Islamic Foundation School
Course Outline

Course Title: Calculus and Vectors	
Course Code: MCV4U	
Course Type: University Preparation	
Grade: 12	
Credit Value: 1.0	
Prerequisites: Advanced Functions, Grade 12, MHF4U (Must be taken before or concurrently with MCV4U)	
Co requisites: None	
Course developed by: Hifzurrahman Patel	**Date:** August 20, 2008
Course revised by: Hifzurrahman Patel	**Date:** February 1, 2014
Course based on Ministry curriculum document: Ministry of Education Curriculum Document 2007 titled as: "Mathematics; The Ontario Curriculum; Grades 11 and 12"	

ISLAMIC FOUNDATION SCHOOL
Course Outline – Calculus and Vectors (MCV4U)
Course Type: University Preparation, Grade: 12, Credit Value: 1.0
Prerequisite: MHF4U (Grade 12 Advanced Functions), Co-requisite: None

Department: Mathematics
Teacher: Hifzurrahman Patel

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 polynomials, sinusodial, 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 mathematical process 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:

1. 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; (Rates of Change, Strand A)
2. 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; (Rates of Change, Strand A)
3. 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. (Rates of Change, Strand A)
4. 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; (Derivatives and Their Applications, Strand B)
5. Solve rate of change and optimization problems, including those arising from real world applications and that involve investigation and mathematical modeling and require the use of the concepts and procedures associated with the derivative. (Derivatives and Their Applications, Strand B)
6. Demonstrate an understanding of vectors in two-space and three-space by representing them algebraically and geometrically and by recognizing their applications; (Geometry and Algebra of Vectors, Strand C)
7. 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; (Geometry and Algebra of Vectors, Strand C)
8. 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; (Geometry and Algebra of Vectors, Strand C)
9. Represent lines and planes using scalar, vector, and parametric equations, and solve problems involving distances and intersections. (Geometry and Algebra of Vectors, Strand C)

Outline of Course Content

Unit #	**Unit Title**	**Time Allotted (hrs)**	**Strands**
Ch 1	Introduction to Calculus	***12***	Strand A
Ch 2	Derivatives	***11***	Strand A/B
Ch 3	Derivatives and their applications	***11***	Strand A/B
Ch 4	Curve Sketching	***11***	Strand B
Ch 5	Derivatives of Exponential and Trigonometric Functions	***11***	Strand B
Ch 6	An Introduction to Vectors	***14***	Strand C
Ch 7	Application of Vectors	***12***	Strand C
Ch 8	Equations of Lines and Planes	***12***	Strand C
Ch 9	Relationships between Points, Lines & Planes	***8***	Strand C
	Final Summative Evaluation	***8***	
Total		***110 Hours***	

Strand A: Rates of Change
Strand B: Derivatives and Their Applications
Strand C: Geometry and Algebra of Vectors

Unit Description

Chapter 1: Introduction to Calculus
A variety of mathematical operations with functions are needed in order to do the calculus of this course. This unit begins with students developing a better understanding of these essential concepts. Students will then deal with rates of change problems and the limit concept. While the concept of a limit involves getting close to a value but never getting to the value, often the limit of a function can be determined by substituting the value of interest for the variable in the function. Students will work with several examples of this concept. The indeterminate form of a limit involving the factoring, rationalization, change of variables, and one sided limits are all included in the exercises.

Chapter 2: Derivatives
The concept of a derivative is, in essence, a way of creating a short cut to determine the tangent line slope function that would normally require the concept of a limit. Once patterns are seen from the evaluation of limits, rules can be established to simplify what must be done to determine this slope function. This unit begins by examining those rules including: the power rule, product rule, the quotient rule and the chain rule followed by a study of the derivatives of composite functions.

Chapter 3: Derivatives and their applications
A variety of types of problems exist in this unit and are generally grouped into the following categories: Pythagorean theorem problems (ladder and intersection problems), volume problems, trough problems, shadow problems, and general rule problems. During this unit, students will look at each of these types of problems individually.

Chapter 4: Curve Sketching
In previous math courses, functions were graphed by developing a table of values and smooth sketching between the values generated. This technique often hides key detail of the graph and produces a dramatically incorrect picture of the function. The missing pieces of the puzzle can be found by the techniques of calculus learned thus far in this course. The key features of a properly sketched curve are all reviewed separately before putting them all together into a full sketch of a curve.

Chapter 5: **Derivatives of Exponential and Trigonometric Functions**
This unit begins with examples and exercise involving exponential and logarithmic functions using Euler's number (e). But as students have already seen, many other bases exist for exponential and logarithmic functions. Students will now look at how they can use their established rules to find the derivatives of such functions.
A brief trigonometry review kicks off this unit. Then students turn their attention to differentiating trigonometric functions which they worked with in Advanced Functions. Students will learn to use product rule, quotient rule, and power rule to find derivatives of functions that contain polynomials and trigonometric functions.

Chapter 6: An Introduction to Vectors
There are four main topics pursued in this initial unit of the course. These topics are: an introduction to vectors and scalars, vector properties, vector operations, and plane figure properties. Students will tell the difference between a scalar and vector quantity, they will represent vectors as directed line segments and perform the operations of addition, subtraction, and scalar multiplication on geometric vectors with and without dynamic geometry software.

Chapter 7: Application of Vectors

Cartesian vectors are represented in two-space and three-space as ordered pairs and triples, respectively. The addition, subtraction, and scalar multiplication of Cartesian vectors are all investigated in this unit. Applications involving work and torque are used to introduce and lend context to the dot and cross products of Cartesian vectors. The vector and scalar projections of Cartesian vectors are written in terms of the dot product. The properties of vector products are investigated and proven. These vector products will be revisited to predict characteristics of the solutions of systems of lines and planes in the intersections of lines and planes.

Chapter 8 & 9: Equations of Lines and Planes & Relationships between Points, Lines & Planes

This unit begins with students determining the vector, parametric and symmetric equations of lines in R2 and R3 . Students will go on to determine the vector, parametric, symmetric and scalar equations of planes in 3-space. The intersections of lines in 3-space and the intersections of a line and a plane in 3-space are then taught. Students will learn to determine the intersections of two or three planes by setting up and solving a system of linear equations in three unknowns. Students will interpret a system of two linear equations in two unknowns geometrically, and relate the geometrical properties to the type of solution set the system of equations possesses. Solving problems involving the intersections of lines and planes, and presenting the solutions with clarity and justification forms the next challenge. As work with matrices continues students will define the terms related to matrices while adding, subtracting, and multiplying them. Students will solve systems of linear equations involving up to three unknowns, using row reduction of matrices, with and without the aid of technology and interpreting row reduction of matrices as the creation of new linear systems equivalent to the original constitute the final two new topics of this important unit.

Chapter descriptions taken from: https://www.virtualhighschool.com/courses/outlines/mcv4u.asp

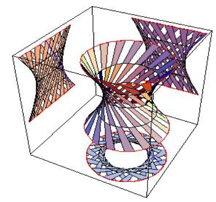
Teaching & Learning Strategies
In this class, a variety of teaching strategies will be used to enhance students learning. These include (but are not limited to): note taking, interactive lessons, cooperative work, investigations, independent learning and study notes.

Learning Skills:
In addition to earning a mark on the report card, Learning Skills will be evaluated as outlined by **Growing Success. Assessment, Evaluation and Reporting in Ontario Schools. 2010.** The Learning Skills are: Responsibility, Organization, Independent Work, Collaboration, Initiative, and Self-Regulation. The Learning Skills are evaluated using four-point scale: E for Excellent, G for Good, S for Satisfactory, and N for Needs Improvement

Late Assignment Submission Policy
"Students are responsible not only for their behaviour in the classroom and the school but also for providing evidence of their achievement of the overall expectations within the time frame specified by the teacher, and in a form approved by the teacher." **Growing Success, page 43**. If a student has not already procured an extension from a teacher and does not meet assignment deadlines, he/she has up until the time the marked assignments are returned to submit the work for a full mark. Any work submitted after this will be marked and given a mark up to 50.

Achievement Policy
For Grades 9 to 12, a final grade (percentage mark) is recorded for every course. 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 should 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. 2010**

Homework is also an essential part of each department's curricula and students are responsible for all work assigned in each class. On-going assessment will occur to allow all students the opportunity to be successful. Students will be evaluated in all four categories of the achievement chart.

Term Work (70%)		**Category Weight**
In class assignments (14%)		Knowledge & Understanding (35%)
Quizzes (10.5%)		Application (35%)
Tests (42%)		Communication (15%)
ISU (3.5%)		Thinking/Inquiry (15%)
		
Cumulative Evaluation (30%)		
Final Exam (30%)		

Resources
Calculus and Vectors (Nelson)
Graphing Calculators

Plagiarism

Students are expected to think independently and work honestly. All students must avoid presenting the work or ideas of others as their own. It is in the best interest of each student to build habits which contribute to genuine academic, personal, and social growth, and which attest to sound character. Plagiarism is an academic dishonesty which cannot be tolerated at IFS. The first offence will result in a mark of zero and all previous work may be put to scrutiny. Subsequent offence may result in removal from school. (IFS Student Planner)

The best guarantees of success in Mathematics are faithful attendance and homework done on a daily basis. There is no substitute!!