

## Course Outline

School Name: **UMC High School**

Department Name: **MATHEMATICS**

**Ministry of Education Course Title: Advance Functions, Gr 12, University Preparation**

**Grade Level: 12, University Preparation**

Ministry Course Code: **MHF4UX**

Instructor:

Developed by: Karthika Manickavasakar

Date: January 2013

Revision Date: Mar 2017

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

Required Texts:

Textbook: *Advanced Functions 12*, Nelson (2008)

Resources:

- Advanced Functions 12, Nelson (2008)
- OAME/OMCA Materials (2007)
- Teacher-made Worksheets
- Graphing Calculators & Computers

Prerequisite:

Functions, Grade 11, University Preparation, or Mathematics for College  
Technology, Grade 12, College Preparation

Credits: 1

Length: 110 hours

Principal: \_\_\_\_\_

Head Teacher: \_\_\_\_\_

## Course Description

This course extends students' experience with functions. Students will investigate the properties of polynomial, rational, logarithmic, and trigonometric functions; develop techniques for combining functions; broaden their understanding of rates of change; and develop facility in applying these concepts and skills. Students will also refine their use of the mathematical processes necessary for success in senior mathematics. This course is intended both for students taking the Calculus and Vectors course as a prerequisite for a university program and for those wishing to consolidate their understanding of mathematics before proceeding to any one of a variety of university programs.

## Overall Curriculum Expectations

By the end of this course, students will:

### **Strand A: *Exponential and Logarithmic Functions***

1. demonstrate an understanding of the relationship between exponential expressions and logarithmic expressions, evaluate logarithms, and apply the laws of logarithms to simplify numeric expressions;
2. identify and describe some key features of the graphs of logarithmic functions, make connections among the numeric, graphical, and algebraic representations of logarithmic functions, and solve related problems graphically;
3. solve exponential and simple logarithmic equations in one variable algebraically, including those in problems arising from real-world applications.

### **Strand B: *Trigonometric Functions***

4. Demonstrate an understanding of the meaning and application of radian measure;
5. make connections between trigonometric ratios and the graphical and algebraic representations of the corresponding trigonometric functions and between trigonometric functions and their reciprocals, and use these connections to solve problems;
6. solve problems involving trigonometric equations and prove trigonometric identities.

***Strand C: Polynomial and Rational Functions***

7. Identify and describe some key features of polynomial functions, and make connections between the numeric, graphical, and algebraic representations of polynomial functions;
8. Identify and describe some key features of the graphs of rational functions, and represent rational functions graphically;
9. Solve problems involving polynomial and simple rational equations graphically and algebraically;
10. Demonstrate an understanding of solving polynomial and simple rational inequalities.

***Strand D: Characteristics of Functions***

11. Demonstrate an understanding of average and instantaneous rate of change, and determine, numerically and graphically, and interpret the average rate of change of a function over a given interval and the instantaneous rate of change of a function at a given point;
12. Determine functions that result from the addition, subtraction, multiplication, and division of two functions and from the composition of two functions, describe some properties of the resulting functions, and solve related problems;
13. Compare the characteristics of functions, and solve problems by modelling and reasoning with functions, including problems with solutions that are not accessible by standard algebraic techniques.

## Course Content

<b>Unit 1</b>	<b>Polynomial Functions (Chapters 1 ~ 2)</b>  Strands: <i>Characteristics of Functions</i> Overall Expectations: 11 and 13	25 hours
<b>Unit 2</b>	<b>Polynomial Equations and Inequalities (Chapters 3 ~ 4)</b>  Strands: <i>Polynomial and Rational Functions</i> Overall Expectations: 7, 9,10	21 hours
<b>Unit 3</b>	<b>Rational Functions (Chapter 5)</b>  Strands: <i>Polynomial and Rational Functions</i> Overall Expectations: 8-10	13 hours
<b>Unit 4</b>	<b>Trigonometric Functions (Chapter 6)</b>  Strand: <i>Trigonometric Functions</i> Overall Expectations: 4-6	15 hours
<b>Unit 5</b>	<b>Trigonometric Identities and Equations (Chapter 7)</b>  Strand: <i>Trigonometric Functions</i> Overall Expectations: 4-6	12 hours
<b>Unit 6</b>	<b><i>Exponential and Logarithmic Functions (Chapter 8)</i></b>  Strand: <i>Exponential and Logarithmic functions</i> Overall Expectations: 1-3	14 hours
<b>Unit 7</b>	<b>Combinations of Functions (Chapter 9)</b>  Strand: <i>Characteristics of Functions</i> Overall Expectations: 12	8 hours
	<b>Final Exam/Summative Evaluation</b> <b>Strands:</b> A. <i>Exponential functions and Logarithmic functions</i> B. <i>Trigonometric functions</i> C. <i>Polynomial and Rational functions</i> D. <i>Characteristics of Functions</i>  <b>Overall Expectations:</b> A1-A3, B1-B3,C1-C4,D1-D3	2 hours

TOTAL 110hours

## Unit Descriptions

### Unit 1 – Polynomial Functions (Chapters 1 ~ 2)

Time: 25 hours

#### Description

In this unit, the students will review the concepts of relation, range, domain, and function notation. They will review how to graph functions using transformations and learn how to graph piece wise functions. Student will be introduced to average rates of change and instantaneous rate of change.

#### Specific Expectations

*D. Characteristics of Functions:* 1.1,1.2.1.3,1.4,1.5,1.6,1.7,1.8,1.9, 2.1,2.7,2.8,3.1,3.3

<b>Assessment For Learning (AFL)</b>	<b>K/U</b>	<b>T</b>	<b>A</b>	<b>C</b>
Homework questions	x	x	x	x
Note Taking	x	x	x	x
Practice Worksheets	x	x	x	x
<b>Assessment As Learning (AAL)</b>				
Reflection – study log	x	x	x	x
Class Discussion	x			x
<b>Assessment Of Learning (AOL)</b>				
Unit 1 Assignment	x	x	x	x
Unit 1 Test	x	x	x	x

## Unit 2 – Polynomial Equations and Inequalities (Chapters 3~ 4)

Time: 21 hours

### Description

In this unit students learn to identify and describe some key features of polynomial functions. They learn to divide one polynomial by another, factor polynomials and graph polynomial function. Student learns to solve polynomial inequalities and learn to transform polynomial functions.

### Specific Expectations

C. *Polynomial and Rational Functions*: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 4.1, 4.2, 4.3

<b>Assessment For Learning (AFL)</b>	<b>K/U</b>	<b>T</b>	<b>A</b>	<b>C</b>
Homework questions	x	x	x	x
Note Taking	x	x	x	x
Practice Worksheets	x	x	x	x
<b>Assessment As Learning (AAL)</b>				
Reflection – study log	x	x	x	x
Class Discussion	x			x
<b>Assessment Of Learning (AOL)</b>				
Unit 2 Assignment	x	x	x	x
Unit 2 Test	x	x	x	x

### Unit 3 – Rational Functions (Chapter 5)

Time: 13 hours

#### Description

Student will identify and describing some key features of the graphs of rational functions. They will represent rational functions graphically; solve problems involving simple rational equations graphically and algebraically so they can demonstrate an understanding of how to solve simple rational inequalities.

#### Specific Expectations

*C. Polynomial and Rational Functions: 2.1, 2.2, 2.3, 3.5, 3.6, 3.7, 4.1, 4.2, 4.3*

<b>Assessment For Learning (AFL)</b>	<b>K/U</b>	<b>T</b>	<b>A</b>	<b>C</b>
Homework questions	x	x	x	x
Note Taking	x	x	x	x
Practice Worksheets	x	x	x	x
<b>Assessment As Learning (AAL)</b>				
Reflection – study log	x	x	x	x
Class Discussion	x			x
<b>Assessment Of Learning (AOL)</b>				
Unit 3 Assignment	x	x	x	x
Unit 3 Test	x	x	x	x

## Unit 4 –Trigonometric Functions (Chapter 6)

Time: 15 hours

### Description

Students learn how to sketch the primary trigonometric functions for angle measures expressed in radians and determine and describe the key properties of the functions. They learn how to determine the amplitude, period and phase shift of the sine and cosine functions when given equations and how to apply transformation to these graphs. They also learn to represent a sinusoidal function with an equation given its graph or a list of its properties and how to solve the equations for their angles. Finally they learn to recognize rates of change and make connections between instantaneous rates of change and average rates of change and solve related real-world problems.

### Specific Expectations

*B. Trigonometric Functions: 1.1,1.2,1.3,1.4,2.1,2.2,2.3,2.4,2.5,2.6,2.7,3.1,3.2,3.3, 3.4*

<b>Assessment For Learning (AFL)</b>	<b>K/U</b>	<b>T</b>	<b>A</b>	<b>C</b>
Homework questions	x	x	x	x
Note Taking	x	x	x	x
Practice Worksheets	x	x	x	x
<b>Assessment As Learning (AAL)</b>				
Reflection – study log	x	x	x	x
Class Discussion	x			x
<b>Assessment Of Learning (AOL)</b>				
Unit 4 Test	x	x	x	x



## Unit 5 –Trigonometric Identities and Equations (Chapter 7)

Time: 12 hours

### Description

Students are introduced to the radian as an alternative unit to the degree for angle measurement. They also develop and apply the relationship between radian and degree measure. They determine the primary trigonometric ratios and the reciprocal trigonometric ratios of angles expressed in radian measure and determine the exact values for the trigonometric ratios for special radian measures. They will also learn to recognize equivalent trigonometric expression and explore the algebraic development of the compound angle formula and use the formulas to determine exact value of trigonometric ratios. Finally the students learn trigonometric identities and strategies to solve them.

### Specific Expectations

*B. Trigonometric Functions: 1.1,1.2,1.3,1.4,2.1,2.2,2.3,2.4,2.5,2.6,2.7,3.1,3.2,3.3, 3.4*

<b>Assessment For Learning (AFL)</b>	<b>K/U</b>	<b>T</b>	<b>A</b>	<b>C</b>
Homework questions	x	x	x	x
Note Taking	x	x	x	x
Practice Worksheets	x	x	x	x
<b>Assessment As Learning (AAL)</b>				
Reflection – study log	x	x	x	x
Class Discussion	x			x
<b>Assessment Of Learning (AOL)</b>				
Unit 5 Test	x	x	x	x

## Unit 6 – Exponential and Logarithmic Functions (Chapter 8)

Time: 14 hours

### Description

Students learn the relationship between logarithms and exponents and make connections between related logarithmic and exponential equations. They make connections between the laws of exponents and the laws of logarithms and use the laws to simplify and evaluate numerical expressions. Students determine the key features of the graph of a logarithmic function and the relationship between an exponential function and the corresponding logarithmic function, that is its' inverse. Students also learn to apply transformations to the exponential and logarithmic functions. Finally they solve problems based on real-world applications of exponential and logarithmic functions include rates of change. Students learn a variety of strategies for solving exponential and logarithmic equations. They will also apply modeling strategies to solve a variety of problems involving data that can be modeled by exponential and other types of curves.

### Specific Expectations

A. *Exponential and Logarithmic functions* 1.1,1.2,1.3,1.4,2.1,2.2,2.3,2.4,3.1,3.2,3.3, 3.4

<b>Assessment For Learning (AFL)</b>	<b>K/U</b>	<b>T</b>	<b>A</b>	<b>C</b>
Homework questions	x	x	x	x
Note Taking	x	x	x	x
Practice Worksheets	x	x	x	x
<b>Assessment As Learning (AAL)</b>				
Reflection – study log	x	x	x	x
Class Discussion	x			x
<b>Assessment Of Learning (AOL)</b>				
Unit 6 Test	x	x	x	x

## Unit 7 – Combination of Functions (Chapter 9)

Time: 8 hours

### Description

Student will determine functions that result from the addition, subtraction, multiplication, and division of two functions. They will form the composition of two functions, describe some properties of the resulting functions, and solve related problems.

### Specific Expectations

*D. Characteristics of Functions 2.2,2.3,2.4,2.5,2.6*

<b>Assessment For Learning (AFL)</b>	<b>K/U</b>	<b>T</b>	<b>A</b>	<b>C</b>
Watching Video Lessons	x	x	x	x
Note taking	x	x	x	x
<b>Assessment As Learning (AAL)</b>				
Graphic organizers	x	x	x	x
Reflection – study log	x	x	x	x
Class Discussion	x			x
<b>Assessment Of Learning (AOL)</b>				
Chapter 9 Assignment	x	x	x	x

## Teaching/Learning Strategies

A variety of strategies are used to allow students many opportunities to attain the necessary skills for success in this course and at university. The teacher uses a variety of whole class, small group and individual activities to facilitate learning. The following is a list of specific teaching/learning strategies that the teacher may use but is not limited to:

- Lecture
- Modeling/Direct Instruction
- Demonstration/exemplars
- Videos
- Graphic organizers (Venn Diagram, T-charts, KWL charts, Placemats)
- Problem-Solving
- Homework questions
- Structured Discussions
- Student Presentation
- Jigsaw
- Brainstorming
- Conference/Interview
- Self-Assessment
- Peer-Assessment
- Teacher feedback
- Group work
- Pair work
- Independent work
- Exit/Entrance Cards
- Tests
- Quizzes
- Exam

### ONLINE & OFFLINE COMPONENTS

The design of this course is intended to offer a rich balance between online and offline elements. The following is a summary of the course components and their delivery format. Please refer to the individual unit outlines for specific details. Course content & instruction: *online* Communication between teacher and students: *online & offline* Collaboration between students: *online* Assessment & evaluation: *online & offline* Practise exercises, textbook work, readings etc: *offline*

## Assessment/Evaluation Strategies

Diagnostic assessment is used at the beginning of a unit to assist in determining a starting point for instruction. Assessment for Learning (AFL) provides information to students as they are learning and refining their skills. Assessment as Learning (AAL) acts as a stepping-stone for students to begin applying their understanding using critical thinking; it bridges the gap between AFL and AOL. Assessment of Learning (AOL), at the end of units and course, provides students with the opportunity to synthesize/apply/demonstrate their learning and the achievement of the expectations. The following is a list of specific assessment/evaluation strategies that the teacher may use but is not limited to:

**Strategies actually used in the classroom are indicated in the chart above and reflected in classroom instruction:**

**Levels:** There are four levels of achievement for students who are passing the course:

- Level 1 (50-59%)
- Level 2 (60-69%)
- Level 3 (70-79%)
- Level 4 (80-100%)

**Level 3 is the provincial standard for student achievement.**

**Final Grade:** The final grade will include the following weighting:

<b>Knowledge and understanding</b>	20%
<b>Thinking and inquiry</b>	30%
<b>Communication</b>	20%
<b>Application</b>	30%

The evaluation for the course is broken down as follows:

- 70% COURSE WORK**  
This portion of the mark is based on performance on assignments and tests 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% COURSE CULMINATING ACTIVITIES**  
All students will write a final examination, which will take into account the entire course, including the student's most recent and most consistent performance. The final evaluation may take the form of a written examination, an independent study project, a presentation, etc. or a combination of these formats.  
**The final evaluation will take the form of a 2-hour written exam.**

**TOTAL: 100%**

## Program Planning

In order to accommodate students' needs, the teachers of UMC High School incorporate appropriate considerations in their program planning and delivery. These considerations may include, but not be limited to:

- ❑ Have a positive attitude towards mathematics
- ❑ Help student activate prior knowledge in math
- ❑ Help students develop mathematical understanding and gives meaning to skills and concepts in all strands
- ❑ Reading aloud strategies that enable ESL students to develop their oral communication skills
- ❑ Provide step-by-step instructions
- ❑ Allow students to reason, communicate ideas, make connections, and apply knowledge and skills
- ❑ Provide opportunities to learn in a variety of ways – individually, cooperatively, collaboratively, independently, with teacher direction, through investigation involving hands-on experience, and through examples followed by practice
- ❑ Use concrete learning tools, such as connecting cubes, measurement tools, algebra tiles, and number cubes, invite students to explore and represent abstract mathematical ideas in varied, concrete, tactile, and visually rich ways
- ❑ Use graphical and algebraic representations to represent mathematical problems
- ❑ Link mathematical concepts learned in class with real-world applications
- ❑ Encourage students to develop a willingness to persist, to investigate, to reason, to explore alternative solutions, to view challenges as opportunities to extend their learning
- ❑ Provide student with problems that are challenging but not beyond their ability to solve.