INSTITUTE OF CANADIAN EDUCATION

Course Title: Calculus and Vectors, Grade 12, University Preparation (MCV4U)
Course Name: Calculus and Vectors
Course Code: MCV4U
Grade: 12
Course Type:University preparation
Credit Value: 1.0
Prerequisite: The new Advanced Functions course (MHF4U) must be taken prior to or concurrently with Calculus and Vectors (MCV4U)
Curriculum Policy Document: Mathematics, The Ontario Curriculum, Grades 11 and 12, 2007 (Revised); Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools (2010)
Course Developer: Institute of Canadian Education.
Department: Mathematics
Head of Department: Meena Yohan
Development Date: 2025
Most Recent Revision Date: August 2026

Course Description

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 space; 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. 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.

COURSE EXPECTATION

UNIT	UNIT NAME	UNIT DESCRIPTION	TIME
Unit 1	Geometry and Algebra of Vectors	Students work with vectors in 2D and 3D, including operations, magnitude, direction, and applications to geometry and physics.	21 Hours
Unit 2	Equations of Lines and Planes	Students represent and analyze lines and planes using vector, parametric, and Cartesian equations, including intersections, angles, and distances.	20 Hours
Midterm Exam	–	Assessment of Units 1–2.	2 Hours
Unit 3	Rates of Change	Students explore average and instantaneous rates of change and develop an introduction to limits and derivatives.	20 Hours
Unit 4	Derivatives and Applications	Students apply differentiation rules to polynomial, rational, exponential, and trigonometric functions, including motion, optimization, and related rates.	25 Hours
Unit 5	Curve Sketching	Students use first and second derivatives to analyze function behaviour, including intervals, concavity, inflection points, asymptotes, and intercepts.	20 Hours
Final Exam	–	Assessment of all course content.	2 Hours
TOTAL	–	–	110 Hours

Overall Curriculum Expectations:

A. GEOMETRY AND ALGEBRA OF VECTORS	
A1	Introduction to Vectors
A2	Operations with Geometric Vectors
A3	Algebraic (Cartesian) Vectors
A4	Dot Product
A5	Cross Product
A6	Properties of Vectors
A7	Applications of Vector
A8	Practice Test
B. Equations of Lines and Planes	
B1	Equations of Lines in 2-Space
B2	Equations of Lines in 3-Space
B3	Vector and Parametric Equations of a Plane
B4	Scalar Equation of a Plane
B5	Investigation of the Intersection of Planes
B6	Intersections of Lines and Planes
B7	Unit Review
C. Rates of Change	
C1	Rates of Change
C2	Slope and Limits
C3	Maximums and Minimums
C4	Graphs of the Derivative
C5	Derivatives
C6	Practice Test
D. Derivatives and their Applications	

D1	Graphing Derivatives of Exponential Functions
D2	Special Exponential Function
D3	Applications
D4	Graphing of Derivatives
D5	Trig Functions
D6	Practice Test
E. Curve Sketching	
E1	Characteristics of a Function given its Derivative
E2	Graphs of Functions and their Derivatives
E3	Transformations and Graphs of Derivative Functions
E4	Concavity, Points of Inflection and Rate of Change of the Dependent Variable
E5	Inflection Points and The Second Derivative
E6	Sketching Graphs of Polynomial and Rational Functions
E7	Applications of Curve Sketching
E8	Unit Review

TEACHING AND LEARNING STRATEGIES

Students will engage in a variety of learning activities designed to develop knowledge, skills, critical thinking, communication, and problem-solving.

- Multimedia Lessons: Videos, presentations, examples, practice questions, simulations, quizzes, and other digital resources support different learning styles.
- Teacher–Student Discussions: Video conferencing, discussions, and instructor demonstrations provide opportunities to ask questions, clarify concepts, and receive feedback.
- Discussion Forums: Students share ideas, explain concepts, and provide constructive peer feedback.
- Reflection: Students connect course concepts to real-world situations, personal experiences, and prior learning.
- Individual Activities and Assessments: Students complete assignments and practice activities at their own pace to reinforce and demonstrate learning. Teachers provide ongoing written and verbal feedback.
- Visual Learning: Diagrams, graphics, charts, and tables help students organize information, identify relationships, and interpret data.

- Practice Problems: Students apply concepts and skills to mathematical and real-world problems to strengthen understanding and problem-solving.
- Design and Application Projects: Students apply their learning to practical problems and develop solutions using research, critical thinking, and problem-solving skills.

Assessment Strategies

Students will be provided with numerous and varied opportunities to demonstrate the full extent of their achievement of the curriculum expectations, across all four categories of the Achievement Chart. Progress will be monitored on an on-going basis using a variety of assessment tools, including written work, formal testing, quizzes, teacher-student communication, discussion boards and chat rooms.

ASSESSMENT ACTIVITIES

- Discussion Forums
- Tests and Quizzes
- Reflections
- Graphing, Plotting, and Data Analysis
- Problem-Solving Calculations
- Lab Reports
- Simulation, Lab, and Case Study Worksheets
- Research Projects and Reports
- Design Projects and Reports
- End-of-Unit Conversations (Google Meet)

Final Grade

The final grade will be determined as follows (in accordance with Ministry of Education standards):

Term Work Based on evaluations conducted throughout the course.	65%
Final Evaluation A final evaluation in the form of a written exam.	25%
Attendance and Participation	10%

Final Examination Breakdown

- 25% written exam

ATTENDANCE POLICY

Regular attendance and active engagement are important for student success. Attendance and participation are monitored through the school's Learning Management System (LMS).
All online credit courses at ICE are designed to meet or exceed the minimum 110 hours of instructional time required for a credit course.
Online instructional time and engagement are monitored through:

- LMS Engagement: Students are expected to log in regularly and actively participate in online learning activities. LMS activity records are used to monitor engagement.
- Biweekly Check-Ins: Students complete a brief check-in every two weeks to review their progress and engagement. Additional support may be provided when concerns are identified.
- Post-Unit Quizzes: Short formative quizzes are completed at the end of each unit to monitor student progress and pacing.
- Discussion Forums: Students participate in required unit discussions and peer activities. Participation is monitored based on completion and engagement.
- Instructional Records: The school maintains records of instructional time, attendance, and student engagement.

Students are responsible for maintaining regular participation and completing required learning activities within the course schedule.

EVALUATION MODEL – 10% TOTAL ATTENDANCE AND ENGAGEMENT WEIGHT

Component	Weight	Quantifiable Metric	Criteria
Biweekly Check-In	3%	Completed every two weeks	Students complete the required check-in within the scheduled time frame.
Post-Unit Formative Quiz	4%	Completed after each unit	Students complete the formative quiz by the assigned deadline.
Discussion Forum Participation	3%	Required posts and responses	Students submits the required original response and completes assigned peer responses.

CONSIDERATIONS FOR PROGRAM PLANNING

Planning Programs for Students with Special Education Needs
Students are supported through Universal Design for Learning, differentiated instruction, and accommodations identified in their IEPs. The asynchronous format provides flexibility through extended time, breaks, assistive technology, and opportunities to review lessons and examples as needed.

Program Considerations for English Language Learners
ELL students are supported through clear instructional language, visual and multimedia resources, opportunities to review lessons, additional time where appropriate, and teacher feedback. Bilingual dictionaries may be permitted when appropriate.

Environmental Education
Environmental education is integrated through mathematical applications involving real-world data, including resource use, climate trends, and population growth. The online format also supports paperless learning.

Equity and Inclusive Education
Learning materials and assessments reflect diverse perspectives and experiences. Students participate in a respectful, inclusive, and supportive online learning environment.

Financial Literacy Education
Students apply mathematics to financial situations such as budgeting, saving, interest, taxes, credit, and comparing costs to support informed financial decisions.

First Nations, Métis, and Inuit Education
Where appropriate to course expectations, students explore Indigenous perspectives, histories, cultures, contributions, and contemporary issues using accurate and respectful resources.

The Role of Information and Communications Technology
ICT supports asynchronous instruction, assessment, communication, and mathematical learning. Students use digital tools such as calculators, spreadsheets, graphing tools, simulations, and other mathematical technologies to collect, analyze, represent, and communicate information. Digital citizenship, academic integrity, and responsible technology use are emphasized.

Career Education
Students develop problem-solving, reasoning, quantitative, and technology skills applicable to careers in mathematics, technology, engineering, finance, data analysis, skilled trades, and related fields.

Cooperative Education and Experiential Learning
Where appropriate, students may connect mathematical learning to workplace experiences, job-shadowing, cooperative education, and other experiential learning opportunities.

Health and Safety
Students are encouraged to maintain healthy online learning practices, including proper ergonomics, balanced screen time, regular breaks, and strategies that support well-being. A safe and respectful virtual learning environment is maintained.

Accommodations
Accommodations are provided based on IEPs and appropriate educational documentation. These may include step-by-step instructions, additional time, assistive technology, alternative response formats, planning organizers, advance access to materials, and enrichment opportunities.

Course Materials – MCV4U

Required Textbooks and Resources:

- Mathematics textbooks covering vectors, equations of lines and planes, rates of change, derivatives, curve sketching, and applications of calculus
- Supplementary resources such as online tutorials, instructional videos, interactive graphing tools, and problem-solving guides related to calculus and vectors
- Teacher-provided worksheets, practice problems, investigations, and problem-based learning tasks

Digital Resources and Software:

- Google Drive – storing, sharing, and submitting assignments and assessments
- Internet access for research, graphing tools, and mathematical reference resources
- Microsoft Office Suite (Word, Excel, PowerPoint) or equivalent software for written solutions, data tables, graphs, and presentations
- Graphing technology (e.g., Desmos, GeoGebra, or graphing calculators) for visualization and analysis

Teacher Considerations:

- Assistive technology (text-to-speech, speech-to-text, screen readers) may be used to support diverse learning needs
- Flexibility in submission formats (Google Docs, PDFs, spreadsheets, slides, or handwritten work submitted digitally)
- Guided notes, worked examples, and scaffolded instruction to support understanding of complex calculus and vector concepts

Tips for Success – MCV4U
Welcome to MCV4U: Grade 12 Calculus and Vectors – University Preparation

Check announcements and course messages daily to stay updated on lessons, assignments, and deadlines.
Stay organized:

- Review the course calendar regularly and complete all assignments, problem sets, and quizzes on time.
- Carefully read instructions and rubrics; use checklists to ensure all steps, calculations, and representations are correct.

Engage actively:

- Participate in discussions, problem-solving activities, and collaborative work to deepen understanding of vectors, derivatives, and calculus applications.

Ask for help:

- For technical issues, contact the Help Desk.
- For course-related questions, email your teacher; expect a response within 24 hours. Mark emails as "URGENT" if needed.

Key Elements to Success:

- Time Commitment: Plan for 1–2 hours of focused study each day, plus additional time for problem-solving and practice exercises.
- Communication: Maintain regular contact with your teacher for guidance, clarification, and feedback.
- Engagement: Stay curious, persistent, and attentive. Active participation and practice are essential for mastering complex calculus and vector concepts.

Remember: This course is designed to help you understand how calculus and vector concepts are applied to real-world problems in science, engineering, and technology. Approach all activities thoughtfully and accurately while developing critical thinking, problem-solving, and analytical skills.