

Course of Study and Evaluation Statement

Advanced Functions, 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: September 2013
- Course title: Advanced Functions, Grade 12: University Preparation (MHF4U). Credit Value 1.0
- Prerequisite: Functions, Grade 11
- Textbook: Advanced Functions; McGraw-Hill Ryerson Ltd. 2008

2. Overall Goals

- 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 Expectations are in the areas of Exponential and Logarithmic Functions; Trigonometric Functions; Polynomial and Rational Functions; and Characteristics of Functions. By the end of the course, students will:
 - in **Exponential and Logarithmic Functions**:
 - * demonstrate an understanding of the relationship between exponential expressions and logarithmic expressions, evaluate logarithms, and apply the laws of logarithms to simplify numeric expressions;
 - * 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;
 - * solve exponential and simple logarithmic equations in one variable algebraically, including those in problems arising from real-world applications.
 - in **Trigonometric Functions**:
 - * demonstrate an understanding of the meaning and application of radian measure;
 - * 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;
 - * solve problems involving trigonometric equations and prove trigonometric identities.
 - in **Polynomial and Rational Functions**:
 - * identify and describe some key features of polynomial functions, and make connections between the numeric, graphical, and algebraic representations of polynomial functions;
 - * identify and describe some key features of the graphs of rational functions, and represent rational functions graphically;
 - * solve problems involving polynomial and simple rational equations graphically and algebraically;
 - * demonstrate an understanding of solving polynomial and simple rational inequalities.

- in **Characteristics of Functions**

- * 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;
- * 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;
- * compare the characteristics of functions, and solve problems by modeling and reasoning with functions, including problems with solutions that are not accessible by standard algebraic techniques.

- 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: **Responsibility, Organization, Independent Work, Collaboration, Initiative and Self-regulation.** Teachers report achievement on the six 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.

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.

Missed Evaluations If a student is legitimately absent for an evaluation, 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 will 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)

Teacher Contact: 416-393-1860 Ext. 20080

Course Outline- Suggested Exercises

Chapter 1: Polynomial Functions

1.1 Power Functions

Exercises: Page 11 #1, 2, 3, 4, 7

1.2 Characteristics of Polynomial Functions

Exercises: Page 26 #1, 2, 3, 4, 5, 7

1.3 Equations and Graphs of Polynomial Functions

Exercises: Page 39 #1, 2 (day 1)

Exercises: Page 39 #3, 4, 7, 8 (day 2)

1.4 Transformations

Exercises: Page 49 #1, 4, 5, 7, 8, 12

1.5 Slopes of Secants and Average Rate of Change

Exercises: Page 62 #1, 2, 5, 7

1.6 Slopes of Tangents and Instantaneous Rate of Change

Exercises: Page 71 #1, 3, 5, 7

Chapter 2: Polynomial Equations and Inequalities

2.1 The Remainder Theorem

Exercises: Page 91 #2, 3 (parts), 4, 6, 9, 10, 13

2.2 The Factor Theorem

Exercises: Page 102 #2, 6 (parts), 10, 11, 19b

2.3 Polynomial Equations

Exercises: Page 110 #1 (parts), 3 (parts), 6 (parts), 7 (parts), 8, 14

2.4 Families of Polynomial Functions

Exercises: Page 120 #5, 8, 9, 15

2.5 Solve Inequalities Using Technology

Exercises: Page 129 #1, 2 (b, c), 4, 5, 6 (parts)

2.6 Solve Factorable Polynomial Inequalities Algebraically

Exercises: Page 139 #1, 2, 4, 6, 9

Chapter 3: Rational Functions

3.1 Reciprocal of a Linear Function

Exercises: Page 153 #1 (a, c), 7 (c, d)

3.2 Reciprocal of a Quadratic Function

Exercises: Page 164 #1 (a, c), 2, 5

3.3 Rational Functions of the Form $f(x)=ax+b$ over $cx+d$

Exercises: Page 174 #6 (a, d, f), 7b, 9

3.4 Solve Rational Equations and Inequalities

Exercises: Page 183 #2, 9 (day 1)

Exercises: Page 183 #4, 5 (day 2)

3.5 Making Connections with Rational Functions and Equations

Exercises: Page 189 #1, 6, 10, 11

Chapter 4: Trigonometry

4.1 Radian Measure

Exercises: Page 208 #5, 6, 7, 8 (parts)

4.2 Trigonometric Ratios and Special Angles

Exercises: Page 216 #2, 3, 5, 6, 7, 8, 16, 17, 18

4.3 Equivalent Trigonometric Expressions

Exercises: Page 225 #2, 3, 6-10

4.4 Compound Angle Formulas

Exercises: Page 232 #1-7, 8, 9

4.5 Prove Trigonometric Identities

Exercises: Page 240 #1-13, 15, 16, 21

Chapter 5: Trigonometric Functions

5.1 Graphs of Sine, Cosine, and Tangent Functions

Exercises: Page 258 #4, 5, 6, 9-14, 17, 18

5.2 Graphs of Reciprocal Trigonometric Functions

Exercises: Page 267 #4, 5, 6, 10, 13

5.3 Sinusoidal Functions of the Form $f(x)=a \sin (k(x-d))+c$ and $f(x)=a \cos (k(x-d))+c$

Exercises: Page 275 #1-6, 10-13

5.4 Solve Trigonometric Equations

Exercises: Page 287 #1, 3, 7, 9-12, 14-20

5.5 Making Connections and Instantaneous Rate of Change

Exercises: Page 296 #10 (day 1)

Exercises: Page 296 #3, 4 (day 2)

Chapter 6: Exponential and Logarithmic Functions

6.1 The Exponential Function and its Inverse

Exercises: Page 318 #1, 2, 5, 6

6.2 Logarithms

Exercises: Page 328 #1, 2, 3, 4, 8, 10

6.3 Transformations of Logarithmic Functions

Exercises: Page 338 #1, 2, 3, 13

6.4 Power Law of Logarithms

Exercises: Page 347 #1, 2, 5, 6/ 4, 10

6.5 Making Connections: Logarithmic Scales in the Physical Sciences

Exercises: Page 353 #1, 2, 6, 7, 8, 9, 10

Chapter 7: Tools and Strategies for Solving Exponential and Logarithmic Equations

7.1 Equivalent Forms of Exponential Equations

Exercises: Page 368 #4, 5, 6, 19

7.2 Techniques for Solving Exponential Equations

Exercises: Page 375 #2, 4, 6, 7, 11/ 3, 8, 14, 15

7.3 Product and Quotient Laws of Logarithms

Exercises: Page 384 #1, 3, 4, 5, 6, 7

7.4 Techniques for Solving Logarithmic Equations

Exercises: Page 391 #1, 2, 3, 5, 6, 7

Chapter 8: Combining Functions

8.1 Sums and Differences of Functions

Exercises: Page 424 #3, 5, 7, 8, 9

8.2 Products and Quotients of Functions

Exercises: Page 435 #4, 8, 9

8.3 Composite Functions

Exercises: Page 447 #1, 4, 9

8.4 Inequalities of Combined Functions

Exercises: Page 458 #3, 5, 6, 8, 9