Introduction to Mathematical Reasoning
MATH 1800 A
Fall 2020

- **Instructor:**
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- **Office hours:** Monday, 2:30–4:30 p.m., on cuLearn (via BigBlueButton)

- **Prerequisites:** Ontario Grade 12 Mathematics: Advanced Functions, or MATH 0005, or equivalent.

- **Precludes** additional credit for MATH 1805/COMP 1805.

- **Material:** William J. Gilbert and Scott A. Vanstone, *An Introduction to Mathematical Thinking: Algebra and Number Systems*, Pearson Prentice Hall, 2005.
  $\rightsquigarrow$ *Available via the Carleton Bookstore.*

  Each section includes various examples, followed by numerous exercises and problems. Solutions to odd-numbered exercises and problems are given at the end of the book.

- **Additional reading (NOT required):**
  - Ulrich Daepp and Pamela Gorkin, *Reading, Writing, and Proving: A Closer Look at Mathematics*, Second Edition, Undergraduate Texts in Mathematics, Springer, 2011.
  - Ted Sunstrom, *Mathematical Reasoning: Writing and Proof*, Second Edition, Addison-Wesley, 2006.

- **Lectures:** Wednesday and Friday, 8:35–9:55 a.m., posted on cuLearn (asynchronous learning modality)

- **Beginning** of classes: Wednesday, September 9, 2020.
  End of classes: Wednesday, December 9, 2020.

- **Tutorials:** Wednesday, 11:35 a.m. – 12:25 p.m., starting September 23, 2020. Teaching Assistants: TBA.

  The tutorial is not mandatory, but it is strictly recommended to participate. Two assignments are to be submitted and will be graded (see "**Evaluation**"). Besides these assignments, there is no credit for your tutorial work. However, the tutorial is very important in order to succeed in the course, and it is essential to do the exercises on a regular basis.

- **Extra help:** The Mathematics and Statistics Learning Assistance Program (MS-LAP), which is free of charge, offers learning support and solutions to practice questions through assistance videos. These services are available on cuLearn. MS-LAP explains step-by-step problem strategies and associated theory, thereby providing students the opportunity to deepen their understanding.

- **Evaluation:** The term mark has two components: there are two assignments (15% each) and a midterm exam (20%). The final exam is 50%. Only absences due to serious illness, jury duty or extreme personal misfortune will be considered as sufficient cause for missing an exam. **Please see me** should such a case arise.

- **Calculators:** ... will not be needed.

- **Withdrawal:** Last day for withdrawal from the course (with full fee adjustment): Wednesday, September 30, 2020.

- **Students with disabilities** who require academic accommodations in this course are encouraged to contact a coordinator at the **Paul Menton Centre** (501 University Centre) – email: PMC@carleton.ca, phone: 613 520 6608 – to complete the required forms. After registering with the PMC, discuss your needs with me at least two weeks prior to the midterm exam. The deadline to request formal examination accommodation forms for December examinations to the Paul Menton Centre is Friday, November 13, 2020.

Course Outline

Brief description (as per the Undergraduate Calendar): Elementary logic, propositional and predicate calculus, quantifiers, sets and functions, bijections and elementary counting, the concept of infinity, relations, well ordering and induction. The practice of mathematical proof in elementary number theory and combinatorics.

The course is an introduction to the use of mathematical language and to mathematical thinking. We shall employ basic concepts from algebra, number theory, and combinatorics to illustrate methods of writing mathematical proofs.

The followings shows the plan of topics[1] to be covered in the course.

I. Basic Logic and Proofs

1. Some elementary terminology (p. 1–2)
2. Some basic logic (p. 2–7)
3. Sets (p. 7–8)
4. Quantifiers (p. 9–13)
5. Proofs (p. 13–18)
6. Counterexamples (p. 18–19)

II. Integers

1. The Division Algorithm (p. 25–28)
2. The Euclidian Algorithm (p. 28–34)
3. Prime numbers (p. 45–49)

III. Congruence and Equivalence Relations

1. Congruence (p. 57–59)
2. Tests for divisibility (p. 59–61)
3. Equivalence relations (p. 61–63)

IV. Induction and the Binomial Theorem

1. Induction (p. 89–96)
2. Recursion (p. 96–98)
3. The Binomial Theorem (p. 98–103)

V. Functions and Bijections

1. Functions (p. 125–127)
2. The graph of a function (p. 127–130)
3. Composition of functions (p. 130–132)
4. Inverse functions (p. 133–135)
5. The Inversion Theorem (p. 135–137)
6. Cardinality (p. 138–142)

[1] The page numbers refer to the above-mentioned textbook.