

Course Outline

School Name: **Agincourt International Academy**

Department Name: **Mathematics**

Ministry of Education Course Title: **Calculus and Vectors**

Grade Level: **GRADE 12, UNIVERSITY PREPARATION**

Ministry Course Code: **MCV4U**

Teacher's Name: **Mr. S Chandrakanth**

Developed by: **Dr. M.Indralingam**

Date: **November 2014**

Revised by: **Mr. S Chandrakanth**

Revised Date: **May 2017**

Developed from: **Ontario Curriculum, Grade 11 and 12, Mathematics, 2007
(Revised)**

Prerequisite: **Grade 12 Advanced Functions, University (MHF4U), must be taken prior to or concurrently with Calculus and Vectors.**

Credits: **1.0**

Duration: **110 hours**

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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 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 modeling 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

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 (U1.1)
- 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 (U1.2)
- 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 (U1.3).

- 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 (U2.1)
- 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 (U2.2)

- Demonstrate an understanding of vectors in two-space and three-space by representing them algebraically and geometrically and by recognizing their applications (U3.1)
- 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 (U3.2)
- 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 (U3.3)
- Represent lines and planes using scalar, vector, and parametric equations, and solve problems involving distances and intersections (U3.4)

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Course Content

Unit	Duration
Rate of Change (U1)	26 hours
Derivatives and their Applications (U2)	48 hours
Geometry and Algebra of Vectors (U3)	36 hours
Total	110 hours

Unit 1 -Rate of Change

Students study rate of change in the context of various mathematical functions and applications from the natural and social sciences. By studying the average and instantaneous rate of change, the idea of the derivative is introduced. Students are introduced to the concept of a limit as it relates to the slope of a tangent and to instantaneous rate of change. In this unit, students extend their concept of a limit to algebraic functions and evaluate limits of polynomial, rational, and exponential functions.

Unit 2 - Derivatives and their Applications

Using paper-and -pencil method and graphing technology, student develop an understanding of the derivative and its connection to the graph of a function by referring to the behavior of the graphs.

The definition of a derivative is developed as a limiting sequence of the slopes of the secants, and students determine the derivatives of polynomial and simple rational functions from first principles. Students determine derivatives of more complex functions using derivative rules. Students determine the derivatives of logarithmic and exponential functions and use them to solve problems, including graph analysis and curve sketching.

With the aid of graphing techniques, students connect the graphs of polynomial, rational, and exponential functions with their respective equations using appropriate algebraic and calculus techniques. First and second derivatives of functions are used to sketch the graph of the function. Students also explore the relationship between the graph of a function and the graphs of its derivative functions.

Students revisit the slope of the tangent and rates of change problems, now using differentiation. Students solve problems and model functions using derivatives as the main tool Optimization and related rates problems bring together many different mathematic skills in a challenging and rich context.

Unit 3 - Geometry and Algebra of Vectors

Students operate with geometric and algebraic vectors, velocity vectors, force vectors, determine equations of lines and planes in three-space, solve systems of equations using matrices, and determine intersections of lines and planes in three-space.

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Teaching/Learning Strategies

Demonstration	Algorithm	Independent study
Reading Direct Instruction	Group work Pair Work	Computer Use Observation
Conversation	Presentations	Brainstorming
Written Assignments	Descriptive Feedback	Group Assignments

Assessment/Evaluation Strategies

Teachers of this course will work collaboratively with colleagues to regularly review course content, instructional strategies and assessment practices, and will make modifications to the program as needed to improve student achievement.

Late Assignment Policy

Naturally, all of our courses require students to complete several rich-assessment tasks that offer students a chance to demonstrate their total understanding of particular overall and specific expectations as laid out by the Ministry of Education. These assessments will measure the student's proficiency in each of the four categories of achievement: **Thinking, Knowledge, Communication, and Application.**

However, we understand that sometimes situations may arise beyond the student's control that necessitates handing in an assignment late. In such cases, AIA follows a strict protocol:

- First, the student must explain why he or she was unable to finish the assignment on time. Should this reason be medical in nature, he or she must present a doctor's note.
- If the reason is not medical – a family event, a funeral, or other social obligations – students under the age of 18 must bring a signed and dated note from their parents/guardians explaining the situation.
- If the reason is academic in nature – the student feels the task is too difficult, or that he or she does not have the appropriate amount of time based on his or her skill level – the instructor will work with the student to create a schedule wherein parts of the assignment will be due over a wider period of time.
- **If the late assignment is not handed in even after the accommodations made by the instructor, the instructor may choose to apply a late submission penalty at a rate of 2% per day up to a maximum of 25%**
- **Should there be no explanation provided, marks will be deducted from the assignment at a rate of 2% per day up to a maximum of 25%.**
- If assignments are continually being handed in late, and the student is under the age of 18, the instructor will contact the student's parents/guardians and determine a course of action to best accommodate the student's needs.

Please note that deducting marks is an **absolute last resort**. AIA believes that it is imperative for students to understand the need to adhere to deadlines and manage their time efficiently. This is a skill that is absolutely necessary to ensure future success in post-secondary institutions, the workforce, and daily life.

Assessment "For" and "As" of Learning:

Assessment is the process of gathering information from a variety of sources that accurately reflects how well a student is achieving the curriculum expectations in a course. As part of assessment, teachers will provide students with descriptive feedback that guides their efforts towards improvement.

Assessment "Of" Learning:

Evaluation is based on the four Ministry of Education achievement categories of knowledge and understanding, thinking/inquiry, communication, and application/creation. A single evaluation may include one or more of the categories. Evaluation in this course will be continuous throughout the year and will include a variety of assessment methods

The Final Grade

The percentage grade represents the quality of the students' overall achievement of the expectations for the course and reflects the corresponding achievement as described in the achievement chart for mathematics. The distribution of marks into a grade is based on the departmental assessment and evaluation guide for the course and will reflect the student's most consistent level of achievement where appropriate. Comments on the development of learning skills and contributions to the course will also be provided on reports. Term work will be 70% of the overall grade for the course; the summative evaluations will be 30% of the overall grade, incorporating summative activities and a final written examination.

Mark Breakdown

Percentage of the Overall Mark	Category	Breakdown of 70%
70% Ongoing evaluation during the semester	Knowledge/Understanding	30%
	Thinking/Inquiry	20%
	Communication	20%
	Application/Making Connection	30%
Percentage of the Overall Mark	Category	Breakdown of 30%
30% End of course evaluation	Knowledge/Understanding	30%
	Thinking/Inquiry	20%
	Communication	20%
	30% - Final Exam	Application/Making Connection

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Sample Assessment/Evaluation Strategies

A-E Strategy	Purpose D-F-S (70%)	Who is completing A-E?	Scoring Tool
Problem Solving (In-class or assignment)	Assessment as or for learning	self/peer or teacher	rubric or marking scheme
Graphing	Assessment as or for learning	self/peer or teacher	rubric or marking scheme
Computer Assisted Instruction (CAI)	Assessment for or as learning	CAI with teacher support	CAI marking tool
Textbook Use	Assessment for or as learning	self/peer or teacher	checklist
Teacher Led Review	Assessment for or as learning	self/peer or teacher	checklist
KnowledgeBuilding	Assessment as or for learning	self/peer or teacher	checklist, rubric or marking scheme
Just in Time problems	Assessment as or for learning	self/peer and teacher	checklist /student response
Quiz (written or CAI)	Assessment as learning	teacher / CAI	marking scheme / CAI
Written Test	Assessment as learning	teacher	marking scheme
Final Written Exam	Assessment of learning	teacher	marking scheme

Resources used for the course listed in Bibliographical style

Erdman, W., Ferguson, J., Lenjosek, A., Petro, D., and Speijer, J. .2008, "Calculus and Vectors 12", McGraw-Hill Ryerson

Learning Skills

Learning Skills and Work Habits		E – Excellent G – Good S – Satisfactory N – Needs Improvement	
Responsibility		Organization	
<ul style="list-style-type: none"> Fulfils responsibilities and commitments within the learning environment. Completes and submits class work, homework, and assignments according to agreed-upon timelines. Takes responsibility for and manages own behaviour. 		<ul style="list-style-type: none"> Devises and follows a plan and process for completing work and tasks. Establishes priorities and manages time to complete tasks and achieve goals. Identifies, gathers, evaluates, and uses information, technology, and resources to complete tasks. 	
Independent Work		Collaboration	
<ul style="list-style-type: none"> Independently monitors, assesses, and revises plans to complete tasks and meet goals. Uses class time appropriately to complete tasks. Follows instructions with minimal supervision. 		<ul style="list-style-type: none"> Accepts various roles and an equitable share of work in a group. Responds positively to the ideas, opinions, values, and traditions of others. Builds healthy peer-to-peer relationships through personal and media-assisted interactions. Works with others to resolve conflicts and build consensus to achieve group goals. Shares information, resources, and expertise, and promotes critical thinking to solve problems and make decisions. 	
Initiative		Self-Regulation	
<ul style="list-style-type: none"> Looks for and acts on new ideas and opportunities for learning. Demonstrates the capacity for innovation and a willingness to take risks. Demonstrates curiosity and interest in learning. Approaches new tasks with a positive attitude. Recognizes and advocates appropriately for the rights of self and others. 		<ul style="list-style-type: none"> Sets own individual goals and monitors progress towards achieving them. Seeks clarification or assistance when needed. Assesses and reflects critically on own strengths, needs, and interests. Identifies learning opportunities, choices, and strategies to meet personal needs and achieve goals. Perseveres and makes an effort when responding to challenges. 	

Attendance

Though there is no mark directly assigned to attendance, **students will not be granted a credit if they miss more than 20% of the in-class hours for a course.** Students are reminded that classes at AIA are often condensed and quite lengthy. As such, one class at AIA may equate to roughly 3-4 classes at a day-school. Thus, missing even one class can seriously hinder a student's progress.

Absences must be dealt with the following day and students must present a doctor's note for medical absences or a note from a parent/guardian for other, familial or social reasons for absence. Chronic absenteeism will not be tolerated and students missing too many hours of instruction will be required to make up time outside of the course's regular hours. In such a case, additional fees may be incurred. Should a student fail to attend make-up hours, he or she may be de-enrolled from the course.

Program Planning

In accordance with the 2005 ministry document, *The Ontario Curriculum, Grades 9 to 12: Program Planning and Assessment*, the course is planned through the lenses of differentiated instruction and the presence of a variety of learning skills in the classroom. The following outlines several of these important considerations:

Education for Students with Exceptionalities. Students with documented exceptionalities, gleaned from Individual Education Plans, will have their needs addressed by the instructor. Any necessary modifications or accommodations will happen in accordance with the student's needs. AIA cannot issue IEPs - they must be provided by an official IPRC.

Technology in the Curriculum. Information and communication technologies offer a range of tools that can increase the level of engagement in a classroom. By utilizing a wide variety of technology in the classroom, the instructor will be able to more effectively communicate the key ideas of the course whilst creating a stimulating environment. These technologies can range from simple video projector or document projector usage to accessing Canadian Census data via the computer lab.

English as a Second Language and English Literacy Development (ESL/ELD). The primary language of instruction for this course is English. However, given the multicultural and hugely diverse population of Ontario, it is very likely that many students may come from not English speaking origins. As such, extra care will be taken to ensure that students have mastered the particular lexicon needed for understanding this course and its goals. New language learners will be able to contribute their views and ideas without fear of being put at a disadvantage.

Literacy, Numeracy, and Inquiry/Research Skills. This particular course emphasizes the need for strong literacy skills in all Ontario students. It introduces certain concepts that can only be discussed using a particular diction related to the topics at hand. As such, students must be able to master and understand the discussion topics and respond appropriately. The literacy component of this course, however, goes beyond diction. Students must learn to formulate questions that are designed to receive particular and specific answers. Students must be able to defend and support their claims via research and properly cited academic sources. Most importantly, students will learn to communicate complicated, perhaps controversial topics in a professional and academic manner, always supporting their claims with sound reasoning. Students who experience difficulty in this method of communication will be offered additional assistance.

	UNITS Titles of all units in the course listed in sequence of delivery	UNITS Approximate time for each unit adding up to 110 hours	OVERALL EXPECTATIONS Taken from appropriate policy document	Evaluation Strategies	√ Assessed Categories			
					K	I	C	A
70%	Rate of Change	26 hours	U1.1 U1.2 U1.3	Test (Assessment as Learning)	√	√	√	√
				Sub-Unit Test [Unit - Chapter - Section - Test] Assessment as Learning	√	√	√	√
				Group Assignment [Work Problem in Class] (Assessment as or for Learning)	√	√	√	√
				Written Assignment (Assessment as or for Learning)	√	√	√	√
	Derivatives and their Applications	48 hours	U2.1 U2.2	Test(Assessment of Learning)	√	√	√	√
				Sub-Unit Test [Unit - Chapter - Section - Test] (Assessment as Learning)	√	√	√	√
				Group Assignment [Work Problem in Class] (Assessment as or for Learning)	√	√	√	√
				Written Assignment (Assessment as or for Learning)	√	√	√	√
	Geometry and Algebra of Vectors	36 hours	U3.1 U3.2 U3.3 U3.4	Test (Assessment as Learning)	√	√	√	√
				Sub-Unit Test [Unit - Chapter - Section - Test] (Assessment as Learning)	√	√	√	√
				Group Assignment [Work Problem in Class] (Assessment as or for Learning)	√	√	√	√
				Written Assignment (Assessment as or for Learning)	√	√	√	√
30%			Overall Expectations	Final Examination(Assessment of Learning)	√	√	√	√
	Category Weight				30%	20%	20%	30%

