

## Course Outline

School Name: Keewatinook Internet High School

Department Name: Mathematics

Ministry of Education Course Title: Functions

Grade Level: 11

Ministry Course Code: MCR3U

Teacher's Name: Erik Tu

Developed by: Lorne Goring Date: February 2010

Revision Date: September 2015

Developed from: The Ontario Curriculum, Grades 11 and 12,  
Mathematics, 2007

Text: None

Prerequisite: Principles of Mathematics, Grade 10, Academic

Credits: 1

Length: 110 hours

Principal's Name: Kevin Dempsey

Principal's Approval (signature)



Approval Date: September 11, 2015

## ***Course Description/rationale***

This course introduces the mathematical concept of the function by extending students' experiences with linear and quadratic relations. Students will investigate properties of discrete and continuous functions, including trigonometric and exponential functions; represent functions numerically, algebraically, and graphically; solve problems involving applications of functions; investigate inverse functions; and develop facility in determining equivalent algebraic expressions. Students will reason mathematically and communicate their thinking as they solve multi-step problems.

## ***Overall Curriculum Expectations***

- demonstrate an understanding of functions, their representations, and their inverses, and make connections between the algebraic and graphical representations of functions using transformations;
- determine the zeros and the maximum or minimum of a quadratic function, and solve problems involving quadratic functions, including problems arising from real-world applications;
- demonstrate an understanding of equivalence as it relates to simplifying polynomial, radical, and rational expressions.
- evaluate powers with rational exponents, simplify expressions containing exponents, and describe properties of exponential functions represented in a variety of ways;
- make connections between the numeric, graphical, and algebraic representations of exponential functions;
- identify and represent exponential functions, and solve problems involving exponential functions, including problems arising from real-world applications.
- demonstrate an understanding of recursive sequences, represent recursive sequences in a variety of ways, and make connections to Pascal's triangle;
- demonstrate an understanding of the relationships involved in arithmetic and geometric sequences and series, and solve related problems;
- make connections between sequences, series, and financial applications, and solve problems involving compound interest and ordinary annuities.
- determine the values of the trigonometric ratios for angles less than  $360^\circ$ ; prove simple trigonometric identities; and solve problems using the primary trigonometric ratios, the sine law, and the cosine law;
- demonstrate an understanding of periodic relationships and sinusoidal functions, and make connections between the numeric, graphical, and algebraic representations of sinusoidal functions;
- identify and represent sinusoidal functions, and solve problems involving sinusoidal functions, including problems arising from real-world applications.

## ***Course Content***

<b><i>Unit</i></b>	<b><i>Length</i></b>
Algebra	11 hours
Representing Functions	13 hours
Quadratic Functions	13 hours
Determining and Applying Trigonometric Ratios	13 hours

Graphing Trigonometric Functions	13 hours
Exponential Functions	13 hours
Sequences and Series	13 hours
Financial Mathematics	11 hours
Summative/Culminating	10 hours
<b>Total</b>	110 hours

## *Unit Descriptions*

### **Unit 1 - Algebra**

In this unit students will simplify polynomial expressions through addition, subtraction and multiplication. Rational expressions will be simplified by adding, subtracting, multiplying, and dividing, stating restrictions on variable values. Finally, students will determine through substitution and simplification if two given algebraic expressions are equivalent.

### **Unit 2- Representing Functions**

Through authentic models, students are introduced to the definition of a function and the notations associated with it. Students use graphing technology and paper-and-pencil tasks to investigate the properties of functions and their inverses, and the transformations of functions. The investigations are used to introduce and extend the use of function notation to inverses and transformations. Students explore the domain and range of functions, inverses, and transformations.

### **Unit 3- Quadratic Functions**

Students will solve problems that involve quadratic functions arising from real-world applications. They will determine the maximum or minimum value of a quadratic function and the number of zeroes (i.e., x-intercepts). Students will simplify radicals and radical expressions obtained by adding, subtracting, and multiplying.

### **Unit 4- Determining and Applying Trigonometric Ratios**

Students consolidate and extend concepts first introduced in Grade 10. Students use the primary trigonometric ratios, the sine law, and the cosine law to model and solve two- and three-dimensional problems involving acute, right, and oblique triangles. Students investigate the relationship between degree and radian measure, and explore the use of the unit circle and special triangles to determine selected values of the primary trigonometric ratios. Methods of proof are introduced and applied to verify trigonometric identities. Students develop the skills to manipulate and solve trigonometric equations.

### **Unit 5- Graphing Trigonometric Functions**

Students investigate the periodic nature and graphical properties of the primary trigonometric functions. Using technology, students explore the effects of simple transformations on their graphs and equations. Students apply these concepts to model authentic problems.

### **Unit 6 - Exponential Functions**

Students will use prior knowledge of linear and quadratic functions to compare with exponential functions (comparing rates of change using finite differences in tables of values; identifying a constant ratio in a table of values, inspecting graphs, comparing equations). Students will graph various exponential functions and make comparisons between the graphs.

### **Unit 7 - Sequences and Series**

Students will investigate arithmetic and geometric series and sequences, and then solve related problems. They will demonstrate an understanding of recursive sequences and represent them in a variety of ways, including connections to Pascal's triangle.

### **Unit 8 - Financial Mathematics**

Students develop the formula for compound interest and solve problems related to compound interest and annuities. As skills are developed, students use spreadsheets to investigate the cost of

borrowing when interest rates, compound periods, lending terms, etc., are varied. The activities are designed to reflect the type of decisions that students are likely to face in the future. Students apply skills with linear and exponential functions.

### **Unit 9 - Summative Assessment**

Students will use the knowledge and skills acquired throughout the course to solve a problem involving all of the mathematics learned in this course.

## ***Teaching/Learning Strategies***

### **Teaching/Learning Strategies**

In order to address the wide range of expectations in this course, a variety of teaching, learning, and assessment strategies and tools need to be used including;

- the use of rich contextual problems which engage students and provide them with opportunities to demonstrate learning, and appreciate the need for new skills;
- the prompting, supporting, and challenging of individual students
- the use of technological tools and software (e.g., graphing software, dynamic geometry software, the Internet, spreadsheets, and multimedia) in activities, demonstrations, and investigations to facilitate the exploration and understanding of mathematical concepts;
- the use of learning/performance tasks that are designed to link several expectations and give the students occasion to demonstrate their optimal levels of achievement through the demonstration of skill acquisition, the communication of results, the ability to pose extending questions following an inquiry, and the determination of a solution to unfamiliar problems;
- the use of accommodations, remediation, and/or extension activities, where necessary, to meet the needs of exceptional students;
- In addition to the contribution of the teacher, students themselves should play an active role in their own learning. In order to successfully complete the requirements of this course, students are expected to
  - develop an increased responsibility for their own learning;
  - be accountable for prerequisite skills;
  - participate as active learners;
  - engage in explorations using technology;
  - apply individual and group learning skills;
  - describe mathematical patterns that emerge verbally, algebraically, and visually in the course of learning.

## ***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 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*. Ontario Ministry of Education Publication, 2010 p.41

Type of Assessment	Category	Details	Weighting (%)	
<b>Term Work (70%)</b>	Knowledge/ Understanding	-Explore exponential relations -Perform algebraic operations on rational expressions	10	
	Thinking/ Inquiry	-Investigate the properties of inverse functions -Investigate sequences	20	
	Communication	-State restrictions on the variable -Formalize the definition of the term function	20	
	Application	-Solve exponential equations -Apply exponent laws to powers containing integer and rational exponents -Discover algebraic approaches for finding the inverse of functions	20	
<b>Final Assessment (30%)</b>	Culminating Activity	-plot quadratic functions using technology -perform transformations to plotted functions -solve quadratic equations representing real world scenarios -calculate triangle side lengths and angles using sine and cosine laws -solve arithmetic and geometric series	K/U	3
			T/I	4
			C	4
			A	4
	Final Exam	-expand and simplify polynomials and radical expressions -analyse quadratic expressions and determine key points such as vertex, intercepts, min/max value -solve problems using graphical representations of data -calculate accrued compound interest on investments	K/U	3
			T/I	4
			C	4
			A	4
<b>TOTAL</b>			100	

## *Assessment/Evaluation Strategies*

An effective assessment program in mathematics must include a balance of diagnostic, formative and summative assessment instruments that incorporate the categories of learning as defined in The Achievement Chart for Mathematics. One approach is shown below:

	Knowledge/ Understanding	Thinking/Inquiry/ Problem Solving	Communication	Application
final examinations	✓	✓	✓	✓
observations		✓	✓	✓
performance tasks	✓	✓	✓	✓

quizzes	✓			
reports/assignments	✓		✓	✓
student-teacher conferences	✓		✓	
unit tests	✓	✓	✓	✓

Assessment tools such as observational checklists, performance criteria, the Achievement Chart for Mathematics, marking schemes, and rating scales can and should be used to assist in developing objective and consistent evaluations of student achievement.

## ***Resources***

*Mathematics 11*, McGraw-Hill Ryerson, 2001

*Foundations for College Mathematics 11*, McGraw-Hill Ryerson, 2007

*Growing Success: Assessment, Evaluation and Reporting in Ontario Schools*. Ontario Ministry of Education Publication, 2010

Course Profile: Course Profile - Functions and Relations, Grade 11

Quattro Pro, Geometer's Sketchpad

## ***Program Planning***

This course is offered to students living in isolated northern Ontario communities which do not have access to regular high school facilities, equipment or teachers associated with secondary education. This course uses the internet for instruction, demonstration and research. It uses a student centered semi-virtual classroom which capitalizes on the strengths of the internet program delivery to minimize the disadvantages of geographic remoteness.

Students are presented with instruction/activity via the internet. All lessons, assignments, questions and course material is presented in this manner with approved print materials available as a student resource. The student and instructor communicate via the internet, and there are regular, interactive, internet-based lessons during which the instructor presents key information to the class, and students have an opportunity to interact verbally with their instructor. A classroom mentor (a fully qualified teacher) assists students in completing tasks in a timely manner and provides tutoring as required.