

CURRICULUM GUIDE: OFFICIAL COURSE OUTLINE

Course Code	MATH 255	Course Title	Ordinary Differential Equations			
Credit Value	3	Department	Mathematics and Science			
No. of weeks	14	Hrs. per week	<i>Lecture</i>	<i>Tutorial</i>	<i>Laboratory</i>	<i>Total</i>
			4	0	0	4
Course Description	This is a first course in the theory of ordinary differential equations. Topics include the solution of first- and higher order differential equations (ODEs), Laplace transforms, linear and non-linear systems, stability, Euler methods and applications. Analytic and quantitative methods will be used to investigate the solutions to ODEs and discuss their behavior.					
Prerequisite(s)	ENGL 098, MATH 152 or MATH 105 (B)					
Initial Articulation Targets	<i>UBC</i>	<i>SFU</i>	<i>UVic</i>	<i>UNBC</i>	<i>TRU</i>	
	MATH 255 (3)	MATH 260 (3) – Q	MATH 2XX (1.5)	MATH 2XX (3)	MATH 2240 (3)	
	For updated information on the transferability of this course, please consult the BC Transfer Guide, www.bctransferguide.ca					
Learning Outcomes	<p>Upon successful completion of this course, the student will be able to:</p> <ul style="list-style-type: none"> • Compute solutions to various differential equations (including separable equations, exact equations, second order linear equations, and impulse functions) using the most appropriate technique. • Analyze the behavior of solutions to differential equations such as the above using analytic and qualitative techniques. • Estimate solutions to differential equations using approximation techniques. • State the definition of the Laplace transform of a function and determine the Laplace transforms for various functions (e.g., basic functions, derivatives, integrals and periodic functions) including their inverse transforms. • Use Laplace transforms to solve various problems including initial value problems, integral equations and integro-differential equations. • Model and solve application problems using linear and non-linear first-order differential equations, including exponential growth, Newton's law of cooling, the (damped) harmonic oscillator and (for systems of ODEs) compartment models. • Describe the mathematical foundations of the techniques we study and why they are valid. • Formulate and solve application problems from various fields using differential equations and interpret the solutions in the given context. 					



Content

Core topics – all of the following will be covered:

- Introduction
 - Direction fields
 - Solutions of differential equations
 - Classification of differential equations

- First Order Differential Equations
 - Linear equations with variable coefficients
 - Separable equations
 - Modeling with first order equations
 - Differences between linear and non-linear equations
 - Autonomous equations and population dynamics
 - Exact equations
 - Existence and uniqueness theorem

- Second Order Linear Equations
 - Homogeneous equations with constant coefficients
 - Fundamental solutions of homogenous equations
 - Linear Independence and the Wronskian
 - Complex Roots of the Characteristic Equation
 - Repeated Roots; Reduction of Order
 - Non-Homogeneous Equations
 - Variation of Parameters
 - Mechanical and Electrical Vibrations*
 - Forced Vibrations*

- The Laplace Transform
 - Definition of the Laplace Transform
 - Solution of Initial Value Problems
 - Step Functions
 - Ordinary Differential Equations with Discontinuous Forcing Functions
 - Impulse Functions
 - The Convolution Integral

- Systems of First Order Linear Equations
 - Introduction
 - Review of Matrices
 - Linear Independence, Eigenvalues, Eigenvectors
 - Basic Theory of Systems of 1st Order Linear Equations
 - Homogeneous Systems with Constant Coefficients
 - Complex Eigenvalues
 - Fundamental Matrices
 - Repeated Eigenvalues
 - Non-Homogeneous Linear Systems



	<ul style="list-style-type: none"> • Numerical Methods <ul style="list-style-type: none"> ○ The Euler Method ○ The Runge-Kutta Method • Nonlinear autonomous planar systems <ul style="list-style-type: none"> ○ Critical points and linearization ○ Stability and classification of isolated critical points ○ Applications <p>Additional topics may also be covered, at the discretion of the instructor:</p> <ul style="list-style-type: none"> • Series solutions of second order linear equations <ul style="list-style-type: none"> ○ Series solutions near an ordinary point ○ Euler equations ○ Series solution near a regular singular point 		
Methods of Instruction	Lecture, seminar, problem-based learning, group work		
Required Textbook(s)	<p>The following textbook(s) is/are required, or approved equivalent(s).</p> <p>Boyce, William E. et al. Elementary Differential Equations and Boundary Value Problems. 12th Ed. Wiley, 2021.</p> <p>Trench, William F. Elementary Differential Equations with Boundary Value Problems. Open Textbook Library. 2013.</p>		
Required Equipment and Technology	<p>Students are required to have a computer with internet access.</p> <p>The following resources are provided by the College:</p> <ul style="list-style-type: none"> • Office 365 • Student email 		
Homework Hours	At minimum, students can expect one hour of homework for every hour of instructional time.		
Evaluation	<i>Component</i>	<i>% Value</i>	
	Assignments, in-class activities, participation	10-30%	
	Quizzes	10-30%	
	Midterm examination(s)	20-30%	
	Final examination	30-35%	
Completion Requirements	The minimum grade to pass this course is D (50%). Unless otherwise stated, a minimum grade of C- (55%) is required for this course to fulfil a prerequisite.		
Course Designer(s)	Keira Gunn, M.Sc. Coordinator, Mathematics Department, Alexander College	Consultant(s), if applicable	Len Berggren, Ph.D., Department of Mathematics, Simon Fraser University
Dean's Approval	Barbara Moon, Ph.D., Dean of Arts and Sciences, Alexander College	Dean's Approval Date	September 30, 2015



Curriculum Committee Approval Date	September 30, 2015	First Term Offered	Winter 2016
Last Review Date	August 11, 2023	Next Review Date	August 11, 2028
Revision History	October 11, 2013 - Assessment revised slightly, topics added to better match Math SFU's Math 215. Approved by Dr. Len Berggren (SFU) and Dr. Barbara Moon (Dean of Arts and Sciences, Alexander College) May 1, 2014 - All MATH and STAT courses will be 4 hours, commencing Fall 2014. SASC August 11, 2023- Topics revised slightly to better match SFU's Math 260 and UBC's Math 255/215		