ORIGINAL COURSE IMPLEMENTATION DATE:	September 2012
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 118

Number of Credits: 4 Course credit policy (105)

Course Full Title: Calculus II for Life Sciences

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:

Students will study the problem of determining a quantity given only knowledge of its rate of change. Designed for students with interest in life sciences, the topics will be motivated by authentic biological, chemical, ecological, epidemiological, and medical applications.

Note: Students with credit for MATH 112 cannot take this course for further credit.

Prerequisites (or NONE):	MATH 111 with a C or better.
Corequisites (if applicable, or NONE):	
Pre/corequisites (if applicable, or NONE):	BIO 112.

Antirequisite Courses *(Cannot be taken for additional credit.)*

Former course code/number:

Cross-listed with:

Dual-listed with:

Equivalent course(s): **MATH 112**

(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	60
Tutorials/workshops	
Supervised laboratory hours	
Experiential (field experience, practicum, internship, etc.)	
Supervised online activities	
Other contact hours:	
Total hours	**60**

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

Department / Program Head or Director: Ian Affleck	**Date approved:**	June 18, 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:**	n/a
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. Demonstrate competence with the fundamental techniques of integration.
2. Develop and evaluate definite and improper integrals arising in a variety of situations in biology.
3. Set up and solve elementary differential equations (DEs) using graphical, numerical and analytical techniques.
4. Apply their knowledge of DEs to solve basic growth and decay problems.
5. Perform qualitative analysis on systems of DEs by finding equilibria, nullclines, and determining stability properties.
6. Apply their knowledge of DEs to construct, interpret, and criticize models of biological phenomena.
7. Set up a discrete dynamical system and use its updating functions to investigate its trajectory.
8. Find and classify equilibrium states of a discrete dynamical system analytically and by cobwebbing.

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 are interspersed with problem sessions; evaluation includes assignments, midterms, and a three-hour comprehensive final. Graphing calculators will be used. In addition, mathematical software may be used.

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.	Keshet	Calculus for the Life Sciences (II)	☐	custom open access edition	
2.	Adler & Lovric	Calculus for the Life Sciences, Modeling the Dynamics of Life 2nd Canadian ed.	☐	Nelson	2014

Typical Evaluation Methods and Weighting

Final exam:	40%	Assignments:	10%	Field experience:	%	Portfolio:	%
Midterm exam:	25%	Project:	10%	Practicum:	%	Other:	%
Quizzes/tests:	15%	Lab work:	%	Shop work:	%	Total:	100%

Details (if necessary):

The weighting of the various components may vary from instructor to instructor and from year to year, although the comprehensive final exam must be worth from 30% to 50% of the final grade. Students must obtain at least 40% on the final exam to pass the course.

Typical Course Content and Topics

Exact course content and ordering may vary slightly from year to year but will encompass the following:

I. Definite Integral:
   1. brief review of derivatives and antiderivatives
   2. integration by substitution
   3. integration by parts
   4. numerical integration including Riemann sums, trapezoidal and midpoint rules, Simpson's rule
   5. trigonometric integrals
   6. improper integrals

II. Applications: constructing Riemann sums and evaluating integrals in a wide variety of settings, including
   1. area and volume
   2. applications biology such as integrals of population densities or concentrations
   3. volumes of revolution

III. Differential Equations
   1. slope fields
   2. Euler's method
   3. separation of variables
   4. stability of equilibria
   5. analysis of systems using nullclines

IV. Models in biology
   1. single species populations
   2. interacting species (predator prey, competition models)
   3. epidemic models
   4. replicator dynamics
   5. excitable systems

V. Discrete dynamical systems
   1. explicit solutions to basic discrete dynamical systems
   2. equilibria
   3. stability of equilibria using cobwebbing