

Forest Hill Collegiate Institute
Course of Study and Evaluation Statement

Calculus and Vectors, Grade 12: University Preparation

Note 1: All Ontario Ministry of Education curriculum documents with full course content information can be located at <http://www.edu.gov.on.ca/eng/curriculum/secondary/subjects.html>

Note 2: Detailed information on Ministry of Education assessment, evaluation, and reporting policy is provided in *The Ontario Curriculum, Grades 9 to 12: Program Planning and Assessment, 2000*, located at <http://www.edu.gov.on.ca/eng/curriculum/secondary/progplan912curr.pdf>

1. Course Details

- Program Area: Mathematics
- Date of Development: February 2016
- Course title: Calculus and Vectors, Grade 12: University Preparation (MCV4U). Credit Value 1.0
- Prerequisite: Advanced Functions Grade 12
- Textbook: Calculus and Vectors; Nelson Education Ltd. 2009

2. Overall Goals

- 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.
- Overall Expectations are in the areas of Rate of Change; Derivatives and their Applications; and Geometry and Algebra of Vectors. By the end of the course, students will:
 - in **Rate of Change**:
 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;
 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;
 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.
 - in **Derivatives and their Applications**:
 1. 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;
 2. 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.
 - in **Geometry and Algebra of Vectors**:
 1. demonstrate an understanding of vectors in two-space and three-space by representing them algebraically and geometrically and by recognizing their applications;
 2. 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;
 3. 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;

4. represent lines and planes using scalar, vector, and parametric equations, and solve problems involving distances and intersections

- Specific Curriculum Expectations

Please refer to Ontario Ministry of Education curriculum document for details of Overall and Specific Expectations, found at <http://www.edu.gov.on.ca/eng/curriculum/secondary/math1112curr.pdf>

3. Program Planning Considerations

- *Individual Education Plan*: Accommodations to meet the needs of exceptional students as set out in their Individual Education Plan will be implemented within the classroom program. Additional assistance is available through the Special Education program.
- *The Role of Technology in the Curriculum*. Using information technology will assist students in the achievement of many of the expectations in the curriculum regarding research, written work, analysis of information, and visual presentations. The computer and the calculator are important problem-solving tools to be used for many purposes. Computers and calculators are tools of mathematicians, and students will be given opportunities to select and use the particular applications that may be helpful to them as they search for their own solutions to problems.
- *English As a Second Language (ESL)*: Appropriate accommodations in teaching, learning, and evaluation strategies will be made to help ESL students gain proficiency in English, since students taking ESL at the secondary level have limited time in which to develop this proficiency. Teachers will ensure that reading levels are appropriate to students' abilities and will strive for clarity in the use of mathematical terminology.
- *Cooperative Education and Other Workplace Experiences*: The knowledge and skills students acquire in this course will assist them in their senior level cooperative-education and work-experience placements related to this course. General information about cooperative education courses can be found at <http://www.edu.gov.on.ca/eng/document/curricul/secondary/coop/cooped.pdf>

4. Learning Skills

Learning Skills are skills and habits are essential to success in school and in the workplace. The Learning Skills evaluated are: Works Independently, Teamwork, Organization, Work Habits/Homework, Initiative. Teachers report achievement on the five Learning Skills using letter symbols: E = Excellent, G = Good, S = Satisfactory, N = Needs Improvement.

Learning Skills clearly affect levels of achievement, but they are *not* part of the evaluation of achievement and are not included in the midterm mark or final course mark.

5. Academic Honesty: Cheating and Plagiarism

Students are expected to submit only their own original work on evaluations done in class or out of class. Plagiarism the passing off the ideas or writings of another as one's own. Cases of academic dishonesty (cheating and/or plagiarism) will be dealt with on a case-by-case basis, but each case will involve an investigation, communication with the student and his/her parent/guardian, and a mark of zero for the plagiarized work. Whether the student has an opportunity to demonstrate his/her learning in another assignment will be at the discretion of the teacher and/or Principal.

6. Teaching Strategies

Teachers use a variety of teaching strategies to maximize student learning. The following teaching strategies will be used in this course:

- *Direct Instruction* is highly teacher-directed. This strategy includes methods such as lecture, didactic questioning, explicit teaching, practice and drill, and demonstrations.
- *Indirect Instruction* is mainly student-centred. Indirect Instruction includes inquiry, induction, problem solving, decision making, and discovery.
- *Interactive Instruction* relies heavily on discussion and sharing among participants. Interactive instruction may include total class discussions, small group discussions or projects, or student pairs or triads working on assignments together.

- *Experiential Learning* is inductive, learner centred, and activity oriented. In Experiential Learning, students participate in an activity; critically look back on the activity to clarify learnings and feelings; draw useful insights from such analysis; and/or put learnings to work in new situations..
- *Independent Study* refers to the range of instructional methods which are provided to foster the development of individual student initiative, self-reliance, and self-improvement. The focus is on planned independent study by students under the guidance or supervision of a classroom teacher.

7. Assessment and Evaluation Strategies

The primary purpose of assessment and evaluation is to improve student learning. Assessment is the process of gathering information from assignments, demonstrations, projects, performances, and tests that accurately reflects how well a student is achieving the curriculum expectations in a course. As part of assessment, teachers provide students with feedback that guides their efforts towards improvement.

Evaluation refers to the process of judging the quality of student work on the basis of established criteria, and assigning a value to represent that quality. In Ontario secondary schools, the value assigned will be in the form of a percentage grade.

- In this course, the following evaluation strategies may be used: chapters/units' evaluation, assignments, investigations, in-class activities, final examination

8. Achievement Chart

The achievement chart provides a standard, province-wide method for teachers to use in assessing and evaluating their students' achievement. Students are evaluated according to the major categories or strands in each course. Ministry curriculum documents provide detailed description of student achievement levels.

In this course, students are evaluated in four categories, according to the weightings shown:

Knowledge/Understanding	Thinking/Inquiry	Communications	Application
30%	20%	20%	30%

9. 70% Mark on Course Work

- Students need to demonstrate achievement of all the overall expectations of the course. 70% of the final mark in the course will be based on work done prior to the culminating activities. Evaluations that are late, missing, and/or incomplete will affect a student's 70% grade. See FHCI Evaluation Policy as printed in the Student Agenda Book for information about late, missed, and/or incomplete assignments.
- *Refer to the end of the outline for daily assignments*

10. 30% Grade Based on Course Culminating Activities

- All students must take part in the culminating activities for each course at every grade and level of study. The steps to follow when a student is absent from one or more culminating activities is included in the FHCI evaluation policy as printed in the Student Agenda Book.
- Culminating activities that occur in class are held within the last three weeks of classes. Culminating activities that are formal examinations occur within the last nine days of the semester

11. Determining Marks for the Midterm Provincial Reports in November and April

This grade will be based on the evaluations that have been conducted to the midterm point in the course. Some of the Overall Expectations, categories/strands, and units will not have been addressed by the midterm, and the students' grades will most likely change when the students' entire work is evaluated by the end of the course.

12. Determining the Mark for the Final Report Card

The mark for the final will report card will be the sum of the 70% mark and the 30% mark.

13. Missed evaluations policy

If a student is legitimately absent for a test or quiz, upon return to school, they must have a doctor's note or a note from their parent or guardian stating the reason for their absence. At that time, and at the convenience of

the teacher, the student may write a makeup test. If a student does not have a valid reason for his/her absence, **a mark of zero will be given**. *Every effort will be made by the subject teacher to notify students well in advance of scheduled test dates.*

Definition of Legitimate Absence

- Illness with a doctor's note
- Death in the family
- Medical appointment (Advance notice required)
- Religious reasons (Advance notice required)
- School authorized field trip (Advance notice required)
- Court appearances (Advance notice required)

UNIT 1: Introduction to Calculus

1. (Sec. 1.1) Rationalizing Denominators
Exercises: Page 9 # 1-3, 5, 6
2. (Sec 1.2) The Slope of a Tangent
Exercises: Page 18 # 4, 5, 7, 11, 18, 21
3. (Sec 1.4) The Limit of a Function
Exercises: Page 38 # 4, 6, 7, 10, 11, 12
4. (Sec 1.5) Properties of Limits [2 periods]
Exercises: Page 45 # 4, 7, 8, 9, 13
5. (Sec 1.6) Continuity
Exercises: Page 52 # 4, 5, 8, 12, 16
6. (Sec 1.3) Rates of Change [2 periods]
Exercises: Page 29 # 7 – 12

UNIT 2: Derivatives

1. (Sec 2.1) The Derivative Function "First Principles"
[2 periods]
Day 1: Ex.: Pg. 73 # 1, 5, 6, 8, 10, 12, 15
Day 2: Ex.: Pg. 73 # 2, 7b, 8, 13, 14, 17
2. (Sec 2.2) The Derivatives of Polynomial Functions
Exercises: Page 82 # 3, 4, 9, 11, 12, 15, 21
3. (Sec 2.3) The Product Rule [2 periods]
Day 1: Ex.: Page 90 # 1, 2, 9
Day 2: Ex.: Page 90 # 5-8
4. (Sec 2.4) The Quotient Rule [2 periods]
Day 1: Ex.: Page 97 # 4, 5, 6
Day 2: Ex.: Page 97 # 7, 9, 10, 12, 14-16
5. (Sec 2.5) The Derivatives of Composite Functions
Day 1: Ex.: Page 105 # 4, 8, 9, 14
Day 2: Ex.: Page 105 # 12, 15, 18

UNIT 3: Derivatives and their Applications

1. Appendix: Implicit Differentiation
Exercises: Page 564 #2, 3, 5, 8, 9
2. (Sec 3.1) Higher-Order Derivatives, Velocity, and Acceleration
Exercises: Page 127 #3, 4, 6, 8, 10, 11
3. Appendix : Related Rates[2 periods]
Day 1: Ex.: Page 569 #4, 5, 7, 12, 13, 16
Day 2: Ex.: Page 569 #8, 10, 11, 18
4. Basic Graph Sketching (Based on qualitative Analysis)

UNIT 4: Derivatives of Exponential, Logarithmic, and Trig Functions

1. (Sec 5.1) Derivatives of Exponential Functions
Exercises: Page 232 #2, 3, 5, 8, 9, 13
2. The Derivative of the Natural Logarithmic Function
Exercises: Page 575 #3, 4, 6, 8, 11, 13, 14
3. (Sec 5.2) Derivatives of General Exponential and Logarithmic Functions
Exercises: Page 240 #1, 2, 3, 4, 6
Page 578 #1 - 5, 7, 8
4. Logarithmic Differentiation
Exercises: Page 582 #1 – 8
5. (Sec 5.4&5.5) Derivatives of Trigonometric Functions
Exercises: Page 256 #1, 2, 3, 5
Page 260 #1, 2, 3, 4, 5

UNIT 5: Curve Sketching

1. (Sec 4.1) Increasing and Decreasing Functions
Exercises: Page 169 #1, 3, 5, 7, 8
2. (Sec 4.2) Critical Points, Local Maxima, and Local Minima
Exercises: Page 178 #3, 5, 7, 10
3. (Sec 4.3) Vertical & Horizontal Asymptotes
Exercises: Page 193 #3, 4, 5
4. (Sec 4.3) Oblique Asymptotes
Exercises: Page 194 #7, 8
5. (Sec 3.2) Maximum and Minimum on an Interval
Exercises: Page 136 #3, 4, 5, 8
6. (Sec 4.4) Concavity and Points of Inflection
[2 periods]
Exercises: Page 205 #1, 2, 4, 8, 9
7. (Sec 4.5) Algorithm for Curve Sketching
Exercises: Page 212 #4, 7
Page 194 #10
8. (Sec 3.3&5.3) Optimization Problems
Exercises: Page 145 #3, 4, 11, 12, 15
Page 151 #2, 4, 5
Page 245 #3(a, b), 4, 6
9. (Sec 3.4) Optimization in Economics and Science
Exercises: Page 151 #2, 4, 5

UNIT 6: Geometric and Algebraic Vectors

1. (Sec 6.1) Vector Concepts
Exercises: Page 279 #1, 2, 5, 6
2. (Sec 6.2-6.4) Vector Laws and Properties
Exercises: Page 290 #1, 3, 5, 12, 13
Page 298 #2, 3, 5, 9
Page 306 #7, 8, 9
3. (Sec 7.1) Vectors as Forces
Exercises: Page 362 #5, 8, 9, 10, 12
4. (Sec 7.2) Velocity
Exercises: Page 369 #1, 3, 4, 6, 9, 12
5. (Sec 6.5) Algebraic Vectors
Exercises: Page 316 #5, 8, 9, 10
6. (Sec 6.6&6.7) Operations With Algebraic Vectors
Exercises: Page 324 #3 – 7, 13
Page 332 #1, 2, 3, 5 – 8, 12
7. (Sec 7.3&7.4) The Dot Product of Two Vectors
Exercises: Page 377 #6, 7, 9, 11
Page 385 #2, 6, 7, 10
8. (Sec. 7.5) Scalar Projection and Direction Angles
Exercises: Page 398 # 1, 6, 8, 11
9. (Sec 7.6) The Cross Product of Two Vectors
Exercises: Page 407 #3, 4, 5, 7, 8
10. (Sec 7.7) Applications of the Dot and Cross Products
Exercises: Page 414 #3, 5, 8

UNIT 7: Lines and Planes

1. (Sec 8.1) Parametric and Vector Equations of a Line in a Plane
Exercises: Page 433 #3, 4, 5, 7
2. (Sec 8.2) Cartesian Equation of a Line in a Plane
Exercises: Page 443 #3, 4, 7
3. (Sec 8.3) Equations of a Line in 3-Space
Exercises: Page 449 #1, 3, 4, 6
4. (Sec 9.1) The Intersection of Two Lines
Exercises Page 497 #8, 9, 11
5. (Sec 8.4) Parametric and Vector Equation of a Plane in Space
Exercises: Page 459 #1, 4, 6, 10, 11, 13
6. (Sec 8.5) The Cartesian Equation of a Plane in Space
Exercises: Page 468 #5, 7, 10, 11, 12
7. (Sec 9.1) The Intersection of a Line with a Plane
Exercises: Page 497 #5, 7
8. (Sec 9.2) Systems of Equations
Exercises: Page 507 #3, 4, 5, 6, 12
9. (Sec 9.3) The Intersection of Two Planes
Exercises: Page 516 #10, 12