UNIVERSITY OF THE FRASER VALLEY

ORIGINAL COURSE IMPLEMENTATION DATE: September 2005

REVISED COURSE IMPLEMENTATION DATE: January 2016

COURSE TO BE REVIEWED: (six years after UEC approval) April 2021

Course outline form version: 07/07/14

OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM

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

Course Code and Number: MATH 415 **Number of Credits:** 3 Course credit policy (105)

Course Full Title: Ordinary Differential Equations II

Course Short Title (if title exceeds 30 characters): ODEs II

Faculty: Faculty of Science | **Department (or program if no department):** Mathematics and Statistics

Calendar Description:

Qualitative properties of differential equations and systems of differential equations. Existence and uniqueness theorems for nonlinear systems, iterative techniques to approximate solutions, oscillation and comparison theorems for second-order linear equations, matrix techniques for linear systems, diffeomorphisms for nonlinear systems, and Lyapunov functions.

Prerequisites (or NONE):	MATH 211, MATH 255, one of (MATH 214 or MATH 265), and one of (MATH 152 or MATH 221).
Corequisites (if applicable, or NONE):	
Pre/corequisites (if applicable, or NONE):	

Equivalent Courses (cannot be taken for additional credit)

Former course code/number:

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: 45

Typical structure of instructional hours:

Lecture hours	45
Seminars/tutorials/workshops	
Laboratory hours	
Field experience hours	
Experiential (practicum, internship, etc.)	
Online learning activities	
Other contact hours:	
Total	**45**

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 second year.

Department / Program Head or Director: Cynthia Loten	**Date approved:**	September 30, 2005
Campus-Wide Consultation (CWC)	**Date of posting:**	March 27, 2015
Faculty Council approval	**Date approved:**	March 2015
Dean/Associate VP: Lucy Lee	**Date approved:**	March 2015
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	April 24, 2015

Learning Outcomes

On completion of the course, the successful student will be able to:
1. Discuss the proofs and relevance of fundamental theorems, for example, uniqueness under Lipschitz continuity;
2. Determine qualitative properties of zeroes of solutions;
3. Use diffeomorphisms to analyse local behaviour of nonlinear systems.
4. Construct Lyapunov functions to prove stability.
5. Convert a differential equation to an equivalent integral equation and solve by Picard iteration.

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)

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.	Arnol'd, V.I.	Ordinary differential equations	☐	Springer-Verlag	1978
2.	Birkhoff, G., G.-C. Rota	Ordinary differential equations	☐	Wiley	1989
3.	Hirsch, M.W., S. Smale	Differential equations, dynamical systems, and linear algebra	☐	Academic Press	1974
4.	Simmons, G.W.	Differential equations with applications and historical notes	☐	McGraw-Hill	1991
5.	Waltman, P.	A second course in elementary differential equations	☐	Dover	2004

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

Use this section for supplies and materials for all sections of this course.

Typical Evaluation Methods and Weighting

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

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

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

Typical Course Content and Topics

1. Existence theorem, Lipschitz condition, uniqueness theorem for first order nonlinear systems.
2. Sturm oscillation and separation theorems for approximate behaviour of zeroes of second order linear equations.
3. Matrix methods for linear systems, exponential of a matrix, classification of critical points using eigenvalues.
4. Study of critical points of nonlinear systems by diffeomorphism to linear systems.
5. Lyapunov functions, energy estimates.
6. Equivalent integral equations, Picard iteration, contraction mappings.