th	ϵ-δ again	Discussion
Oct. 17th	Continuity	§5.2
Oct. 20th	Consequences of continuity	§5.3
Oct. 22nd	Continuous functions	Discussion
Oct. 24th	Uniform continuity	§5.4
Oct. 27th	Generalizations of continuity	§5.5
Oct. 29th	Proofs involving (uniform) continuity	Discussion
Oct. 31th	Review	Ch. 5
Nov. 3rd	The derivative	§6.1
Nov. 4th	Linear approximations	Discussion
Nov. 6th	The Mean Value Theorem	§6.2
Nov. 10th	Term Test 2	
Nov. 12th	Test results	Discussion
Nov. 14th	L'Hospital's Rule and Taylor's Theorem	§§6.3-6.4
Nov. 17th	The Riemann integral	§7.1
Nov. 19th	Derivatives	Discussion
Nov. 21st	Properties of the Riemann integral	§7.2
Nov. 24th	The Fundamental Theorem of Calculus	§7.3
Nov. 26th	Integration	Discussion
Nov. 28th	Beyond the Riemann integral	Handout
Dec. 1st	Review	
Dec. 3rd	Review	
Dec. 8 - 16: Fall exams		