Differential Calculus (SN2)

Mathematics Department, Vanier College

	Topic: ***FUNCTIONS***	
	Content	**Performance Criteria***
1.1	Define a function of real numbers and identify if a given graph is the graph of a function.	1, 2, 9
1.2	Find domains and ranges of functions, in particular linear, quadratic, polynomial, algebraic, trigonometric, logarithmic and exponential functions.	1, 5, 6, 9
1.3	Know the definitions, basic properties and identities for trigonometric functions.	1, 9
1.4	Solve elementary trigonometric equations: $sin(x) = a$, $cos(x) = a$, $tan(x) = a$, $cot(x) = a$ (optional)	1, 8, 9
1.5	Know the definitions, domains and ranges of $arcsin(x)$, $arcsec(x)$ and $arctan(x)$.	1, 9
1.6	Know the definitions, domains and ranges of the other inverse trigonometric functions.	1, 9
1.7	Apply vertical and horizontal stretching and reflecting about the horizontal and vertical axes to the functions mentioned above.	1, 3, 9
1.8	Know the definitions, properties and laws of logarithms and exponentials.	1, 5, 9
1.9	Solve logarithmic and exponential equations.	1, 5, 6, 9
1.10	Carry out arithmetic operations on polynomials (including long division and factoring).	1, 5, 6, 9
1.11	Find the composition of functions and the inverse of a function.	1, 5, 9
1.12	Definition of hyperbolic functions. (optional)	1, 9
1.13	Find x and y intercepts and graph linear, quadratic, absolute value, piecewise, trigonometric, logarithmic and exponential functions.	1, 3, 5, 6, 9

	Topic: ***LIMITS AND CONTINUITY***	
	Content	**Performance Criteria***
2.1	Calculate two-sided and one-sided limits, limits at infinity and infinite limits from the graph of a function.	1, 5, 6, 7, 9
2.2	Use the Limit Theorems to calculate limits.	1, 5, 6, 9
2.3	Explain why a limit does not exist.	1, 5, 6, 7, 9
2.4	Give the formal definition of a limit and use it in simple examples.	1, 5, 6, 9
2.5	For limits of the form $\frac{0}{0}$ evaluate them by factoring, reducing fractions to a common denominator and rationalizing.	1, 5, 6, 9
2.6	Evaluate limits of the indefinite forms by algebraic manipulation.	1, 5, 6, 9
2.7	Calculate limits of trigonometric functions, in particular making use of the limit of $\frac{\sin x}{x}$ as x tends to 0.	1, 5, 6, 9
2.8	Squeeze Theorem.	1, 9
2.9	Define continuity of a function at a point and on an interval.	1, 9
2.10	State the three conditions which must be satisfied in order that a function to be continuous at a point.	1, 9
2.11	State the intervals on which a given function is continuous.	1, 5, 6, 9
2.12	Discuss the continuity of the functions named specifically above.	1, 5, 6, 9
2.13	Identify removable and essential discontinuities and be able to explain the difference using the definition.	1, 5, 6, 9
2.14	Graph a function having certain limit and continuity properties.	1, 3, 5, 6, 9
2.15	State the Intermediate and Extreme Value Theorems and use them in examples.	1, 5, 6, 9

	Topic: ***DIFFERENTIATION***	
	Content	**Performance Criteria***
3.1	Give the definition of the derivative of a function.	1, 9
3.2	Interpret the derivative as the slope of the tangent line to the function and as a rate of change.	1, 9
3.3	Explain why a given function does not have a derivative at a given point, in particular through the absolute value and piecewise functions.	1, 5, 6, 7, 9
3.4	Use the definition to calculate derivatives.	1, 5, 6, 9
3.5	Find the equations of tangent lines and normal lines to given functions.	1, 5, 6, 9
3.6	Apply the rules to differentiate a sum, scalar multiple, product, quotient and composition of functions.	1, 4, 5, 6, 9
3.7	Find derivatives of algebraic, trig., inverse trig., log and exponential functions.	1, 4, 5, 6, 9
3.8	Find higher order derivatives.	1, 4, 5, 6, 9
3.9	Find the general relation between the derivative of a function and the derivative of its inverse, in particular for trig and log functions.	1, 4, 5, 6, 9
3.10	Use implicit differentiation to find first and second derivatives.	1, 4, 5, 6, 9
3.11	State Rolle's Theorem	1, 9
3.12	State the Mean Value Theorem and use it in examples.	1, 4, 5, 6, 9
3.13	Use logarithmic differentiation appropriately.	1, 4, 5, 6, 9

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	Topic: *APPLICATIONS*	
	Content	**Performance Criteria***
4.1	Find the intervals on which a function is increasing or decreasing.	1, 4, 5, 6, 7, 9
4.2	Find critical points where f'(x) = 0 and where f'(x) does not exist.	1, 4, 5, 6, 7, 9
4.3	Find local extrema by using: a) first derivative test; b) second derivative test.	1, 4, 5, 6, 7, 9
4.4	Find absolute extrema.	1, 4, 5, 6, 7, 9
4.5	Find intervals on which a function is concave up or down.	1, 4, 5, 6, 7, 9
4.6	Find points of inflection.	1, 4, 5, 6, 7, 9
4.7	Find horizontal and vertical asymptotes (with appropriate limits).	1, 4, 5, 6, 7, 9
4.8	Find slant asymptote(s) (optional)	1, 4, 5, 6, 7, 9
4.9	Use all the information above to sketch the graph of a function.	1, 3, 4, 5, 6, 7, 9
4.10	Newton's Method (optional)	1, 4, 5, 6, 7, 9
4.11	Linear Approximation	1, 4, 5, 6, 7, 9
4.12	L 'Hospital's Rule	1, 4, 5, 6, 7, 9
4.13	Solve velocity and acceleration problems.	1, 2, 4, 5, 6, 7, 8, 9
4.14	Formulate a word problem in mathematical terms and solve it, in particular problems involving related rates, maximization/ minimization and rates of change.	1, 2, 4, 5, 6, 7, 8, 9
4.15	Solve exponential growth and decay problems.	1, 2, 4, 5, 6, 7, 8, 9

	Topic: *ANTIDERIVATIVES, TECHNIQUES OF INTEGRATION, APPLICATIONS*	
	Content	**Performance Criteria***
5.1	Define antiderivative, indefinite integral, constant of integration and give the properties of indefinite integrals.	1, 7, 8
5.2	Give basic indefinite integrals involving algebraic, trig, log, exponential and inverse trig functions (i.e. those following directly from the derivatives).	1, 3, 8
5.3	Find antiderivatives satisfying certain boundary conditions.	1, 3, 4, 5, 8
5.4	Perform algebraic substitutions.	1, 3, 4, 5, 8
5.5	Solve separable differential equations.	1, 3, 4, 5, 8

	Topic: *INFINITE SEQUENCES*	
	Content	**Performance Criteria***
6.1	Define the convergence or divergence of an infinite sequence.	1, 5, 8, 9

*** Performance Criteria**

1: Appropriate use of concepts.
2: Representation of a situation as a function.
3: Accurate graphical representation of a function.
4: Correct choice and application of differentiation techniques.
5: Use of algebraic operations in conformity with rules.
6: Accuracy of calculations.
7: Correct interpretation of results.
8: Explanation of steps in problem-resolution procedure.
9: Use of appropriate terminology

Remarks:

1) The numbering of the content in this document is merely for reference purposes. The actual order in which the course material is presented is at the teacher's discretion.
2) At the teacher's discretion, appropriate and closely related definitions, derivations, proofs and applications using pertinent technology may be added and form part of the evaluation.