CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

October 2012

No calculators are to be used on this exam.
Note: This examination consists of ten questions on one page.

Time: 3 hours

Q. No		Marks Value	Earned
1.	a) What is the inverse of the function f(x) = 2 sin 3x ? Is that inverse unique? b) Is that function f(x) = 2 sin 3x continuous and differentiable? Briefly justify.	5 5	
2.	a) Differentiate the following function $z = x^{x+1}$ with respect to x. b) Integrate the following expression dz/dx = ln x where ln means $\log_e$.	5 5	
3.	a) Given the function $g(x) = \sin^2 x$, what is the direction of its tangent at some $x = x_o$? b) For the same function $g(x) = \sin^2 x$, what is its curvature at some $x = x_o$?	5 5	
4.	a) Expand the expression $(1 + 3x)^{-1}$ about x = 0. Give the first three terms only. b) What can be said about the convergence of the preceding expansion?	5 5	
5.	a) Given the function f(x,y,z) = sin xyz, what is its total derivative? b) What is the Laplacian Δ or ∇^2 of this function f(x,y,z) = sin xyz ?	5 5	
6.	a) What is the LU (i.e. lower triangular times upper triangular) decomposition of a given square matrix? Illustrate with a small 3 x 3 matrix. b) How is the LU decomposition of the coefficient matrix useful for solving a system of N linear equations for N unknowns? Illustrate with a system of 3 equations.	5 5	
7.	a) What is an orthogonal matrix? Give examples of orthogonal matrices of orders 2 and 3. b) A covariance matrix is normally symmetric and positive definite. Briefly explain.	5 5	
8.	a) Cartesian reference systems (or datums) are related by isometries i.e. rotations and translations. Formulate a datum transformation (X, Y) → (X', Y') using a rotation θ and translations X_o and Y_o. b) Briefly indicate how to generalize the previous datum transformation to three dimensions: (X, Y, Z) → (X', Y', Z').	5 5	
9.	a) Euler's most famous relation or identity $e^{\pi i} = -1$ for the exponential of πi with i being the imaginary or the square root of -1 is easily justified. Briefly explain. b) Use the preceding expression to evaluate the logarithm of a negative number.	5 5	
10.	On the spherical Earth, given two arbitrary points $P_1 = (\varphi_1, \lambda_1)$ and $P_2 = (\varphi_2, \lambda_2)$ in terms of their latitudes and longitudes, draw the corresponding spherical triangle and indicate how to compute the spherical distance P_1P_2 and the azimuth from the first point P_1 to the second P_2 (i.e. the clockwise direction measured from the North pole).	10	
	Total Marks:	100	