

MAT2125B – Elementary Real Analysis

Winter 2021 | Instructor: P. Boily

COURSE DESCRIPTION

Review of the completeness properties of real numbers. Supremum and infimum, \limsup , \liminf . The topology of \mathbb{R}^n . Uniform continuity. Compactness, Heine-Borel. The Riemann integral, the fundamental theorem of calculus, improper integrals. Sequences and series of functions, uniform convergence. Fourier series.

PRE-REQUISITES

MAT1325 or MAT2122 or (MAT1322 and one of MAT1348, MAT1362, MAT2362).

ACCOMMODATIONS

If you feel that you need accommodations, you should contact *Access Services* as soon as possible. Accommodations are not limited to those with physical disabilities. Unfortunately there is a deadline to receive accommodations, so please do not delay.

MAIN TEXT

The primary text will be the lecture notes *Elementary Real Analysis* by Alistair Savage. These notes are available on the course website.

Although textbooks are not mandatory, there are several free textbooks that cover similar material in greater depth. The course website contains a collection of such resources.

COURSE SCHEDULE

VIDEO LECTURES are asynchronous and available on the course website.

EXERCISE SESSIONS are held on WED 13:00-14:20, WED 14:30-15:50, and FRI 11:30 - 12:50; they will be recorded and made available on the course website, as will the Zoom link to attend.

OFFICE HOURS will be held during the exercise sessions; outside of those, appointments can be made by email.

EVALUATION

If your mark on the final examination is less than 40%, the mark on the final exam will be your grade in the course. If your mark on the final is 40% or more, your grade in the course will be calculated as follows:

- **Assignments** (25%)
- **Midterm Exam** (25%)
- **Final Exam** (50%)

Late assignments will not be accepted, as solutions will be posted early to help you go over your work. To account for the fact that bad luck or other commitments sometimes prevent you from finishing a particular assignment, the lowest assignment grade will be dropped.

There will be no make-up midterm. If your final exam score is higher than your midterm exam score (and also ≥ 40 percent), then your final exam mark will count as your midterm mark.

If you are unable to write the final exam, then the policies of the Faculty of Science will apply.

ASSIGNMENTS AND MIDTERM

The assignments are due at midnight on the following dates:

- HW1 [1.2, 2.1-2.2]: Jan 25
- HW2 [2.3, 3.2-3.6]: Feb 08
- HW3 [3.7, 4.1-4.2]: Mar 01
- HW4 [4.3, 4.4-4.7, 5.1-5.5]: Mar 22
- HW5 [5.6-5.9, 6.1-6.2, 7.1-7.3]: Apr 12

The midterm will be held on Mar ?? (details TBD). You may use your notes and calculators.

MAT2125B – Elementary Real Analysis

Winter 2021 | Instructor: P. Boily

NOTES

Any change to the course outline will be announced in the exercise sessions, on the course webpage, or on Brightspace.

You do not have permission to upload the course materials, including any lecture notes, recordings, assignment and exam questions to any website.

Online monitoring software such as Respondus will **NOT** be used.

EXPECTATIONS

Ideally, you'd spend at least 8-10 hours each week on each of your courses, on average (watching the videos, trying some of the exercises, in the classroom, working on the assignments, etc.). And because this specific course is so crucial to the rest of your degree, it's perhaps even more important that you put time aside to work on it. But let's not forget that we're in the middle of the \$#&% pandemic, ok? Priorities, people, priorities.

For all course deliverables, you must write your answers individually, according to the University's Academic Regulation 14. The penalty for cheating is an F for ALL the term's courses.

Students are encouraged to ask questions (or open discussions) throughout the term, not necessarily only about specific homework problems.

Questions are welcome (and very much encouraged) during exercise sessions.

For all text communication besides *personal accommodations* and *office hour requests*, there is a *Piazza* forum available at: piazza.com/uottawa.ca/winter2021/mat2125. All short questions about course content, logistics, and so on should be asked in that forum.

I can set up Zoom videoconferencing meetings, if needed. Please send me an email with

- a list of your availabilities, and
- a quick summary of what you'd like to discuss.

I will try to accommodate requests, but the chance of finding a common meeting time goes up if you send a request earlier (at least 24 hours notice) and list 3+ meeting times. Keep in mind that I'm teaching 3 courses this session and that I have 2 young children at home, however.

If you feel that you are missing some foundations, we can work together on that as well.

MAT2125B – Elementary Real Analysis

Winter 2021 | Instructor: P. Boily

FINAL EXAM

The 3-hour exam will be held online during the **exam period** and will cover all subject matter seen during the semester.

It is your responsibility to determine its date and time. Do not rely on your friends and classmates to relay this information.

In addition, I suggest not to write an **examination** – especially a final exam – if you are sick, as this cannot be taken into account after the fact.

ACADEMIC FRAUD

Academic Regulation 14 defines academic fraud as “any act by a student that may result in a distorted academic evaluation for that student or another student. Academic fraud includes but is not limited to activities such as:

1. Plagiarism or cheating in any way;
2. Submitting work not partially or fully the student’s own, excluding properly cited quotations and references. Such work includes assignments, essays, tests, exams, research reports and theses, regardless of whether the work is written, oral or another form;
3. Presenting research data that are forged, falsified or fabricated;
4. Attributing a statement of fact or reference to a fabricated source;
5. Submitting the same work or a large part of the same piece of work in more than one course, or a thesis or any other piece of work submitted elsewhere without the prior approval of the appropriate professors or academic units;
6. Falsifying or misrepresenting an academic evaluation, using a forged or altered supporting document or facilitating the use of such a document;
7. Taking any action aimed at falsifying an academic evaluation.”

It is not worth getting a failing grade (or worst, expelled!) over academic fraud. Word to the wise.

NOTICE AGAINST HARASSMENT

The University of Ottawa will not tolerate acts of violence. This includes acts such as rape and sexual harassment, as well as misconduct that take place without consent, which includes cyberbullying. The University, as well as various employee and student groups, offers a variety of services and resources to ensure that all uOttawa community members have access to confidential support and information, and to procedures for reporting an incident or filing a complaint.

MAT2125B – Elementary Real Analysis

Winter 2021 | Instructor: P. Boily

CONTENTS

We will cover the following topics:

1. Preamble

- 1.1 Historical Perspective
- 1.2 Introduction to LaTeX

2. The Real Numbers

- 2.1 Number Systems and Properties of R
- 2.2 Cardinality
- 2.3 Nested Interval Theorem

3. Sequences

- 3.1 Infinity vs Intuition
- 3.2 Introduction to Sequences
- 3.3 Calculating Limits
- 3.4 Monotone Sequences
- 3.5 Bolzano-Weierstrass Theorem
- 3.6 Cauchy Sequences
- 3.7 Sequences and Topology of R^d

WEEK-BY-WEEK CONTENTS

- 11/1–17/1: 1.1-1.2, 2.1 (parts 1-3)
- 18/1–24/1: 2.1 (parts 4-6), 2.2
- 25/1–31/1: 2.3, 3.1-3.3, 3.4 (part 1)
- 01/2–07/2: 3.4 (part 2), 3.5-3.6
- 08/2–14/2: 3.7
- 15/2–21/2: Reading Week
- 22/2–28/2: 4.1, 4.2
- 01/3–07/3: 4.3-4.7 [week of the midterm]
- 08/3–14/3: 5.1-3
- 15/3–21/3: 5.4-5.5, 5.6 (parts 1, 2)
- 22/3–28/3: 5.6 (parts 3, 4, 5), 5.7-5.9
- 29/3–04/4: 6.1-6.2
- 05/4–11/4: 7.1-7.3

4. Limits and Continuity

- 4.1 Limit of a Function
- 4.2 Properties of Limits
- 4.3 Continuous Functions
- 4.4 Images and Continuity
- 4.5 Intermediate Value Theorem
- 4.6 Maximum/Minimum Theorem
- 4.7 Uniform Continuity

5. Calculus

- 5.1 Differentiation
- 5.2 Mean Value Theorem
- 5.3 Taylor's Theorem
- 5.4 Relative Extrema and Derivatives
- 5.5 Riemann Integration
- 5.6 General Integration Results
- 5.7 Composition Theorem
- 5.8 Fundamental Theorem of Calculus
- 5.9 Evaluation of Integrals

6. Sequences of Functions

- 6.1 Pointwise and Uniform Convergence
- 6.2 Limit Interchange Theorems

7. Series

- 7.1 Series of Real Numbers
- 7.2 Series of Functions
- 7.3 Power Series