LEARNING LANGUAGES INSTITUTE

MCR3U Course Outline	
Name of School	Learning Languages Institute
Department	Mathematics
Course Developer	Dr. Lida Hosseini and Mr. Ben Huynh
Course Development Date	August 2008
Revision Date	Feb 2020
Course Reviser	Hassan Mirzai
Course Title	Functions
Grade	11
Course Type	University
Ministry Course Code	MCR3U
Credit Value	1.0
Developed From	The Ontario Curriculum, Grades 11 and 12: Mathematics, 2007 (revised); Ministry of Education; Growing Success (2010)
Prerequisite	Grade 10 Principles of Mathematics, Academic

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Course Description

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

A. CHARACTERISTICS OF FUNCTIONS

A_1• demonstrate an understanding of functions, their representations, and their inverses, and make connections between the algebraic and graphical representations of functions using transformations;

A_2• 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;

A_3• demonstrate an understanding of equivalence as it relates to simplifying polynomial, radical, and rational expressions.

B. EXPONENTIAL FUNCTIONS

B_1• evaluate powers with rational exponents, simplify expressions containing exponents, and describe properties of exponential functions represented in a variety of ways;

B_2• make connections between the numeric, graphical, and algebraic representations of exponential functions;

B_3• identify and represent exponential functions, and solve problems involving exponential functions, including problems arising from real-world applications.

C. DISCRETE FUNCTIONS

C_1• demonstrate an understanding of recursive sequences, represent recursive sequences in a variety of ways, and make connections to Pascal's triangle;

C_2• demonstrate an understanding of the relationships involved in arithmetic and geometric sequences and series, and solve related problems;

C_3• make connections between sequences, series, and financial applications, and solve problems involving compound interest and ordinary annuities.

D. TRIGONOMETRIC FUNCTIONS

D_1• determine the values of the trigonometric ratios for angles less than 360°; prove simple trigonometric identities; and solve problems using the primary trigonometric ratios, the sine law, and the cosine law;

D_2• demonstrate an understanding of periodic relationships and sinusoidal functions, and make connections between the numeric, graphical, and algebraic representations of sinusoidal functions;

D_3• identify and represent sinusoidal functions, and solve problems involving sinusoidal functions, including problems arising from real-world applications.

Course Content

Unit		Length
A. CHARACTERISTICS OF FUNCTIONS		25 Hours
B. EXPONENTIAL FUNCTIONS		25 Hours
C. DISCRETE FUNCTIONS		30. Hours
D. TRIGONOMETRIC FUNCTIONS		30. Hours
	Total	110 hours

Units Listed in the Sequence of Delivery

Unit Titles and Descriptions	**Time and Sequence**
Introduction to Functions Students will learn to identify a function as a special type of relation, recognize functions in various representations, and make connections between the algebraic and graphical representations of functions	11 hours

using transformations in this unit. They will also explore the properties of some basic functions and their inverses.	
Quadratic Functions Students will learn to graph and analyze the properties of quadratic functions in this unit. They will also determine the zeros and the maximum and minimum of quadratic functions. In addition, they will solve problems involving quadratic functions, including problems arising from real-world applications.	14 hours
Exponential Functions This unit will explore several topics including evaluating powers with rational exponents, simplifying expressions containing exponents, and describing properties of exponential functions represented in a variety of ways. The emphasis will be on problem solving using these concepts.	25 hours
Trigonometric Ratios In this unit, students will learn to relate the six trigonometric ratios to the unit circle, solve real-life problems by using trigonometric ratios, properties of triangles, and the sine and cosine laws. They will also learn to prove simple trigonometric identities.	10 hours

Sinusoidal Functions Students will be able to demonstrate an understanding of periodic relationships and sinusoidal functions, make connections between the numeric, graphical, and algebraic representations of sinusoidal functions, and solve problems involving sinusoidal functions, including problems arising from real-world applications in this unit. They will also understand the effect of applying transformations to the trigonometric functions.	20 hours
Discrete Functions: Sequences and Series This unit entails an exploration of recursive sequences and their representation in a variety of ways, an understanding of Pascal's triangle and the relationships involved in arithmetic and geometric sequences and series.	15 hours
Discrete Functions: Financial Applications This unit involves the exploration of discrete functions' related problems involving compound interest and ordinary annuities.	15 hours
Total	110 hours

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Teaching and Learning Strategies

A wide variety of instructional strategies are used to provide learning opportunities to accommodate a variety of learning styles, interests and ability levels. These strategies include, but are not limited to:

- Whole-class, small group, and individual instruction;
- Direct instruction as well as opportunities for open-ended exploration;
- Electronic technology – use of videos, tapes, internet resources;
- Computer technology – reports, class data taken from measurements, graphics, flow charts, concept maps, diagrams of investigations, databases, electronic presentation;
- Encourage maximum student participation in classroom activities;
- Encourage inquiry – questioning, investigating, communicating in a variety of ways;
- Use of scientific investigation and communication;
- Assign tasks where students are able to define some of the parameters (such as scope and procedure);
- Identify & address different learning styles throughout the course;
- Use self-assessments;
- Encourage brainstorming, exchange of ideas, debating;
- Use of researching as learning tools; accessing, selecting and analyzing information;
- STSE- relate science to technology, society & environment;
- Respect cultural differences of international students.

Assessment and Evaluation Strategies for Student Performance

	UNITS	Duration	OVERALL EXPECTATIONS	AFL	AAL	AOL	K 25 %	A 25 %	C 25 %	T 25%
70 %	A	25	A1-A3	Home Work Worksheets Student-Teacher Conferencing	Self-Assessment Reflective Journal	Test Written Assignments	√	√	√	√
	B	25	B1-B3	Home Work Worksheets Student-Teacher Conferencing	Self-Assessment Learning Log	Test	√	√	√	√
	C	30	C1-C3	Home Work Worksheets Student-Teacher Conferencing	Self-Assessment Learning Log	Test Written Assignments	√	√	√	√
	D	30	D1-D3	Home Work Worksheets Student-Teacher Conferencing	Self-Assessment Reflective Journal	Assignments	√	√	√	√
30 %			A1-D3	and Final Exam 30% (Written Component)			√	√	√	√

CONSIDERATIONS FOR PROGRAM PLANNING

When planning a program in mathematics, teachers must take into account considerations in a number of important areas, including those discussed below.

PLANNING MATHEMATICS PROGRAMS FOR STUDENTS WITH SPECIAL EDUCATION NEEDS

Classroom teachers are the key educators of students who have special education needs. They have a responsibility to help all students learn, and they work collaboratively with special education teachers, where appropriate, to achieve this goal. Special Education Transformation: The Report of the Co-Chairs with the Recommendations of the Working Table on Special Education, 2006 endorses a set of beliefs that should guide program planning for students with special education needs in all disciplines. Those beliefs are as follows: All students can succeed. Universal design and differentiated instruction are effective and interconnected means of meeting the learning or productivity needs of any group of students. Successful instructional practices are founded on evidence-based research, tempered by experience. Classroom teachers are key educators for a student's literacy and numeracy development. Each student has his or her own unique patterns of learning. Classroom teachers need the support of the larger community to create a learning environment that supports students with special education needs. Fairness is not sameness. In any given classroom, students may demonstrate a wide range of learning styles and needs. Teachers plan programs that recognize this diversity and give students performance tasks that respect their particular abilities so that all students can derive the greatest possible benefit from the teaching and learning process. The use of flexible groupings for instruction and the provision of ongoing assessment are important elements of programs that accommodate a diversity of learning needs.

PROGRAM CONSIDERATIONS FOR ENGLISH LANGUAGE LEARNERS

Ontario schools have some of the most multilingual student populations in the world. Ontario's linguistic heritage includes several Aboriginal languages and many African, Asian, and European language.

When these students start school in Ontario, they are entering a new linguistic and cultural environment. All teachers share in the responsibility for these students' English language development.

English language learners (students who are learning English as a second or additional language in English-language schools) bring a rich diversity of background knowledge and experience to the classroom. These students' linguistic and cultural backgrounds not only support their learning in their new environment but also become a cultural asset in the classroom community. Teachers will find positive ways to incorporate this diversity into their instructional programs and into the classroom environment.

Most English language learners in Ontario schools have an age-appropriate proficiency in their first language. Although they need frequent opportunities to use English at school, there are important educational and social benefits associated with continued development of their first language while they are learning English. Teachers need to encourage parents to continue to use their own language at home in rich and varied ways as a foundation for language and literacy development in English. It is also important for teachers to find opportunities to bring students' languages into the classroom, using parents and community members as a resource.

During their first few years in Ontario schools, English language learners may receive support through one of two distinct programs from teachers who specialize in meeting their language-learning needs:

In planning programs for students with linguistic backgrounds other than English, teachers need to recognize the importance of the orientation process, understanding that every learner needs to adjust to the new social environment and language in a unique way and at an individual pace. For example, students who are in an early stage of English-language acquisition may go through a "silent period" during which they closely observe the interactions and physical surroundings of their new learning environment. They may use body language rather than speech or they may use their first language until they have gained enough proficiency in English to feel confident of their interpretations and responses. Students thrive in a safe, supportive, and welcoming environment that nurtures their self-confidence while they are receiving focused literacy instruction. When they are ready to participate in paired, small-group, or whole-class activities, some students will begin by using a single word or phrase to communicate a thought, while others will speak quite fluently.
Research has shown that it takes five to seven years for most English language learners to catch up to their English-speaking peers in their ability to use English for academic purposes. Moreover, the older the children are when they arrive, the more language knowledge and skills they have to catch up on, and the more direct support they require from their teachers.

Responsibility for students' English-language development is shared by the classroom teacher, the ESL/ELD teacher (where available), and other school staff. Volunteers and peers may also be helpful in supporting English language learners in the language classroom.

Teachers must adapt the instructional program in order to facilitate the success of these students in their classrooms. Appropriate adaptations include:

- modification of some or all of the subject 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, graphic organizers, and scaffolding; 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, and materials that reflect cultural diversity);
- use of assessment accommodations (e.g., granting of extra time; use of oral interviews, demonstrations or visual representations, or tasks requiring completion of graphic organizers or cloze sentences instead of essay questions and other assessment tasks that depend heavily on proficiency in English).

When learning expectations in any course are modified for an English language learner (whether the student is enrolled in an ESL or ELD course or not), this information must be clearly indicated on the student's report card.

ANTIDISCRIMINATION EDUCATION

The implementation of antidiscrimination principles in education influences all aspects of school life. It promotes a school climate that encourages all students to work to attain high standards, affirms the worth of all students, and helps students strengthen their sense of identity and develop a positive self-image. It encourages

staff and students alike to value and show respect for diversity in the school and the wider society. It requires schools to adopt measures to provide a safe environment for learning, free from harassment, violence, and expressions of hate.

Antidiscrimination education encourages students to think critically about themselves and others in the world around them in order to promote fairness, healthy relationships, and active, responsible citizenship.

Access to computers should be monitored and a range of software applications provided.

A problem-solving approach can benefit students who are having difficulties with materials or equipment. Because access to equipment at home will vary, it is important to offer challenges for or support to students whose levels of prior knowledge differ.

Critical thinking is the process of thinking about ideas or situations in order to understand them fully, identify their implications, and/or make a judgement about what is sensible or reasonable to believe or do. Critical thinking includes skills such as questioning, predicting, hypothesizing, analyzing, synthesizing, examining opinions, identifying values and issues, detecting bias, and distinguishing between alternatives.

LITERACY, MATHEMATICAL LITERACY, AND INVESTIGATION (INQUIRY/RESEARCH) SKILLS

Literacy, mathematical literacy, and investigation skills are critical to students' success in all subjects of the curriculum and in all areas of their lives. Many of the activities and tasks that students undertake in the science curriculum involve the literacy skills related to oral, written, and visual communication. Communication skills are fundamental to the development of scientific literacy, and fostering students' communication skills is an important part of the teacher's role in the mathematics curriculum.

To develop their oral communication skills, students need numerous opportunities to listen to information and talk about a range of subjects in mathematics. The science program provides opportunities for students to engage in various oral activities in connection with expectations in all the strands, such as brainstorming to identify what they know about the new topic they are studying, discussing strategies for solving a problem, presenting and defending ideas or debating issues, and offering critiques of models and results produced by their peers.

THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY IN MATHEMATICS

Information and communication technologies (ICT) provide a range of tools that can significantly extend and enrich teachers' instructional strategies and support students' learning in mathematics. Teachers can use ICT tools and resources both for

whole-class instruction and to design programs that meet diverse student needs. Technology can help to reduce the time spent on routine mathematical tasks, allowing students to devote more of their efforts to thinking and concept development. Useful ICT tools include simulations, multimedia resources, databases, sites that give access to large amounts of statistical data, and computer-assisted learning modules. Applications such as databases, spreadsheets, dynamic geometry software, dynamic statistical software, graphing software, computer algebra systems (CAS), word-processing software, and presentation software can be used to support various methods of inquiry in mathematics. Technology also makes possible simulations of complex systems that can be useful for problem-solving purposes or when field studies on a particular topic are not feasible. Information and communications technologies can be used in the classroom to connect students to other schools, at home and abroad, and to bring the global community into the local classroom. Although the Internet is a powerful electronic learning tool, there are potential risks attached to its use. All students must be made aware of issues of Internet privacy, safety, and responsible use, as well as of the ways in which this technology is being abused – for example, when it is used to promote hatred. Teachers, too, will find the various ICT tools useful in their teaching practice, both for whole class instruction and for the design of curriculum units that contain varied approaches to learning to meet diverse student needs.

CAREER EDUCATION IN MATHEMATICS

Teachers can promote students' awareness of careers involving mathematics by exploring applications of concepts and providing opportunities for career-related

project work. Such activities allow students the opportunity to investigate mathematics-related careers compatible with their interests, aspirations, and abilities. Students should be made aware that mathematical literacy and problem solving are valuable assets in an ever-widening range of jobs and careers in today's society. The knowledge and skills students acquire in mathematics courses are useful in fields such as science, business, engineering, and computer studies; in the hospitality, recreation, and tourism industries; and in the technical trades.

Teaching / Learning Resources

- McGraw-Hill Ryerson Functions 11, McGraw-Hill Ryerson ©
- Growing Success Documents, Ministry of Education, 2010.