ORIGINAL COURSE IMPLEMENTATION DATE:	September 2001
REVISED COURSE IMPLEMENTATION DATE:	September 2019
COURSE TO BE REVIEWED: (six years after UEC approval)	December 2024
Course outline form version: 09/15/14	

OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM

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

Course Code and Number: MATH 312

Number of Credits: 3 Course credit policy (105)

Course Full Title: Vector Calculus

Course Short Title (if title exceeds 30 characters):

Faculty: Faculty of Science

Department (or program if no department): Mathematics & Statistics

Calendar Description:

This course concludes the traditional calculus sequence. Fundamental forms of derivative and integral are extended into two- and three-dimensional settings. Focus of the course is geometry of space curves and core results of calculus on vector fields

Note: Students with credit for MATH 212 cannot take this course for further credit.

Prerequisites (or NONE):	MATH 211.
Corequisites (if applicable, or NONE):	NONE
Pre/corequisites (if applicable, or NONE):	

Equivalent Courses (cannot be taken for additional credit)

Former course code/number: **MATH 212**

Cross-listed with:

Equivalent course(s):

Note: Equivalent course(s) should be included in the calendar description by way of a note that students with credit for the equivalent course(s) cannot take this course for further credit.

Transfer Credit

Transfer credit already exists: ☒ Yes ☐ No

Transfer credit requested (OReg to submit to BCCAT):
☐ Yes ☐ No (if yes, fill in transfer credit form)

Resubmit revised outline for articulation: ☐ Yes ☐ No

To find out how this course transfers, see **bctransferguide.ca**.

Total Hours: 50

Typical structure of instructional hours:

Lecture hours	50
Seminars/tutorials/workshops	
Laboratory hours	
Field experience hours	
Experiential (practicum, internship, etc.)	
Online learning activities	
Other contact hours:	
Total	**50**

Special Topics

Will the course be offered with different topics?
☐ Yes ☐ No

If yes, different lettered courses may be taken for credit:
☐ No ☐ Yes, repeat(s) ☐ Yes, no limit

Note: The specific topic will be recorded when offered.

Maximum enrolment (for information only): 36

Expected frequency of course offerings (every semester, annually, every other year, etc.): every other year

Department / Program Head or Director: IAN AFFLECK	**Date approved:**	March 19, 2018
Faculty Council approval	**Date approved:**	November 2, 2018
Campus-Wide Consultation (CWC)	**Date of posting:**	November 30, 2018
Dean/Associate VP: LUCY LEE	**Date approved:**	November 2, 2018
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	December 14, 2018

Learning Outcomes

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

1. Interpret vector-valued functions and their derivatives as descriptions of motion in two or three dimensions.
2. Apply derivatives of vector-valued functions to the problem of finding geometric information such as arc length, curvature, and torsion.
3. Define and interpret the divergence and curl of vector fields.
4. Define and interpret the gradient and Laplacian of scalar fields.
5. Compute derivative quantities such as divergence, curl, gradient, and Laplacian in standard coordinates as well as general orthogonal curvilinear coordinate systems.
6. Identify conservative vector fields and make use of the associated potential functions to evaluate line integrals.
7. Evaluate integrals over curves, surfaces, and volumes.
8. Apply the fundamental results of calculus in the form of Green's Theorem, Stokes' Theorem, and the Divergence Theorem.
9. Investigate at least one additional application or extension of the course concepts.
10. Demonstrate theory and techniques of vector calculus to model and solve real-world problems in areas such as 3-dimensional motion, fluid dynamics, and electrodynamics
11. Effectively communicate to others their approaches to solving problems in the discipline.

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, with some computational support provided by a computer algebra system such as Maple.

Grading system: Letter Grades: ☒ Credit/No Credit: ☐ Labs to be scheduled independent of lecture hours: Yes ☐ No ☐

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.	Robert Adams	Calculus: A Complete Course (9th ed.)	☒	Addison Wesley	2017
2.	J. Marsden & A Tromba	Vector Calculus, (6th ed.)	☒	Freeman	2011
3.	Colley, Susan J.	Vector Calculus (4th ed.)	☒	Pearson	2011
4.			☐		
5.			☐		

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

Access to a computer algebra system

Typical Evaluation Methods and Weighting

Final exam:	40%	Assignments:	20%	Midterm exam:	30%	Practicum:	%
Quizzes/tests:	10%	Lab work:	%	Field experience:	%	Shop work:	%
Other:	%	Other:	%	Other:	%	Total:	100%

Details (if necessary): A grade of 40% or better on the final exam is necessary in order to pass the course.

Typical Course Content and Topics

1. Curves in Space
   - Vector valued functions, differentiation, parametrized curves, tangent, normal and binormal, Frenet frame, Frenet formulae, curvature
2. Generalized orthogonal curvilinear coordinates
3. Vector Fields
   - Vector fields, *div, grad* and curl, conservative fields, stream lines
4. Integration over Paths and Surfaces
   - Path integrals, line integrals, parametrized surfaces, integrals of scalar and vector functions over surfaces
5. Integral Theorems
   - Green's theorem, Stokes' theorem, Divergence theorem.
6. Applications
   - Investigation of differential forms, implicit function theorem, or Partial differential equations of electrodynamics or fluid dynamics, as time permits.