Department of Mathematics & Statistics
Concordia University

MATH 494 (MAST 661), Sec. B
Topics in Pure & Applied Math: Introduction to Mathematical
Topics in Analysis: Introduction to Logic
Winter 2025

Instructor: Dr. A. Shani
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Schedule: Tuesdays & Thursdays, 16:15-17:30.
Note: There will be a mid-term break from February 24 to March 2.

Office Hours: TBA.

Pre-requisites: MATH 222 or MAST 217 or COMP 232 or COEN 231. Or familiarity with rigorous mathematical proofs from a more advanced class.

Textbooks: *A Friendly Introduction to Mathematical Logic* by Christopher C. Leary and Lars Kristiansen.
The book is freely available online:
https://milneopentextbooks.org/a-friendly-introduction-to-mathematical-logic/
Additional notes will be provided on Moodle.

See the course Moodle page for more information.
The Moodle page will be updated with relevant information throughout the semester.
You are expected to monitor the Moodle page regularly.

Course Outline: Roughly speaking, mathematical logic studies mathematical objects by first formalizing them in a precise ``mathematical language'', and then studying how these objects can be defined (or expressed) in this language. We will develop in generality the notion of a mathematical structure in some language, and formalize notions such as truth, provability, and isomorphism.

One basic question is the following: given some axioms (assumptions), is there a structure satisfying such axioms? We will prove Godel's Completeness Theorem, which asserts that the answer is always yes, as long as there is no ``evident logical contradiction between the axioms''.
Another fundamental question is whether truth can be axiomatized. That is, can we write a list of axioms from which all mathematical truth

can be deduced? Godel's famous Incompleteness Theorem states that this is not possible! For any reasonable list of axioms, there will always be true statements which we cannot prove. Time permitting, we will discuss the formal statement of Godel's incompleteness theorem and its proof.

Course Objectives: Understand the following concepts, including examples and relevant results: mathematical structure, isomorphism, logical implication, formal deduction, countable and uncountable sets, Peano Arithmetic, computable set, computable function.
Understand the statements, proofs, and applications of the following results: The Completeness Theorem, The Compactness Theorem, Cantor's Theorem, Godel's Incompleteness Theorem.

Term Exam: There will be a midterm during class. Midterm date TBA.

Grading Scheme: The grade will be calculated as the highest of the following:

- 30% midterm and 70% final exam.
  OR
- 100% final exam.

If the grading scheme for this course includes graded assignments, a subset of each assignment may be graded. Students will not be told in advance which subset of the assigned problems will be marked and should therefore attempt all assigned problems.

Student Services
You may wish to access the many services available to you as a Concordia student. An overview of these resources can be found here: https://www.concordia.ca/students/services.html

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Behaviour
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