Ontario eSecondary School
Course Outline
2019-2020

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 created: March 1st, 2017** **Date revised: May 1st, 2019**
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)

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. 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

Unit 1, 2, 4:
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.

Unit 3:
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.

Unit 5, 6:
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
1: Rate of Change and Limits	13 hours
2: Derivatives and their Applications	17 hours
3: Curve Sketching and Optimization	20 hours
4: Derivatives of Expo and Trigs	16 hours
5: Geometry and Algebra of Vectors	20 hours
6: Equations of Lines and Planes	18 hours
Culminating Project	4 hours
Final Exam	2 hours
Total	**110 Hours**

UNIT DESCRIPTIONS

Unit 1- Rates of Change and Limits
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.

Unit 6 – Equations of Lines and Planes
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

The students will experience a variety of activities:

Whole-Class Activities (facilitated through discussion forums)

Whole class activities are designed to introduce concepts and skills that are directly applicable to the workplace and to build on the content being studied during small group and individual activities. These activities include the following:

Class discussions that are facilitated through video conferencing and telephone conversations with their subject teacher or discussions with other students concerning the concepts and skills being studied.

Teacher demonstrations (research skills, etc.) through video conferencing, email, or telephone conversations with subject teacher, or videos provided of a teacher or student demonstrating the concepts and skills being studied. This helps the student and teacher create an atmosphere of trust and respect to aid in the online learning environment.

Video presentations and technological aids (research) with videos embedded to enrich the course content and clarify concepts and skills being studied. Also the use of online pre-approved quizzes and games to help a student become more familiar with the concepts and skills being studied.

Diagnostic and review activities (audio and video taping) can be student-lead or teacher lead to work as a review for students through audio and video made to share among each other to help reinforce the concepts and skills being studied.

Brainstorming, charts and graphs are a great way for students to demonstrate their knowledge of subject matter through graphic organizers, pictures, and texts. This is communicated through assignments in Moodle.

Small Group Activities

The teacher sets up small group activities to provide opportunities for active and oral learning as well as to bolster practical communication and teamwork skills. The teacher plays a critical role during group activities by monitoring group progress as well as answering questions that arise and using questions to assist students in their understanding. In this way, the teacher also facilitates student understanding of effective learning, communication, and team building during group activities.

The small group activities include the following:

Practical extension and application of knowledge is used as an effective learning strategy in this course because it allows the students to read and listen to the texts and stories and reflect back with connections to themselves, other texts and the world. Students are encouraged to share their understandings through work submitted each day, phone conversations about course work, or videoconferencing.

Oral presentations in an online environment we have the equipment to have student either live video conference oral presentations, or make videos and submit them for their oral presentations. These oral presentations can be viewed by fellow students (when appropriate) and the teacher. Students can learn from one another, and from their teacher. Such activities include dramatic readings and performances.

Individual Activities

The teacher should provide a variety of individual assignments to expand and consolidate the learning that takes place in the whole-class and small group activities. Individual activities allow the teacher to accommodate interests and needs and to access the progress of individual students. The teacher plays an important role in supporting these activities through the provision of ongoing feedback to the students, both orally and in writing. Teachers are encouraged to include individual activities such as the following in the course:

Research is completed in an online environment by teaching the students first about plagiarism rules and giving examples of good sources to use. The students are not only limited to the online search for information, but have resources available by links on the Moodle page of information that has been scanned and uploaded.

Individual assignments are worked on at a student's own pace. The teacher can support the student in these activities with ongoing feedback.

Oral presentations are facilitated through the use of video conferencing and video recording.

Practical extension and application of knowledge helps students develop their own voice, and gives them the ability to make personal connections, and connections to the world throughout their course. Students are given a variety or reading and viewing texts to give them many chances to apply their new concepts, skills, and knowledge.

Ongoing project work is something that is valued in the earning of an English credit. The ongoing project can be submitted to the teacher for ongoing feedback in both written and oral work.

Reading students are able to read material online. The students may print out the reading material to use it to highlight, take notes, and have with them when a computer is not available.

Written assignments are used to allow students to develop their skills in writing, comprehension, and communication. With the online format students submit their work, and have a chance to get feedback from the teacher, and submit their best work. This can be demonstrated with reading responses, personal writing, report writing, essay writing, script writing, business and technical writing, and individual research assignments.

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.

Evaluation: Assessment of Learning 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

- ❑ Homework assignments
- ❑ Individual conference meetings
- ❑ Discussion Forums
- ❑ Diagnostic tests and writing tasks
- ❑ Editing Checklists
- ❑ Reflections
- ❑ Oral presentations & Active Listening
- ❑ Tests & Exam
- ❑ Evaluations
- ❑ Labs and interactive diagrams

EVALUATION

The final grade will be determined as follows:

- ❑ Seventy per cent 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.

- ❑ Thirty per cent of the grade will be based on a final evaluation administered at or towards the end of the course. This evaluation will be based on evidence from one or a combination of the following: an examination, a performance, an essay, and/or another method of evaluation suitable to the course content. The final evaluation allows the student an opportunity 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)

Weightings	
Course Work	**70**
Knowledge/Understanding	17.5
Thinking/Inquiry	17.5
Communication	17.5
Application	17.5
Final Evaluation	**30**
Culminating Project	10
Final Exam	20

TERM WORK EVALUATIONS (70%):

Evaluation Item	Description	Category
Reflective research projects	Research-based projects for units 1 through 3 based on applications of derivatives, vectors and rates of change	K,T,C,A
Problem sets	Problem sets supplement lessons and are used to assess whether or not students are meeting criteria for success	K,T,C
Simulations/Live interview evaluations	Live interviews are used to evaluate students through observation and conversation. Some of these are a part of other research projects.	K,T,C,A
Unit Test(s)	Unit tests are based on curriculum expectations and cover the entirety of each unit	K,T,C,A

FINAL EVALUATIONS (30%):

Evaluation Item	Description	Category
Final Exam	A final, written examination, covering all curriculum expectations for the course.	K,T,C,A
Culminating Project	A project covering all curriculum expectations for the course.	K,T,C,A

AFL/AAL/AOL Tracking sheet:

Unit 1: Rates of Change and Limits

AAL	AFL	AOL
Discussion Forum	Gizmos Investigation	Assignment: Quiz
Assignment: Problem Set	Online quiz	Unit Project
Assignment: POODLL	Lesson Problem Set [Self-Check Answers]	Unit Test

Unit 2: Derivatives

AAL	AFL	AOL
Discussion Forum	Gizmos Investigation	Assignment: Quiz
Assignment: Problem set	Online quiz	Unit Project

Assignment: POODLL	Lesson Problem Set [Self-Check Answers]	Unit Test

Unit 3: Curve Sketching and Optimization

AAL	AFL	AOL
Discussion Forum	Gizmos Investigation	Assignment: Quiz
Assignment: Problem set	Online quiz	Unit Project
Assignment: POODLL	Lesson Problem Set [Self-Check Answers]	Unit Test

Unit 4: Derivatives of Exponential and Trigonometric Functions

AAL	AFL	AOL
Discussion Forum	Gizmos Investigation	Assignment: Quiz
Assignment: Problem set	Online quiz	Unit Project
Assignment: POODLL	Lesson Problem Set [Self-Check Answers]	Unit Test

Unit 5: Geometry and Algebra of Vectors

AAL	AFL	AOL
Discussion Forum	Investigation	Assignment: Quiz on
Assignment: Problem set	Online quiz	Unit Project
Assignment: POODLL	Lesson Problem Set [Self-Check Answers]	Unit Test

Unit 6: Equations of Lines and Planes

AAL	AFL	AOL
Discussion Forum	Investigation	Assignment: Quiz

Assignment: Problem set	Online quiz	Unit Project
Assignment:	Lesson Problem Set [Self-Check Answers]	Unit Test

Finals

AOL
Culminating Activity
Final Exam

CONSIDERATION FOR PROGRAM PLANNING

Students learn best when they are engaged in a variety of ways of learning. Guidance and career education courses lend themselves to a wide range of approaches in that they require students to research, think critically, work cooperatively, discuss relevant issues, and learn through practice in a variety of settings. Helping students become self-directed, lifelong learners is a fundamental aim of the guidance and career education curriculum. When students are engaged in active and experiential learning strategies, they tend to retain knowledge for longer periods and develop meaningful skills. Active and experiential learning strategies also enable students to apply their knowledge and skills to real-life issues and situations.

ANTIDISCRIMINATION EDUCATION IN GUIDANCE AND CAREER EDUCATION
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 per cent 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 ENGLISH 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 parent, teachers, administration and external educational assessment report. 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.
- ❑ *Environmental accommodations:* such as preferential seating or special lighting.
- ❑ *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.
- ❑ Record key words on the board or overhead when students are expected to make their own notes.
- ❑ 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.