

COURSE IMPLEMENTATION DATE: September 2005  
 COURSE REVISED IMPLEMENTATION DATE: September 2006  
 COURSE TO BE REVIEWED: September 2009  
 (Four years after UPAC Final Approval Date) (MONTH YEAR)

**OFFICIAL COURSE OUTLINE INFORMATION**

Students are advised to keep course outlines in personal files for future use.  
 Shaded headings are subject to change at the discretion of the department and the material will vary  
 - see course syllabus available from instructor

FACULTY/DEPARTMENT:	Science, Health & Human Services / Mathematics & Statistics	
<b>MATH 415</b>		<b>3</b>
COURSE NAME/NUMBER	FORMER COURSE NUMBER	UCFV CREDITS
	<b>Ordinary Differential Equations II</b>	
COURSE DESCRIPTIVE TITLE		

**CALENDAR DESCRIPTION:**

This course will study qualitative properties of differential equations and systems of differential equations. Topics include 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: **MATH 211, MATH 214 or MATH 265, MATH 255, and one of MATH 152 or MATH 221.**  
 COREQUISITES:

SYNONYMOUS COURSE(S)	<b>SERVICE COURSE TO:</b>
(a) Replaces: _____ (Course #)	_____
(b) Cannot take: _____ For further credit. (Course #)	_____
	(Department/Program)

TOTAL HOURS PER TERM:	<b>60</b>	TRAINING DAY-BASED INSTRUCTION
<b>STRUCTURE OF HOURS:</b>		LENGTH OF COURSE: _____
Lectures:	<b>60</b> Hrs	HOURS PER DAY: _____
Seminar:	Hrs	
Laboratory:	Hrs	
Field Experience:	Hrs	
Student Directed Learning:	Hrs	
Other (Specify):	Hrs	

MAXIMUM ENROLLMENT:	<b>36</b>
EXPECTED FREQUENCY OF COURSE OFFERINGS:	<b>Every second year</b>
<b>WILL TRANSFER CREDIT BE REQUESTED? (lower-level courses only)</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>WILL TRANSFER CREDIT BE REQUESTED? (upper-level requested by department)</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>TRANSFER CREDIT EXISTS IN BCCAT TRANSFER GUIDE:</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

**AUTHORIZATION SIGNATURES:**

Course Designer(s): _____ Erik Talvila	Chairperson: _____ Gillian Mimmack ( <i>Curriculum Committee</i> )
Department Head: _____ Gillian Mimmack	Dean: _____ Jacalyn Snodgrass
PAC Approval in Principle Date: _____	PAC Final Approval Date: September 30, 2005

**LEARNING OBJECTIVES / GOALS / OUTCOMES / LEARNING OUTCOMES:**

On completion of the course, the successful student will be able to:

1. Prove existence for first order nonlinear systems under conditions of continuity;
2. Prove uniqueness under Lipschitz continuity;
3. Prove the Sturm separation and comparison theorems;
4. Determine qualitative properties of zeroes of solutions using the above two theorems;
5. Use diffeomorphisms to analyse local behaviour of nonlinear systems.
6. Construct Lyapunov functions to prove stability.
7. Convert a differential equation to an equivalent integral equation and solve by Picard iteration.

Students will extend and generalize the concepts covered in MATH 255.

**METHODS:**

This course will be primarily lecture based.

**PRIOR LEARNING ASSESSMENT RECOGNITION (PLAR):**

Credit can be awarded for this course through PLAR (Please check:)  Yes  No

**METHODS OF OBTAINING PLAR:**

Course challenge. Please check online at <http://www.ucfv.ca/math/challenge.htm> for the departmental challenge policy.

**TEXTBOOKS, REFERENCES, MATERIALS:**

[Textbook selection varies by instructor. An example of texts for this course might be:]

The textbook is chosen by a departmental curriculum committee. Recommended texts are:

- V.I. Arnol'd. Ordinary differential equations. Springer-Verlag.
- G. Birkhoff and G.-C. Rota, Ordinary differential equations. Wiley.
- M.W. Hirsch and S. Smale. Differential equations, dynamical systems, and linear algebra. Academic Press.
- G.F. Simmons. Differential equations with applications and historical notes. McGraw-Hill.

**SUPPLIES / MATERIALS:**

**STUDENT EVALUATION:**

[An example of student evaluation for this course might be:]

Assignments	40%
Term Tests	20%
Final Exam	40%

Students must obtain at least 40% on the final exam in order to pass the course.

**COURSE CONTENT:**

[Course content varies by instructor. An example of course content might be:]

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.