Course Code: MHF4U
Course Name: Advanced Functions
Grade: 12
Course Type: University
Credit Value: 1.0

School Name: Salvador Academy
Department: Mathematics
Department Head: Mario Salvador
Development: 2017 by Mario Salvador
Revision: 2017 by Mario Salvador

Curriculum Policy Document: Mathematics, The Ontario Curriculum, Grades 11 and 12, 2007

Prerequisite: MCR3U, Functions, Grade 11, University **or** MCT4C, Mathematics for College Technology, Grade 12, College

Course Description/Rationale

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:

A. Exponential and Logarithmic Functions
A1. demonstrate an understanding of the relationship between exponential expressions and logarithmic expressions, evaluate logarithms, and apply the laws of logarithms to simplify numeric expressions;
A2. 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;
A3. solve exponential and simple logarithmic equations in one variable algebraically, including those in problems arising from real-world applications.

B. Trigonometric Functions
B1. demonstrate an understanding of the meaning and application of radian measure;

B2. 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;

B3. solve problems involving trigonometric equations and prove trigonometric identities.

C. Polynomial and Rational Functions

C1. identify and describe some key features of polynomial functions, and make connections between the numeric, graphical, and algebraic representations of polynomial functions;

C2. identify and describe some key features of the graphs of rational functions, and represent rational functions graphically;

C3. solve problems involving polynomial and simple rational equations graphically and algebraically;

C4. demonstrate an understanding of solving polynomial and simple rational inequalities.

D. Characteristics of Functions

D1. 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;

D2. 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;

D3. 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.

Outline of Course Content

Course Units

Unit 1 – Polynomial and Rational Expressions (8 Hours)
Unit 2 – Polynomial and Rational Equations (10 Hours)
Unit 3 – Functions and their Properties (10 Hours)
Unit 4 – Polynomial and Rational Functions (10 Hours)
Unit 5 – Exponential Functions (9 Hours)
Unit 6 – Logarithmic Functions (12 Hours)
Unit 7 – Trigonometric Expressions (11 Hours)
Unit 8 – Trigonometric Functions (10 Hours)
Unit 9 – Creating New Functions (10 Hours)
Unit 10 – Limits and Rates of Change (17 Hours)
Final Exam (3 Hours)

Teaching and Learning Strategies

Each course is broken into eight to ten units that each consist of three to six modules. Each module begins with a review of prerequisite skills and ensures mastery of these skills to start learning new material. Through competency-based learning, each course encourages mastery of individual skills/learning outcomes. Learners will work with one competency at a time in order to complete learning goals of the course. Learners will be given opportunities to refine their skills and deepen their understanding without advancing to more abstract material. Teachers will identify when a

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student is struggling on particular concepts and facilitate appropriate instruction and activity to help the student overcome obstacles.

All modules are carefully scaffolded so that students can effectively tackle abstract problems and apply their understanding to real-life applications the end of the unit. At the end of each module is an assignment where no solutions are given as they are to be submitted for assessment. As well, the unit will conclude with a test. Both the assignment and the test for each module will contribute to the student's grade.

Teachers and administrators will help students to enjoy learning and encourage them to take control of their learning process by learning independently and taking risks without a fear of failure. Teachers will ask more questions than give answers so students can arrive at answers on their own through investigation and reasoning. Through competency-based learning, students will become more confident with math after achieving mastery of smaller goals and skills.

Various instructional strategies will be used to meet a range of learning needs and accommodate different learning styles, interests and abilities. All learning activities will take into consideration seven mathematical processes:
- **Communicating**: To improve student success, there will be several opportunities for students to share their understanding both in oral and as written form.
- **Problem solving**: Scaffolding of knowledge; detecting patterns; making and justifying conjectures; guiding students as they apply their chosen strategy; directing students to use multiple strategies to solve the same problem, when appropriate; recognizing, encouraging, and applauding perseverance; and discussing the relative merits of different strategies for specific types of problems.
- **Reasoning and proving**: Asking questions that get students to hypothesize, providing students with one or more numerical examples that parallel them with the generalization and describing their thinking in more detail.
- **Reflecting**: Modeling the reflective process, asking students how they know.
- **Selecting Tools and Computational Strategies**: Modeling the use of tools and having students use technology to help solve problems.
- **Connecting**: Activating prior knowledge when introducing a new concept in order to make a smooth connection between previous learning and new concepts, and introducing skills in context to make connections between particular manipulations and problems that require them.
- **Representing**: Modeling various ways to demonstrate understanding, posing questions that require students to use different representations as they are working at each level of conceptual development - concrete, visual or symbolic, allowing individual students the time they need to solidify their understanding at each conceptual stage.

Strategies for Assessment & Evaluation of Student Performance

We follow the leadership of the Ministry of Education in regards to Assessment and Evaluation as outlined in *Growing Success, 2010*. It details that the primary purpose of assessment and evaluation is to improve student learning. Salvador Academy will use assessment to ensure mastery of necessary skills, build confidence in students, and develop self-assessment skills and metacognitive skills.

In accordance with *Growing Success*, teachers will use practices and procedures that:

1) are fair, transparent, and equitable for all students;
2) support all students, including those with special education needs, those who are learning the language of instruction (English or French), and those who are First Nation, Métis, or Inuit;
3) are carefully planned to relate to the curriculum expectations and learning goals and, as much as possible, to the interests, learning styles and preferences, needs, and experiences of all students;
4) are communicated clearly to students and parents at the beginning of the school year or course and at the appropriate points through the school year or course;
5) are ongoing, varied in nature, and administered over a period of time to provide multiple opportunities for students to demonstrate the full range of their learning;
6) provide ongoing descriptive feedback that is clear, specific, meaningful, and timely to support improved learning and achievement
7) develop students' self-assessment skills to enable them to assess their own learning, set specific goals, and plan next steps for their learning

Achievement in this course will consider four categories:

- Knowledge and Understanding: subject-specific content acquired in each course (knowledge), and the comprehension of its meaning and significance (understanding).
- Thinking: the use of critical and creative thinking skills and/or processes such as: planning skills, processing skills and critical/creative thinking processes.
- Communication: the conveying of meaning through various oral, written, and visual forms
- Application: the use of knowledge and skills to make connections within and between various contexts.

70% of the grade will be based on evaluations conducted through the course. 30% of the grade will be based on a final exam to be completed at the end of the course. A final grade is recorded for this course, and a credit is granted if the student's grade is 50% or higher.

A midterm report card will be issued after completion of half of the modules in the course. A final report card will be issued after completion of the entire course. Student achievement of the curriculum expectations will be reported as a percentage grade. The report card will also contain the course median grade (as a percentage) and letter grades for six learning skills:

- Responsibility
- Organization
- Independent Work
- Collaboration
- Initiative
- Self-Regulation

A final report card will be sent to the student's home school to be added to the student's transcript of completed OSSD credits.

Considerations for Program Planning

Considerations are made when planning this course and efforts are made to align with the Ministry of Education policies and initiatives:

Planning Related to Students with Special Needs

Teachers have a responsibility to help all students learn and succeed. Accommodations can support each student's unique style of learning. For those with special education needs, teachers and administrators in conjunction with the student, parent and any recommendations from a board designated Individual Education Plan (IEP) will determine whether it is appropriate to make accommodations or modify expectations. Accommodations may include instructional modifications, environmental accommodations, or assessment accommodations.

Program Considerations for English Language Learners

Teachers have a responsibility to help all students learn and succeed. Students whose first language is not English may come from regions with highly sophisticated educational systems or regions where formal school was limited. Teachers share in the responsibility for their English-language development and can give necessary support in a variety of methods.

Antidiscrimination Education in Mathematics

Teachers have a responsibility to help all students learn and succeed. To ensure that all students in the province have an equal opportunity to achieve their full potential, the curriculum must be free from bias, and all students must be provided with a safe and secure environment characterized by respect for others that allows them to participate fully and responsibly in the educational experience. Teachers will facilitate a learning environment that is inclusive in nature, and the curriculum should be enriched the diverse experiences of students with varying backgrounds, abilities, interests, and learning styles. It is our philosophy that this can be more easily achieved when mathematics is viewed in real-life contexts whether through analysis of data trends or solving problems in health, science and the environment.

Literacy/Inquiry Research Skills

Teachers have a responsibility to help all students learn and succeed. We advance a student's development by helping them to learn skills such as literacy and inquiry research skills. Achievement in written, oral, and visual communication is important in mathematics. Teachers will help students be precise in mathematical terminology. It is also important that teachers develop a student's ability to ask questions and plan investigations when solving problems in an effort to deepen the learner's understanding.

The Role of Information and Communication Technology in Mathematics

Teachers will engage students in many information and communication technologies (ICT) to support a student's learning of mathematics. This will include, but not be limited to, simulations, multimedia, online portals, graphing technologies, databases, spreadsheets, word-processing software, and computer algebra systems (CAS).

Career Education

Teachers have a responsibility to help all students learn and succeed. Mathematics is more enjoyable when students explore concepts that are career-related and connections are made to each student's interests, aspirations and abilities. The curriculum will emphasize the usefulness of math in various fields such as science, business, engineering, computer studies; industries such as hospitality, recreation, and tourism; and the technical trades.

Health and Safety in Mathematics

It is paramount that we provide a safe learning environment and that all classroom practice complies with relevant federal, provincial, and municipal health and safety legislation and by-laws. These include, but are not limited to, the Workplace Safety and Insurance Act, the Workplace Hazardous Materials Information System (WHMIS), the Food and Drug Act, the Health Protection and Promotion Act, the Ontario Building Code, and the Occupational Health and Safety Act (OHSA). The OHSA requires all schools to provide a safe and productive learning and work environment for both students and employees.

Resources

Casio fx-991ES Plus C Calculator
Scanner or camera to upload work
*Textbook not required.