Ontario eSecondary School
Course Outline
2024-2025

Ministry of Education Course Title: Calculus and Vectors, University Preparation	
Ministry Course Code: MCV4U	
Course Type: University Preparation	
Grade: 12	
Credit Value: 1.0	
Prerequisite(s): Advanced Functions (MHF4U), University Preparation (pre or co-requisite)	
Department: Mathematics	
Course developed by: **Marieta Angjeli**	**Date: March 2019** **Revised: June 2024**
Length: One Semester	**Hours:** 110
This course has been developed based on the following Ministry documents: 1. *The Ontario Curriculum, Grades 11 and 12 Mathematics, Revised 2007* 2. Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools (2010) 3. Learning For All (2013)	

COURSE DESCRIPTION/RATIONALE

This course builds on students' previous experience with functions and their developing understanding of rates of change. Students will solve problems involving geometric and algebraic representations of vectors and representations of lines and planes in three dimensional spaces; broaden their understanding of rates of change to include the derivatives of polynomial,

sinusoidal, exponential, rational, and radical functions; and apply these concepts and skills to the modelling of real-world relationships, and communicating subject-matter skills and strategies with peers. Students will also refine their use of the mathematical processes necessary for success in senior mathematics. This course is intended for students who choose to pursue careers in fields such as science, engineering, economics, and some areas of business, including those students who will be required to take a university-level calculus, linear algebra, or physics course.

OVERALL CURRICULUM EXPECTATIONS

A. Rate of Change

By the end of this course, students will:

- Demonstrate an understanding of rate of change by making connections between average rate of change over an interval and instantaneous rate of change at a point, using the slopes of secants and tangents and the concept of the limit;
- Graph the derivatives of polynomial, sinusoidal, and exponential functions, and make connections between the numeric, graphical, and algebraic representations of a function and its derivative
- Verify graphically and algebraically the rules for determining derivatives; apply these rules to determine the derivatives of polynomial, sinusoidal, exponential, rational, and radical functions, and simple combinations of functions; and solve related problems.

B. Derivatives and Their Applications

By the end of this course, students will:

- Make connections, graphically and algebraically, between the key features of a function and its first and second derivatives, and use the connections in curve sketching
- Solve problems, including optimization problems, that require the use of the concepts and procedures associated with the derivative, including problems arising from real-world applications and involving the development of mathematical models.

C. Geometry and Algebra of Vectors

By the end of this course, students will:

- Demonstrate an understanding of vectors in two-space and three-space by representing them algebraically and geometrically and by recognizing their applications
- Perform operations on vectors in two-space and three-space, and use the properties of these operations to solve problems, including those arising from real-world applications
- Distinguish between the geometric representations of a single linear equation or a system of two linear equations in two-space and three-space, and determine different geometric configurations of lines and planes in three-space
- Represent lines and planes using scalar, vector, and parametric equations, and solve problems involving distances and intersections.

COURSE CONTENT

Unit	***Length***
Unit 1: Rate of Change and Limits	10 hours
Unit 2: Derivatives and their Applications	20 hours
Unit 3: Curve Sketching and Optimization	20 hours
Unit 4: Derivatives of Expo and Trigs	14 hours
Unit 5: Geometry and Algebra of Vectors	20 hours
Unit 6: Equations of Lines and Planes	20 hours
Culminating Project and Final Exam	6 hours
Total	**110 Hours**

UNIT DESCRIPTIONS

Unit 1 - Rate of Change
Students will demonstrate an understanding of rate of change by making connections between average rate of change over an interval and instantaneous rate of change at a point, using the slopes of secants and tangents and the concept of the limit. Students will learn about limit properties and continuous and discontinuous functions.

Unit 2 - Derivatives and their Applications
Students will graph the derivatives of polynomial functions and make connections between the numeric, graphical, and algebraic representations of a function and its derivative. Students will verify graphically and algebraically the rules for determining derivatives. They will further apply these rules to determine the derivatives of polynomial, rational and radical functions, and simple combinations of functions. Students will solve related problems.

Unit 3- Curve Sketching and Optimization
Students will make connections, graphically and algebraically, between the key features of a function and its first and second derivatives and use the connections in curve sketching. Students will solve problems, including optimization problems, that require the use of the concepts and procedures associated with the derivative, including problems arising from real-world applications and involving the development of mathematical models.

Unit 4 - Derivatives of Exponential and Trigonometric Functions
Students will graph the derivatives of sinusoidal, and exponential functions, and make connections between the numeric, graphical, and algebraic representations of a function and its derivative. Students will verify graphically and algebraically the rules for determining derivatives and apply these rules to determine the derivatives of sinusoidal and exponential functions, and simple combinations of functions. In addition, they will solve related problems.

Unit 5 - Geometry and Algebra of Vectors
Students will demonstrate an understanding of vectors in two-space and three-space by representing them algebraically and geometrically and by recognizing their applications in real world scenarios. In addition, students will perform operations on vectors in two-space and three-space and use the properties of these operations to solve problems, including those arising from real-world applications. Students will distinguish between the geometric representations of a single linear equation or a system of two linear equations in two-space and three-space and determine different geometric configurations of lines and planes in three-space. In addition, students will represent lines and planes using scalar, vector, and parametric equations, and solve problems involving distances and intersections of lines and planes.

TEACHING AND LEARNING STRATEGIES

In this course, students will experience the following activities.

General

Presentations with embedded videos are utilized to outline concepts, explain theory with the use of examples and practice questions, and incorporate multi-media opportunities for students to learn more (e.g. online simulations, quizzes, etc.).

Reflection is an opportunity for students to look back at concepts and theories with new eyes, to relate theory to practice, and to align learning with their own values and beliefs.

Discussions with the instructor are facilitated through video conferencing, discussing the concepts and skills being studied. This enables two-way communication between the student and the instructor, to share

ideas and ask questions in dialogue. This also helps to build a relationship between the student and instructor.

Instructor demonstrations (research skills, etc.) are opportunities for the instructor to lead a student through a concept or skill through video conferencing, videos, or emailing with the student.

Discussion forums are an opportunity for students to summarize and share their ideas and perspectives with their peers, which deepens understanding through expression. It also provides an opportunity for peer-to-peer feedback.

Practical extension and application of knowledge are integrated throughout the course. The goal is to help students make connections between what they learn in the classroom and how they understand and relate to the world around them and their own lives. Learning becomes a dynamic opportunity for students to be more aware that their learning is all around them and enable them to create more meaning in their lives.

Individual activities/assignments assessments are completed individually at a student's own pace and are intended to expand and consolidate the learning in each lesson. Individual activities allow the teacher to accommodate interests and needs and to assess the progress of individual students. For this reason, students are encouraged to discuss IEPs (Individual Education Plans) with their teacher and to ask to modify assessments if they have a unique interest that they feel could be pursued in the assessment. The teacher plays an important role in supporting these activities by providing ongoing feedback to students, both orally and in writing.

STEM

Virtual simulations are interactive websites that provide students with an opportunity to ask questions, explore hypotheses, relate variables, examine relationships, and make connections between theory and application in a safe environment that promotes intellectual risk taking and curiosity.

Virtual labs are interactive websites that provide students with an opportunity to follow a procedure to test hypotheses using scientific apparatus, gather and record observations, analyze observations using formula and relevant theory/concepts, and then formulate conclusions that relate hypotheses to analysis.

Diagrams are visual representations of scientific ideas and concepts. They provide another perspective to organize ideas. Visuals are thought to promote cognitive plasticity - meaning, they can help us change our minds or help us to remember an idea.

Graphics/images are visual representations of ideas/concepts. Visuals are thought to promote cognitive plasticity - meaning, they can help us change our minds or help us to remember an idea.

Charts are visual representations of scientific ideas and concepts using math that support analysis.

Tables involve organizing information in terms of categories (rows and columns). This helps us to understand the relationships between ideas and data, as well as highlight trends.

Practice problems provide students with a scenario/problem to solve by applying concepts and skills learned in a context. This helps students to understand the relevance of their learning.

Design projects are an opportunity for students to put their learning to the test in a real-world scenario, to address a design problem with a direct connection to people, the environment, economics, etc. Students collect information, apply problem solving, and use critical thinking to develop practical solutions that directly address their design problems.

ASSESSMENT, EVALUATION, AND REPORTING

Assessment: The process of gathering information that accurately reflects how well a student is achieving the identified curriculum expectations. Teachers provide students with descriptive feedback that guides their efforts towards improved performance. These assessments are not for marks.

- In assessment for learning (AFL), teachers provide students with descriptive feedback and coaching for improvement.

- In assessment as learning (AAL), teachers help students develop their capacity to be independent, autonomous learners who are able to set individual goals, monitor their own progress, determine next steps, and reflect on their thinking and learning.

Evaluation: Assessment of Learning (AOL) focuses on evaluation which is the process of making a judgement about the quality of student work on the basis of established criteria over a limited, reasonable period of time.

Reporting: Involves communicating student achievement of the curriculum expectations and Learning Skills and Work Habits in the form of marks and comments as determined by the teacher's use of professional judgement.

STRATEGIES FOR ASSESSMENT

Assessment practices can nurture students' sense of progress and competency and information instruction. Many diagnostic tools, e.g. checklists and inventories, are used at regular intervals throughout the units to encourage students' understanding of their current status as learners and to provide frequent and timely reviews of their progress. Assessment of student acquisition of listening and talking, reading and viewing and writing skills also occurs regularly through unobtrusive teacher observation and conferencing.

Units conclude with performance tasks. Teachers are encouraged to share goals with students early in the course and to connect unit learning experiences frequently and explicitly with big ideas, overall expectations, and performance tasks, i.e. check bricks; teacher-adapted generic rubrics available in many sources, including the *Ontario Secondary School Literacy Course (OSSLC) Profile,* so that they are more task-specific. The teacher might ask: "What does the criteria look like for this particular task?" Or "What does limited effectiveness look like?" The teacher could involve students in the discussion or creation of rubrics, and teach students to use rubrics as a learning tool that can support the writing process and practice.

ASSESSMENT ACTIVITIES

- ❑ Discussion forums
- ❑ Tests and quizzes
- ❑ Reflections
- ❑ Graphs - plotting and analyzing
- ❑ Problem solving calculations
- ❑ Lab reports
- ❑ Simulation, lab, and case study worksheets
- ❑ Research projects and reports
- ❑ Design projects and reports
- ❑ End of unit conversations (Google Meets)
- ❑ Final exam

EVALUATION

The final grade will be determined as follows:

- 70% of the grade will be based on evaluation conducted throughout the course. This portion of the grade should reflect the student's most consistent level of achievement throughout the course, although special consideration will be given to more recent evidence of achievement.
- 30% of the grade will be based on a final evaluation administered at the end of the course. This evaluation will be based on evidence from a final project and final exam, both comprehensive of the course. The final evaluation is an opportunity for the student to demonstrate comprehensive achievement of the overall expectations for the course.

(*Growing Success: Assessment, Evaluation and Reporting in Ontario Schools*. Ontario Ministry of Education Publication, 2010 p.41)

	Weight
Course Work	**70**
Knowledge/Understanding (K)	17.5
Thinking/Inquiry (T)	17.5
Communication (C)	17.5
Application (A)	17.5
Final	**30**
Exam	20
Culminating Project	10

TERM WORK EVALUATIONS (70%)

Evaluation Item	Description	Category	Weight
Unit 1	Assignment 1.3 Quiz	K, T, C, A	12%
Unit 1	Unit 1 Culminating Assignment	K, T, C, A	
Unit 1	Unit 1 Test	K, T, C, A	
Unit 2	2.3 Quiz	K, T, C, A	12%
Unit 2	Unit 2 Culminating Assignment	K, T, C, A	
Unit 2	Unit 2 Test	K, T, C, A	
Unit 3	3.3 Quiz	K, T, C, A	13%
Unit 3	Unit 3 Project	K, T, C, A	
Unit 3	Unit 3 Test	K, T, C, A	
Unit 4	Assignment 4.2 Quiz	K, T, C, A	
Midterm			
Unit 4	Unit 4 Culminating Assignment	K, T, C, A	11%
Unit 4	Unit 4 Test	K, T, C, A	
Unit 5	5.3 Quiz	K, T, C, A	11%
Unit 5	Unit 5 Culminating Assignment	K, T, C, A	
Unit 5	Unit 5 Test	K, T, C, A	
Unit 6	6.2 Quiz	K, T, C, A	11%
Unit 6	Unit 6 Culminating Activity	K, T, C, A	
Unit 6	Unit 6 Test	K, T, C, A	

FINAL EVALUATIONS (30%)

Evaluation Item	Description	Category	Weight
Final Project	Culminating Assignment	K, T, C, A	10
Final Exam	Proctored Final Exam	K, T, C, A	20

AAL/AFL/AOL TRACKING SHEET

Unit 1: Rates of Change and Limits

AAL	AFL	AOL
Discussion Forums	Continuity Assignment	Culminating Activity
Assignment Quizzes		Unit 1 Test
Lesson Notes and Problem Set submissions		Assignment Quiz

Unit 2: Derivatives

AAL	AFL	AOL
Lesson Notes and Problem Set submissions	2.1 Assignment Quiz	2.3 Quiz
Discussion Forums	2.2 Assignment Quiz	Unit 2 Culminating Project
	2.4 Assignment Quiz	Unit 2 Test

Unit 3: Curve Sketching and Optimization

AAL	AFL	AOL
Lesson Notes and Problem Set submissions	3.1 Assignment Quiz	3.3 Quiz
Discussion Forums	3.2 Assignment Quiz	Unit 3 Culminating Project
	3.4 Assignment Quiz	Unit 3 Test
	3.5 Assignment Quiz	

Unit 4: Derivatives of Exponential and Trigonometric Functions

AAL	AFL	AOL
Lesson Notes and Problem Set submissions	4.1 Assignment Quiz	4.2 Assignment Quiz
Learning Log	4.3 Assignment Quiz	Unit 4 Culminating Project
Discussion Forums		Unit 4 Test

Unit 5: Geometry and Algebra of Vectors

AAL	AFL	AOL
Lesson Notes and Problem Set submissions	5.1 Assignment Quiz	5.3 Assignment Quiz
Discussion Forums	5.2 Assignment Quiz	Unit 5 Culminating Project
	5.4 Assignment Quiz	Unit 5 Test
	5.5 Assignment Quiz	
	5.6 Assignment Quiz	

Unit 6: Equations of Lines and Planes

AAL	AFL	AOL
Lesson Notes and Problem Set submissions	6.1 Assignment Quiz	6.2 Assignment Quiz
Discussion Forums	6.3 Assignment Quiz	Unit 6 Culminating Project
	6.4 Assignment Quiz	Unit 6 Test
	6.5 Assignment Quiz	

CONSIDERATION FOR PROGRAM PLANNING

PLANNING PROGRAMS FOR STUDENTS WITH SPECIAL EDUCATION NEEDS

Classroom teachers are the key educators of students who have special education needs. They have a responsibility to help all students learn, and they work collaboratively with special education teachers, where appropriate, to achieve this goal. Special Education Transformation: The Report of the Co-Chairs with the Recommendations of the Working Table on Special Education, 2006 endorses a set of beliefs that should guide program planning for students with special education needs in all disciplines. Those beliefs are as follows: All students can succeed. Universal design and differentiated instruction are effective and interconnected means of meeting the learning or productivity needs of any group of students. Successful instructional practices are founded on evidence-based research, tempered by experience.

PROGRAM CONSIDERATIONS FOR ENGLISH LANGUAGE LEARNERS

Ontario schools have some of the most multilingual student populations in the world. The first language of approximately 20 percent of the students in Ontario's English language schools is a language other than English. Ontario's linguistic heritage includes several Aboriginal languages; many African, Asian, and European languages; and some varieties of English, such as Jamaican Creole. Many English language learners were born in Canada and raised in families and communities in which languages other than English were spoken, or in which the variety of English spoken differed significantly from the English of Ontario classrooms. Other English language learners arrive in Ontario as newcomers from other countries; they may have experience of highly sophisticated educational systems, or they may have come from regions where access to formal schooling was limited. When they start school in Ontario, many of these students are entering a new linguistic and cultural environment.

THE ROLE OF TECHNOLOGY IN THE PROGRAM

Information and communications technologies (ICT) provide a range of tools that can significantly extend and enrich teachers' instructional strategies and support students' language learning. ICT tools include multimedia resources, databases, Internet websites, digital cameras, and word-processing programs. Tools such as these can help students to collect, organize, and sort the data they gather and to write, edit, and present reports on their findings. Information and communications technologies can also be used to connect students to other schools, at home and abroad, and to bring the global community into the local classroom. Whenever appropriate, therefore, students should be encouraged to use ICT to support and communicate their learning.

ACCOMMODATIONS

Accommodations will be based on meeting with parents, teachers, administration and external educational assessment reports. The following three types of accommodations may be provided:

- ***Instructional accommodations:*** such as changes in teaching strategies, including styles of presentation, methods of organization, or use of technology and multimedia.
- ***Assessment accommodations:*** such as allowing additional time to complete tests or assignments or permitting oral responses to test questions.

Other examples of modifications and aids, which may be used in this course, are:

- ❑ Provide step-by-step instructions.
- ❑ Help students create organizers for planning writing tasks.
- ❑ Allow students to report verbally to a scribe (teacher/ student) who can help in note taking.
- ❑ Permit students a range of options for reading and writing tasks.
- ❑ Where an activity requires reading, provide it in advance.
- ❑ Provide opportunities for enrichment.