Erindale College

Assessment Period:	**2021 S2**
Course:	**SPECIALIST METHODS**
Unit:	**Unit 2: Specialist Methods (1.0)**
Accreditation:	**T**
Year:	**11**

Unit Goals

- understand the concepts and techniques used in algebra, sequences and series, functions, graphs and calculus
- solve problems in algebra, sequences and series, functions, graphs and calculus
- apply reasoning skills in algebra, sequences and series, functions, graphs and calculus
- interpret and evaluate mathematical and statistical information and ascertain the reasonableness of solutions to problems
- communicate arguments and strategies when solving problems

Content Description

Topic 1: Exponential functions

- **Indices and the index laws:**
  - review indices (including fractional and negative indices) and the index laws
  - use radicals and convert to and from fractional indices
  - understand and use scientific notation and significant figures
  - solve problems involving very large and very small numbers
  - solve simple indicial equations and inequations
  - define logarithms as the inverses of exponentials: $a^x = b$ is equivalent to $x = \log_a b$
  - solve equations involving indices using logarithms

- **Exponential functions:**
  - establish and use the algebraic properties of exponential functions
  - sketch, and hence recognise the qualitative features of, the graph of $y = a^x (a > 0)$ including asymptotes, and of its translations ($y = a^x + b$ and $y = a^{x+c}$) and dilations ($y = ba^x$)
  - identify contexts suitable for modelling by exponential functions and use them to solve practical problems
  - solve equations and inequations involving exponential functions using technology, and algebraically in simple cases

Topic 2: Arithmetic and geometric sequences and series

- **General sequences and number patterns**
  - consider the role of patterns in defining mathematics generally
  - consider a range of types of number patterns and ways of defining and describing them (including for example Fibonacci, triangular and perfect numbers)
  - use difference equations to determine the algebraic rule for a number pattern
  - Use sigma notation for series

- **Arithmetic sequences:**
  - recognise and use the recursive definition of an arithmetic sequence: $t_{n+1} = t_n + d$
  - prove and use the formula $t_n = t_1 + (n-1)d$ for the general term of an arithmetic sequence and recognise its linear nature
  - use arithmetic sequences in contexts involving discrete linear growth or decay, including simple interest
  - establish and use the formulae for the sum of the first *n* terms of an arithmetic sequence.

- **Geometric sequences:**
  - recognise and use the recursive definition of a geometric sequence: $t_{n+1} = rt_n$
  - use the formula $t_n = r^{n-1}t_1$ for the general term of a geometric sequence and recognise its exponential nature
  - understand the limiting behaviour as $n \to \infty$ of the terms t_n in a geometric sequence and its dependence on the value of the common ratio *r*
  - establish and use the limiting sum of a geometric sequence
  - establish and use the formula $S_n = t_1 \frac{r^n - 1}{r - 1}$ for the sum of the first *n* terms of a geometric sequence
  - use geometric sequences in contexts involving geometric growth or decay, including compound interest and the determination of half-lives

Topic 3: Introduction to differential calculus

- **Rates of change:**
  - interpret the difference quotient $\frac{f(x+h) - f(x)}{h}$ as the average rate of change of a function *f*
  - use the Leibniz notation δx and δy for changes or increments in the variables *x* and *y*
  - use the notation $\frac{\delta y}{\delta x}$ for the difference quotient $\frac{f(x+h) - f(x)}{h}$ where $y = f(x)$
  - interpret the ratios $\frac{f(x+h) - f(x)}{h}$ and $\frac{\delta y}{\delta x}$ as the slope or gradient of a chord or secant of the graph of $y = f(x)$

- **The concept of the derivative:**
  - consider continuity of functions and types of discontinuity
  - explore limits of functions from the left and from the right
  - examine the behaviour of the difference quotient $\frac{f(x+h) - f(x)}{h}$ as $h \to 0$ as an informal introduction to the concept of a limit
  - define the derivative $f'(x)$ as $\lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$
  - use the Leibniz notation for the derivative: $\frac{dy}{dx} = \lim_{\delta x \to 0} \frac{\delta y}{\delta x}$ and the correspondence $\frac{dy}{dx} = f'(x)$ where $y = f(x)$
  - consider examples of rates of change, eg of flow from different shaped vessels, and sketch graphs describing these rates
  - interpret the derivative as the instantaneous rate of change

- compare average and instantaneous rates of change
- interpret the derivative as the slope or gradient of a tangent line of the graph of $y = f(x)$, and explore the relationship between the graphs of $f(x)$ and $f'(x)$

- **Computation of derivatives:**
  - estimate numerically the value of a derivative, for simple power functions
  - examine examples of variable rates of change of non-linear functions
  - establish the formula $\frac{d}{dx}(x^n) = nx^{n-1}$ for positive integers *n* by expanding $(x+h)^n$ or by factorising $(x+h)^n - x^n$
  - extend the formula $\frac{d}{dx}(x^n) = nx^{n-1}$ to apply for all rational *n*.

- **Properties of derivatives:**
  - recognise whether or not a function is differentiable based on understanding the conditions for differentiability of a function
  - understand the concept of the derivative as a function
  - recognise and use linearity properties of the derivative
  - calculate derivatives of polynomials and other linear combinations of power functions
  - understand where stationary points occur and their nature from graphs of derivative functions and vice versa

- **Applications of derivatives:**
  - find instantaneous rates of change
  - find the slope of a tangent and normal and the equation of the tangent and normal
  - construct and interpret position-time graphs, with velocity as the slope of the tangent
  - sketch curves associated with polynomials; find stationary points, and local and global maxima and minima; and examine behaviour as $x \to \infty$ and $x \to -\infty$
  - solve optimisation problems arising in a variety of contexts involving polynomials on finite interval domains
  - apply calculus techniques to straight line motion graphs including those of position time, velocity and acceleration

- **Anti-derivatives:**
  - calculate anti-derivatives of polynomial functions and apply to a variety of contexts including motion in a straight line.

Assessment Tasks

Name	Due Date	Weighting
Assignment	23 August - 27 August	25%
Exam 1	3 September - 8 September	30%
Validation Tasks	Ongoing Assessment: 12 July - 16 November	15%
Exam 2	17 November - 19 November	30%

Specific Unit Information

Students require a graphics calculator for this course. These are available for hire at a cost of $100 per year, consisting of a $50 hire fee and a $50 refundable deposit. Students may choose to purchase or provide their own calculator.

School Assessment Information

For penalties for late and non-submission of work

See BSSS Policy and Procedure Manual 4.3.10 for further information.

For academic integrity

See BSSS Policy and Procedure Manual 4.3.12 for further information.

For appeals processes

See BSSS Policy and Procedure Manual 7.2 for further information.

For moderation procedures (internal and external)

See BSSS Policy and Procedure Manual 5 for further information.

For meshing procedures

See BSSS Policy and Procedure Manual 5.4.1 for further information.

For method of unit score calculation

See BSSS Policy and Procedure Manual 4.3.6.2 for further information.

For procedures for calculating course scores

See BSSS Policy and Procedure Manual 4.3.13.2 for further information.

Achievement Standards for SPECIALIST METHODS T - Year 11

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Reasoning and Communications	• represents complex mathematical concepts in numerical, graphical and symbolic form in routine and non-routine problems in a variety of contexts • communicates mathematical judgements and arguments in oral, written and/or multimodal forms, which are succinct and well-reasoned, using appropriate and accurate language • evaluates the reasonableness of solutions to routine and non-routine problems in a variety of contexts • reflects with insight on their own thinking and that of others and evaluates planning, time management, use of appropriate strategies to work independently and collaboratively • evaluates the potential of Mathematics to generate knowledge in the public good	• represents mathematical concepts in numerical, graphical and symbolic form in routine and non-routine problems a variety of contexts • communicates mathematical judgements and arguments in oral, written and/or multimodal forms, which are clear and reasoned, using appropriate and accurate language • analyses the reasonableness of solutions to routine and non-routine problems • reflects on their own thinking and analyses planning, time management, use of appropriate strategies to work independently and collaboratively • analyses the potential of Mathematics to generate knowledge in the public good	• represents mathematical concepts in numerical, graphical and symbolic form to some routine and some non-routine problems in some contexts • communicates mathematical judgements and arguments in oral, written and/or multimodal forms, using appropriate and accurate language • explains the reasonableness of solutions to some routine and non-routine problems • reflects on their own thinking and explains planning, time management, use of appropriate strategies to work independently and collaboratively • explains the potential of Mathematics to generate knowledge in the public good	• represents simple mathematical concepts in numerical, graphical or symbolic form in routine problems in limited contexts • communicates simple mathematical judgements or arguments in oral, written and/or multimodal forms, with some use of appropriate language • describes the appropriateness of solutions to routine problems • reflects on their own thinking with some reference to planning, time management, use of appropriate strategies to work independently and collaboratively • describes the potential of Mathematics to generate knowledge in the public good	• represents simple mathematical concepts in numerical, graphical or symbolic form in structured contexts • communicates simple mathematical information in oral, written and/or multimodal forms, with limited use of appropriate language • identifies solutions to routine problems in structured contexts • reflects on their own thinking with little or no reference to planning, time management, use of appropriate strategies to work independently and collaboratively • identifies some ways in which Mathematics is used to generate knowledge in the public good
Concepts and Techniques	• critically applies mathematical concepts in a variety of complex contexts to routine and non-routine problems • selects and applies advanced mathematical techniques to solve complex problems in a variety of contexts • constructs, selects and applies complex mathematical models to routine and non-routine problems in a variety of contexts • uses digital technologies efficiently to solve routine and non-routine problems in a variety of contexts	• applies mathematical concepts in a variety of contexts to routine and non-routine problems • selects and applies mathematical techniques to solve routine and non-routine problems in a variety of contexts • selects and applies mathematical models to routine and non-routine problems to a variety of contexts • uses digital technologies effectively to solve routine and non-routine problems in a variety of contexts	• applies mathematical concepts in some contexts to routine and non-routine problems • applies mathematical techniques to solve routine and non-routine problems in some contexts • applies mathematical models to routine and non-routine problems in some contexts • uses digital technologies appropriately to solve routine and non-routine problems in some contexts	• applies simple mathematical concepts in limited contexts to routine problems • applies simple mathematical techniques to solve routine problems in limited contexts • applies simple mathematical models to routine problems in limited contexts • uses digital technologies appropriately to solve routine problems in limited contexts	• applies simple mathematical concepts in structured contexts • uses simple mathematical techniques to solve routine problems in structured contexts • demonstrates limited familiarity with mathematical models in structured contexts • uses digital technologies to solve routine problems in structured contexts