ORIGINAL COURSE IMPLEMENTATION DATE:	January 2006
REVISED COURSE IMPLEMENTATION DATE:	September 2020
COURSE TO BE REVIEWED (six years after UEC approval)**:**	January 2026

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 444

Number of Credits: 3 Course credit policy (105)

Course Full Title: Metric Spaces

Course Short Title:

(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): Mathematics & Statistics

Calendar Description:

Metrics are generalized notions of distance, allowing concepts such as continuity and convergence to be studied in more general settings than Euclidean space. Topics include topological concepts such as open and closed sets, convergence, completeness, continuity, connectedness and compactness.

Prerequisites (or NONE):	MATH 221 and one of MATH 320 or MATH 340. Note: As of January 2021, prerequisites will change to the following: MATH 221 and MATH 340.
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):

(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	50
Tutorials/workshops	
Supervised laboratory hours	
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:

Every third year *(Every semester, Fall only, annually, etc.)*

Department / Program Head or Director: Ian Affleck	**Date approved:**	June 2019
Faculty Council approval	**Date approved:**	October 4, 2019
Dean/Associate VP: Lucy Lee	**Date approved:**	October 4, 2019
Campus-Wide Consultation (CWC)	**Date of posting:**	January 10, 2020
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	January 31, 2020

Learning Outcomes:

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

1. State the definition of metric space and demonstrate whether or not a given space is a metric space.
2. Define the appropriate topological concepts such as connectedness, compactness, completeness, boundary, limit point.
3. Formulate proofs to establish elementary results and the truth or falsity of elementary statements regarding these basic concepts.
4. Discuss convergence in terms of Cauchy sequences, construct the completion of a metric space, state and use the theorems regarding completeness and compactness.
5. State equivalent versions of the definition of continuity, and use them to establish the continuity or discontinuity of given functions.
6. Show via elementary formal arguments the role continuity plays in the various results (e.g. preservation of compactness under continuous functions, fixed point theorems).

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.)*

This course will be primarily lecture-based.

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.	V. Bryant	Metric Spaces	☐	Cambridge University Press	1985
2.	T. W. Gamelin and R. E. Greene	Introduction to Topology	☐	Dover	1999
3.	R. B. Reisel	Elementary Theory of Metric Spaces	☐	Springer-Verlag	1983
4.	W. A. Sutherland	Introduction to Metric and Topological Spaces	☐	Oxford University Press	2010
5.					

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

Typical Evaluation Methods and Weighting

Final exam:	40%	Assignments:	15%	Field experience:	%	Portfolio:	%
Midterm exam:	30%	Project:	%	Practicum:	%	Other:	%
Quizzes/tests:	15%	Lab work:	%	Shop work:	%	Total:	100%

Details (if necessary): In addition, students must score at least 40% on the final exam in order to pass the course.

Typical Course Content and Topics

1. Definition of metric spaces, examples.
2. Subspaces, product spaces.
3. Topological concepts – open and closed sets, bounded sets.
4. Limit points, interior and boundary points.
5. Equivalent metrics, isometries.
6. Sequences – convergence, Cauchy sequences.
7. Complete spaces, completions.
8. Continuous functions – neighbourhoods, bases, mapping properties of functions and inverses, homeomorphisms, extreme value theorem.
9. More topological concepts: connectedness, compactness.
10. As time permits, contraction mapping theorem--proof, applications to algebraic, differential or integral equations.