NSRIC International School in Toronto

London, ON, Canada

1. Course Outline: 2023-2024

Name of School: NSRIC International School in Toronto

Department: Mathematics

Course Title: Calculus and Vectors, Grade 12 University Preparation

Course Name: Calculus and Vectors

Ministry Course Code: MCV4U

Course Type: University Preparation

Credit Value: 1.00

Prerequisites: MHF4U, Grade 12 Advanced Functions

Course Developer: Anna A Nicolaou

Course Development Date: June 2023

2. Curriculum Policy Documents

1.The Ontario Curriculum, Grades 11 and 12, Mathematics, 2005 (Revised)
2.Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools, 2010
3.Ontario Schools Kg to Gr 12 – Policy and Program Requirement, 2011

3. Course Description

This course builds on student's 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 university-level calculus, linear algebra, or

physics course.

4. Course Unit Titles and Descriptions

Unit Titles and Descriptions	Time
Unit 1 - Introduction to Limits By the end of this unit, students will be able to find the slope of the tangent using first principles, find the rates of change using limits, and find basic limits and infinite limits using the limit laws.	17 hours
Unit 2/3 - Derivatives and Applications of Derivatives By the end of this unit, students will be able to find derivatives using power rule, chain rule, product rule, and quotient rule. They will also be able to apply them to situations involving rates of change, velocity, acceleration, and finiding minimum and maximum values (optimization).	30 hours
Unit 4/5 - Curve Sketching and Special Derivatives By the end of this unit, students will learn to find the derivatives of the sine, cosine, tangent, logarithmic, and exponential functions. They will also learn all the steps involved in curve sketching that includes the optimal values (local/global minimums and maximums, points of inflection, etc.), finding increasing and decreasing intervals, finding asymptotes and removable discontinuities, and using this information to sketch curves more accurately.	30 hours
Unit 6 - Introduction to Vectors By the end of this unit, students will be able to add, subtract, and multiply vectors. Students will also understand how to use vectors in 2-space and 3-space along with understanding the difference between a vector and a scaler. They will also learn how to determine whether or not two vectors are linear combinations and how to identify or disprove a spanning set.	15 hours
Unit 7 - Applications of Vectors By the end of this unit, students will learn to find the dot product and cross product of a vector. They will also learn how to use vectors in a physics context including as a force and velocity.	15 hours

Final Assessment	
Exam and Final Assignment This is a proctored exam worth 20% of your grade and a final assignment to be completed outside of classroom hours worth 10% of your final grade.	3 hours
Total	**1 1 0 hours**

5. Overall Curriculum Expectations

A. Introduction to Limits	
A1	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;
A2	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;
B. Derivatives and Their Applications	
B1	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;
B2	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.
B3	
C. Curve Sketching and Special Derivatives	
C1	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;

C2	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.
C3	
D. Introduction to Vectors	
D1	demonstrate an understanding of vectors in two-space and three-space by representing them algebraically and geometrically and by recognizing their applications;
D2	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;
D3	
E. Applications of Vectors	
E1	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;
E2	analyse, interpret, and draw conclusions from two-variable data using numerical, graphical, and algebraic summaries;
E3	represent lines and planes using scalar, vector, and parametric equations, and solve problems involving distances and intersections.
F1	
F2	
F3	

6. Teaching and Learning Strategies

The overriding aim of this course is to help students use the language of mathematics skillfully, confidently, and flexibly. A wide variety of instructional strategies are used to provide learning opportunities to accommodate a variety of learning styles, interests, and ability levels. The following mathematical processes are used throughout the course as strategies for teaching and learning the concepts presented:

- *Problem solving:* This course scaffolds learning by providing students with opportunities to review and activate prior knowledge (e.g., reviewing factoring techniques from prior mathematics courses), and build off of this knowledge to acquire new skills. The course guides students toward recognizing opportunities to apply knowledge they have gained to solve real-world problems.

- *Selecting Tools and Computational Strategies:* Modeling the use of tools and having students use technology to help solve problems.

- *Connecting:* This course models the use of software for personal finance to familiarize students with available software and resources which will allow them to simplify calculations in order to better and more accurately manage money.

- *Representing:* Through the use of examples, practice problems, and solution videos, the course models various ways to demonstrate understanding, poses questions that require students to use different representations as they are working at each level of conceptual development - concrete, visual or symbolic, and allows individual students the time they need to solidify their understanding at each conceptual stage.

- *Self-Assessment:* Through the use of interactive activities (e.g. multiple choice quizzes, and drag-and-drop activities) students receive instantaneous feedback and are able to self-assess their understanding of concepts.

- Computer-based Learning - students use simulations and relevant computer programs to explore physics problems
- Brainstorming - group generation of initial ideas expressed without criticism or analysis
- Case Study - investigation of real and simulated problems
- Collaborative/Co-operative Learning - various small group learning techniques
- Conferencing - student to student or student to teacher discussion
- Field Study - students perform investigations on locations beyond the school
- Independent Study - students explore and research a topic of interest
- Report/Presentation - oral and written presentation of researched topic to class

7. Strategies for Assessment and Evaluation of Student Performance

Assessment and evaluation techniques are an integral part of teaching/learning strategies and expectations. The assessment/evaluation techniques are selected to effectively assist students in achieving the overall and specific expectations and be consistent with the teaching/learning strategies. A variety of assessment and evaluation methods, strategies and tools are required as appropriate to the expectation being assessed. Our theory of assessment and evaluation follows the Ministry of Education's *Growing Success* document, and it is our firm belief that doing so is in the best interests of students. These include Assessment for Learning (diagnostic), Assessment as Learning (formative) and Assessment of Learning (summative) within the course as a whole and within each unit. Specific strategies and tools are described in detail in each activity and unit.

a) Assessment strategies include:

self-assessment
cooperative learning/group work
student-teacher conferencing
research projects/reports
practical applications
Exam
peer assessment
case studies
concept maps
presentations
unit and activity tests/quizzes.

Strategy Example	**Assessment Type / Assessor**	**Assessment Tool**
Speeches	- for learning / teacher - as learning / by student, peer, teacher - of learning / by teacher	checklist or rubric or marking scheme
Tests	- of learning / by teacher	marking scheme
Homework/ Study and Discussion questions	- for learning / teacher - as learning / by student, peer, teacher	Checklist or rubric
Analytical Writing or Experiment	- for learning / teacher - as learning / by student - of learning / by teacher	Guided questions, checklist, and rubric
Creative	- for learning / teacher - as learning / by student - of learning / by teacher	Guided questions, checklist, and rubric
Independent Study Unit	- for learning / teacher - as learning / by student - of learning / by teacher	Checklist, marking scheme, rubric

Summative Assignment	- as learning / teacher - of learning / by teacher	rubric or marking scheme, checklist
Final Written Exam	- of learning / by teacher	marking scheme

b) Assessments AS learning, FOR learning, and OF learning are listed for the following strategies:

The performance standards, outlined in the achievement chart for the course, are a standard province-wide guide and are used to assess and evaluate student achievement of the expectations in the course.
The achievement chart identifies four categories of knowledge and skills which are as follows:

- **Knowledge and Understanding:** Subject-specific content acquired in the course (knowledge), and the comprehension of its meaning and significance (understanding).
- **Thinking:** The use of critical and creative thinking skills and/or processes.
- **Communication:** The conveying of meaning through various forms.
- **Application:** The use of knowledge and skills to make connections within and between various contexts.

For a full explanation, please refer to *Growing Success*.

c) The Final Grade

The evaluation for this course is based on the student's achievement of curriculum expectations and the demonstrated skills required for effective learning. The final percentage grade represents the quality of the student's overall achievement of the expectations for the course and reflects the corresponding level of achievement as described in the achievement chart for the discipline. A credit is granted and recorded for this course if the student's grade is 50% or higher. The final grade will be determined as follows:

- 70% of the grade will be based upon evaluations conducted throughout the course. This portion of the grade will reflect the student's most consistent level of achievement throughout the course, although special consideration will be given to more recent evidence of achievement.
- 30% of the grade will be based on final evaluations administered at the end of the course. The final assessment may be a final exam, a final project, or a combination of both an exam and a project.

8. Learning Skills and Work Habits

The development of learning skills and work habits is an integral part of a student's learning; therefore, assessing, evaluating, and reporting on the achievement of curriculum expectations and on the demonstration of learning skills and work habits are done separately, apart from when learning skills and work habits may be included as part of a curriculum expectation. All curriculum expectations are accounted for in instruction and assessment. Evidence of student achievement for evaluation is collected over time from three different sources: observations, conversations, and student products.

The development, assessment, and evaluation of the following categories of learning skills and work habits will occur responsibility, organization, independent work, collaboration, initiative, and self-regulation. Learning skills and work habits, apart from when learning skills and work habits may be included as part of a curriculum expectation, will not be considered in the determination of a student's grade.

9. Considerations for Program Planning

9 a). Instructional Approaches

Effective instructional approaches and learning activities draw on students' prior knowledge, capture their interest, and encourage successful/meaningful practice both inside the classroom. Successful classroom practices engage students in activities that require higher-order thinking, with an emphasis on problem solving. Students will be encouraged to see the connection between the mathematical concepts they are learning and their application in their workplace and everyday life.

Students will have opportunities to learn in a variety of ways – individually, cooperatively, independently, with teacher direction, through hands-on experiences, and through examples followed by practice. In this course students will learn concepts and procedures, acquire skills for analysis of a problem, analyze workplace and everyday life related mathematical problems, and apply mathematical processes of the problems, so that they become competent in these various areas with the aid of instructional and learning strategies that are suited to the learning. Activities related with practical life experience/examples are necessary for supporting the effective learning of this course for all students.

9 b). Promoting Positive Attitudes towards Learning Mathematics

Students will be encouraged to develop a willingness to persist, to investigate, to reason, to explore alternative solutions, to view challenges as opportunities to extend their learning, and to take the risks necessary to become successful problem solvers. Students will be provided with problems that are challenging but not beyond their ability to solve to develop their confidence and reduce anxiety and frustration.

Collaborative learning enhances students' understanding of mathematics. Working cooperatively in groups reduces isolation and provides students with opportunities to share ideas and communicate their thinking in a supportive environment as they work together towards a common goal. Communication and the connections among ideas that emerges students interact with one another enhance the quality of student learning. Considering these, group work will be encouraged by assigning group assignments and projects.

9 c). Planning Mathematics Programs for Students with Special Education Needs

This course work will be designed that recognize the diversity of learning process of among individual students. Student's performance will be given considering their particular abilities so that all students can derive the greatest possible benefit from the teaching and learning process. To planning the course for students with special education needs the current achievement level of the individual student, their strengths and learning needs, and the knowledge and skills that all students are expected to demonstrate at the end of the course will be examined in order to determine the types of accommodation they need in the course.

9 d). Program Considerations for English Language Learners

Appropriate adaptations and strategies for instruction and assessment to facilitate the success of the English language learners in their classrooms will be incorporate so that they can understand the lessons and complete their task properly. These adaptations and strategies might include:

- modification of some or all of the course expectations so that they are challenging but attainable for the learner at his or her present level of English proficiency, given the necessary support from the teacher;
- use of a variety of instructional strategies (e.g., extensive use of visual cues, scaffolding, manipulatives, pictures, diagrams, graphic organizers; attention to clarity of instructions);
- modeling of preferred ways of working in mathematics; previewing of textbooks; pre-teaching of key vocabulary; peer tutoring; strategic use of students' first languages;
- use of a variety of learning resources (e.g., visual material, simplified text, bilingual dictionaries, materials that reflect cultural diversity);
- use of assessment accommodations (e.g., granting of extra time; simplification of language used in problems and instructions; use of oral interviews, learning logs, portfolios, demonstrations, visual representations, and tasks requiring completion of graphic organizers or cloze sentences instead of tasks that depend heavily on proficiency in English).

10. Resources

Selections from the following may be considered for use:

- Ministry of Education and Training "Course Profile" (www.curriculum.org)
- Ontario Secondary Schools 9 to 12 – Program and Diploma Requirements 1999
- The Ontario Curriculum, Grades 9 to 12: Program Planning and Assessment, 2000.

- OTDSB documents
- Approved textbook: https://amzn.to/3BDz5SX **Nelson Calculus and Vectors (University Preparation)**
- **Study Guide:** https://amzn.to/3pJpAyK **or/and** https://amzn.to/41MdRh7
- Other sources

11. Late Submission Policy

There will be a **DUE DATE** and a **DEADLINE** to hand in assignments, projects, etc. For example,
I, the teacher, decide that Project A is due on Monday. That will be the **DUE DATE.** The **DEADLINE** will be five school days after the due date i.e., on next Monday but for 1st 3-days of delay in submission 10% marks will be deducted per day and after that 20% for rest of the days. No submission will be accepted after deadline. However, in case sickness or any other acceptable reason, the student could not submit his/her work within deadline; the student might get extension of time on the condition that the student provides a doctor's note or parent's note explaining the condition.

12. Test/Exam Policy

A student who remains absent with acceptable reason on the day of a test or exam will get no marks on that test/exam. A re-test will only be allowed on the condition that the student provides acceptable explanation of his/her absence on that day with proper evidence (doctor's and/or parent's note).

13. Academic Honesty

Academic honesty is a fundamental cornerstone in student learning. Academic dishonesty, including instances of **plagiarism** and **cheating**, are serious breaches of the school code of conduct. **All cases of academic dishonesty** will be reported to the school administration and guardians, and a disciplinary action taken. Disciplinary action taken may include Academic counselling; a compensatory task (e.g., writing an article about "ethics"); or a zero mark.