ORIGINAL COURSE IMPLEMENTATION DATE:	September 1998
REVISED COURSE IMPLEMENTATION DATE:	September 2019
COURSE TO BE REVIEWED (six years after UEC approval)**:**	February 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 211

Number of Credits: 3 Course credit policy (105)

Course Full Title: Calculus III

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): MATH & STATS

Calendar Description:

Extends the concepts of first-year calculus from the one-variable setting to a multi-variable setting. Topics include 3-dimensional analytic geometry, Euclidean spaces, partial derivatives and gradient, optimization, multiple integrals, and applications.

Prerequisites (or NONE):	C or better in MATH 112 or MATH 118.
Corequisites (if applicable, or NONE):	NONE
Pre/corequisites (if applicable, or NONE):	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 year *(Every semester, Fall only, annually, etc.)*

Department / Program Head or Director: Ian Affleck	**Date approved:**	October 22 2018
Faculty Council approval	**Date approved:**	November 30, 2018
Dean/Associate VP: Lucy Lee	**Date approved:**	November 30, 2018
Campus-Wide Consultation (CWC)	**Date of posting:**	January 18, 2019
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	February 1, 2019

Learning Outcomes:

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

- Graph points and vectors in Cartesian 3-space, calculate with the vector operations of addition and scalar multiplication, interpret geometrically.
- Calculate the dot product and cross product in 3-space, interpret geometrically, use the interpretation to construct elementary arguments for various geometric facts or to test elementary statements, establish elementary facts about vector algebra from the definitions.
- Given various constraints, construct equations and systems of equations for lines and planes in 3-space, use the equations to establish elementary properties thereof.
- Graph points in the polar, cylindrical and spherical coordinate systems, convert between coordinate systems.
- Identify and graph simple surfaces in 3-space (cylinders and quadric surfaces).
- Use multivariable functions in Cartesian, polar, cylindrical and spherical coordinate systems: determine domain, graph lines and surfaces (via traces and level curves), model real-world problems.
- Calculate limits of multivariable functions, define and test for continuity.
- Calculate partial derivatives, interpret the results of the calculations in real-world contexts, establish elementary propositions.
- Calculate gradient and directional derivatives, interpret the results in real-world contexts, and establish elementary propositions.
- Calculate tangent planes and normal lines to a given surface and establish elementary propositions.
- Use differentials and linear approximations to estimate change in nonlinear functions.
- Find the extrema of functions of two or more variables on various domains, including using the technique of Lagrange multipliers, apply to solve real-world optimization problems.
- Set-up the appropriate iterated integral to integrate functions over a given region in the plane or 3-space, in Cartesian, polar, cylindrical and spherical coordinates, in particular to calculate surface area, volume etc.
- Convert given multiple integrals between coordinate systems with Jacobians.
- Clearly state and interpret the central definitions and theorems for all the topics discussed above.

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.)*

The course will be primarily lecture-based. Evaluation will include quizzes, midterm exams, assignments and a final exam. This course may use an online homework system and/or computer software such as Maple, Sage, etc.

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.	Larson, Hostetler & Edwards	Multivariable Calculus (7 ed)	☐	Houghton and Mifflin	2002
2.	Stewart, J	Calculus (8 ed)	☐	Nelson Education	2016
3.			☐		
4.			☐		
5.			☐		

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

Typical Evaluation Methods and Weighting

Final exam:	40%	Assignments:	10%	Field experience:	%	Portfolio:	%
Midterm exam:	40%	Project:	%	Practicum:	%	Other:	%
Quizzes/tests:	10%	Lab work:	%	Shop work:	%	Total:	100%

Details (if necessary): Students must obtain at least 40% on the final exam to pass the course.

Typical Course Content and Topics

I Vectors and the geometry of space

1. Vectors in the plane and in 3-dimensional space
2. The dot product of two vectors
3. The cross product of two vectors in space
4. Lines and planes in space
5. Surfaces in space
6. Cylindrical and spherical coordinates

II Functions of several variables

1. Limits and continuity of functions of several variables
2. Partial derivatives and chain rules
3. Directional derivatives and gradients
4. Tangent planes and normal lines
5. Linear approximations and differentials
6. Extrema of function of two variables and applications

III Multiple Integration

1. Iterated integrals and area in the plane
2. Double integrals and volume
3. Change of variables: Polar coordinates
4. Surface area
5. Triple integrals and applications
6. Triple integrals in cylindrical and spherical coordinates
7. Change of variables: Jacobians