ORIGINAL COURSE IMPLEMENTATION DATE: January 2006
REVISED COURSE IMPLEMENTATION DATE: January 2020
COURSE TO BE REVIEWED (six years after UEC approval)**:** August 2025
Course outline form version: 05/18/2018

OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM

Note: The University reserves the right to amend course outlines as needed without notice.

Course Code and Number: MATH 265	**Number of Credits:** 3 Course credit policy (105)

Course Full Title: Transition to Advanced Mathematics
Course Short Title: Transition to Advanced Math
(Transcripts only display 30 characters. Departments may recommend a short title if one is needed. If left blank, one will be assigned.)

Faculty: Faculty of Science	**Department (or program if no department):** MATH & STATS

Calendar Description:

Introduction to elementary logic, structures and discourse of mathematics, and the communication of mathematical ideas. Topics include logic, proof techniques, set theory, number theory, real and complex numbers, proof structure, strategy, effective mathematical communication and the LaTeX typesetting language.

Note: Students with credit for MATH 214 cannot take this course for further credit.

Prerequisites (or NONE):	C+ or better in either MATH 112 or MATH 118.
Corequisites (if applicable, or NONE):	
Pre/corequisites (if applicable, or NONE):	

Antirequisite Courses *(Cannot be taken for additional credit.)*
Former course code/number:
Cross-listed with:
Dual-listed with:
Equivalent course(s): **MATH 214**
(If offered in the previous five years, antirequisite course(s) will be included in the calendar description as a note that students with credit for the antirequisite course(s) cannot take this course for further credit.)

Typical Structure of Instructional Hours

Lecture/seminar hours	45
Tutorials/workshops	
Supervised laboratory hours	5
Experiential (field experience, practicum, internship, etc.)	
Supervised online activities	
Other contact hours:	
Total hours	**50**

Labs to be scheduled independent of lecture hours: ☐ No ☐ Yes

Special Topics *(Double-click on boxes to select.)*
This course is offered with different topics:
☒ No ☐ Yes *(If yes, topic will be recorded when offered.)*

Independent Study
If offered as an Independent Study course, this course may be repeated for further credit: *(If yes, topic will be recorded.)*
☐ No ☐ Yes, repeat(s) ☐ Yes, no limit

Transfer Credit
Transfer credit already exists: *(See **bctransferguide.ca**.)*
☐ No ☒ Yes
Submit outline for (re)articulation:
☒ No ☐ Yes *(If yes, fill in transfer credit form.)*

Grading System
☒ Letter Grades ☐ Credit/No Credit

Maximum enrolment (for information only): 36

Expected Frequency of Course Offerings:
Annually *(Every semester, Fall only, annually, etc.)*

Department / Program Head or Director: Ian Affleck	**Date approved:**	May 2019
Faculty Council approval	**Date approved:**	May 31, 2019
Dean/Associate VP: Lucy Lee	**Date approved:**	May 31, 2019
Campus-Wide Consultation (CWC)	**Date of posting:**	June 21, 2019
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	August 29, 2019

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Read, critique, and construct elementary mathematical arguments by:
    a. using the common elements of mathematical communication: definition, proof, example, counterexample, etc.
    b. employing the syntactics and semantics of propositional and elementary predicate logic.
    c. using the standard argument forms (contradiction, induction etc.).
2. Reason effectively about a mathematical proposition, work towards proof or counterexample employing reasoning techniques such as generalization, specialization, method of counterexample, alternate representation etc.
3. Communicate mathematical constructions and arguments clearly and effectively in written form, in particular:
    a. clearly guide a reader through an argument or construction of an example.
    b. assess what needs to be provided to a reader, and what may be assumed.
4. Articulate an understanding of the basic notions of elementary set theory, in particular subset, Cartesian product, functions, relations, equivalence relation, quotient structure and cardinality, by clearly stating definitions, constructing examples and counterexamples, and establishing elementary propositions.
5. Demonstrate a working knowledge of the elementary structure of the real numbers by:
    a. constructing simple propositions working from the axioms for the real numbers, and clearly articulating the significance of the axiomatic approach.
    b. stating definitions and reading, critiquing and constructing elementary arguments, examples and counterexamples using concepts of order, cardinality, density, supremum.
6. Demonstrate a working knowledge of the elementary structure of the integers, by stating definitions and reading, critiquing and constructing elementary arguments, examples and counterexamples involving concepts of primality, factorization, and modular arithmetic.
7. Perform elementary calculations using complex numbers, and prove elementary statements about complex numbers.
8. Typeset mathematics and mathematical arguments in the LaTeX typesetting language.

Prior Learning Assessment and Recognition (PLAR)

☒ Yes ☐ No, PLAR cannot be awarded for this course because

Typical Instructional Methods *(Guest lecturers, presentations, online instruction, field trips, etc.; may vary at department's discretion.)*

Lectures, supervised computer labs.

NOTE: The following sections may vary by instructor. Please see course syllabus available from the instructor.

Typical Text(s) and Resource Materials *(If more space is required, download Supplemental Texts and Resource Materials form.)*

	Author (surname, initials)	Title (article, book, journal, etc.)	Current ed.	Publisher	Year
1.	Daepp & Gorkin	Reading Writing and Proving 2nd ed	☐	Springer	2011
2.	Chartrand, Polimeni, & Zhang	Mathematical Proofs: A Transition to Advanced Mathematics 4thd ed.	☐	Pearson	2017
3.	Open source documentation on LaTeX and LaTeX editors		☐		
4.			☐		
5.			☐		

Required Additional Supplies and Materials *(Software, hardware, tools, specialized clothing, etc.)*

Access to (open software) LaTeX editors and compilers, such as OverLeaf, MikTeX, Texify, TexLive

Typical Evaluation Methods and Weighting

Final exam:	30%	Assignments:	20%	Field experience:	%	Portfolio:	%
Midterm exam:	30%	Project:	%	Practicum:	%	Other:	%
Quizzes/tests:	20%	Lab work:	%	Shop work:	%	Total:	100%

Details (if necessary): Students must achieve at least 40% on the final exam in order to receive credit for this course

Typical Course Content and Topics

The techniques of construction and communication of mathematical argument are an essential part of the course, to be covered explicitly, rather than assumed. They will be distributed throughout the course as part of the material being discussed at the time, rather than being dealt with in the abstract. In particular the following will be included:

1. Argument forms (methods of proof): contradiction, contrapositive, direct, induction, cases etc.
2. "How to prove it:" softer notions of how to solve a problem/construct an argument: generalization, specialization, working backwards, representation.
3. "How to write it:" communicating an argument (guiding a reader towards your solution).

4. Language of mathematics: this material should be covered near the beginning of the course
    a. Logic (propositional logic), notions of converse, contrapositive etc.
    b. Basic set theory (include infinite index sets for unions, Cartesian products etc.),
    c. Quantifiers (predicate calculus) negation of statements. Proving and disproving universal and existential statements
    d. Functions, domain, range, pre-image, surjections, injections, bijections
    e. Relations, equivalence relations, quotient set.
5. The integers. The integers provide a natural place to learn how to read and construct arguments, and a natural source of examples to illustrate the ideas of logic, quantifiers etc.
    a. The integers (from the axioms)
    b. Primes/divisibility
    c. Modular arithmetic (example of quotient structures)
6. The real numbers. Basic arguments/facts from analysis are covered both to provide a concrete place for the students to construct arguments, and also just to provide some basic analysis.
    a. Axioms for the reals (and basic facts which follow, as an exercise in proof construction from axioms)
    b. Supremum, infimum, completeness
    c. Density of rationals, dense sets in general
    d. Cardinality (uncountability of R, countability of Q, general cardinality arguments)
    e. Sequences an introduction to epsilon-N arguments, basic theorems, another statement of the completeness axiom, decimal representation
7. The complex numbers: Enough is covered to be able to support the needs of later courses such as linear algebra, abstract algebra or differential equations
    a. The definition (including the formulation via quotient structure on the reals)
    b. Complex arithmetic
    c. The complex numbers as a field
    d. Complex exponentiation, De'Moivre's formula and roots
    e. Statement of Fundamental Theorem of Algebra
8. LaTeX: LaTeX as the typesetting language of mathematics. Assignments in the course are done in LaTeX
    a. The structure of a LaTeX file and the edit, compile, review cycle
    b. Mathematics symbols in LaTeX
    c. Mathematical environments (e.g. definition, arrays, displayed equations)
    d. Tables in LaTeX