# MAT336: Elements of Analysis
# Winter term 2016

**Course Description:** This is an introductory course on real analysis. We will make a rigorous development of properties of real numbers, and various concepts in calculus. Although the course is intended for students with little prior experience with mathematical proofs, you will be expected to eventually be able to understand and produce rigorous proofs over the course of the semester.

**Instructor:** André Belotto

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Office-Hours: T 12:00-14:00 in BA 6283 (to be confirmed)
(from: Jan. 12 to Apr. 5 - no office hours on Feb. 9 and 16)

**Teaching Assistant:** Iván Camilo Salgado Patarroyo

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**Lectures:** Mondays 16:10-17:00 in SF 1101 and Wednesdays 14:10-16:00 in UC 140.

**Textbook:**

- *Real Analysis and Applications: Theory in Practice*, by Kenneth. R. Davidson and Allan P. Donsig.

**Problem Sets:** Six bi-weekly homework problem sets will be assigned and collected. Each assignment you turn in will count for 2% of your total mark, up to a total of 10%. We will only count the best 5 out of the 6 grades. You will receive half credit just for turning the assignment in!

The tentative due dates of homework are as follows: Jan. 20, Feb. 3, Feb. 24, Mar. 9, Mar. 23, Apr. 6 (all Wednesdays).

**Midterms:** There will be two midterm exams, each 50 minutes, which will account for 25% of the course mark each. The tentative dates are:

- Exam 1: Monday, Feb. 8, 16:10-17:00

- Exam 2: Monday, Mar. 21, 16:10-17:00.

**Final Exam:** The Final exam will be during exam period in April and will account for 40% of the course mark. The exam will be comprehensive and will test all the material covered throughout the semester.

**Marks:** The overall course mark will be calculated by

$$(\text{Combined Assignments} = 10\%) + (\text{Midterm}\,1 = 25\%) + (\text{Midterm}\,2 = 25\%) + (\text{Final Exam} = 40\%)$$

**Absences:** Late homework will not receive any credit. *An unexcused absence from a midterm exam will result in a zero for that mark!*

If you need to miss an exam for legitimate reasons, please see me beforehand. As the midterm exams are scheduled during regular lecture times, (per university regulations) no absences will be granted for academic conflicts (this means even if you are registered for another class at the same time, this will not be considered as a valid absence). If you have an exam or test from another course at an irregularly scheduled time which conflicts with a MAT336 exam, the instructor of the other course must make accommodations (also per university regulation).

An absence cannot be excused unless you provide the proper documentation. Similarly, if you miss an exam due to a medical or family emergency, you must also provide the proper documentation (e.g., from the doctor). In either case, the documentation should be submitted no later than one week after the date of the exam. If you miss a midterm exam, then the weight of that exam is shifted to the Final exam grade.

**Academic Integrity:** You are permitted (and encouraged) to collaborate on homework problems, but you should make sure to write up your own answers.

Regarding examinations: *Cheating is, of course, forbidden!* Don't do it! No calculators or aids of any form (including but not limited to: cell phones, computers, tablets, notes, etc.) will be allowed on exams. Copying off your friends, communicating with other students, and receiving outside help are also not allowed.

Academic dishonesty is viewed as a very serious offense and comes with serious consequences, please familiarize yourself with university rules regarding academic conduct: http://www.artsci.utoronto.ca/osai/students.

**Course outline:** The tentative schedule is the following:

1. Properties of real numbers: Dedekind cuts (*), least upper bound principle, Archimedes principle (2.2, 2.3), cardinality (2.9)
2. Sequences: limits, monotone convergence, subsequences, limsup, liminf, Bolzano-Weierstrass Theorem, Cauchy sequences, completeness (2.4-2.8)
3. Series: Cauchy criterion, absolute convergence, convergence tests, alternating series (Chp. 3)
4. Elementary topology: topology in $\mathbb{R}^n$ (4.2-4.4), (sequential) compactness (9.1-9.3), connectedness(*)
5. Functions: continuity (5.1-5.3), uniform continuity (5.5), extreme and intermediate value theorems (5.4, 5.6)
6. Differentiation: chain rule (6.1), mean value Theorem (6.2), inverse (6.1) and implicit (*) function Theorems
7. Integration: partitions, upper/lower Darboux sums, Fundamental Theorem of Calculus (6.2-6.4)
8. Sequences of functions: uniform convergence (8.1-8.3)
9. Series of functions: Weierstrass M-test, function spaces (8.4, 8.5, 8.6)
10. Convex optimization (Chp. 16) (if there is time!)

Sections covered and their order *may be subject to change* depending on time constraints and pacing. (*) indicates a topic not from the textbook.