CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS   October 2015

Although programmable calculators may be used, candidates must show all formulae used, the substitution of values into them, and any intermediate values to 2 more significant figures than warranted for the answer. Otherwise, full marks may not be awarded even though the answer is numerically correct.

Note: This examination consists of ten questions on one page.

Q. No		Time: 3 hours	Value	Earned
1.	a)	In three-dimensional Cartesian coordinates, what is the equation of a triaxial ellipsoid with semi-axes a, b and c?	5	
	b)	In three-dimensional spherical polar coordinates, what is the equation of a unit sphere?	5	
2.	a)	Given (x_o, y_o) on a unit circle centered at the origin of a two-dimensional Cartesian system, what is the equation of a tangent line at (x_o, y_o)?	5	
	b)	What is the curvature at (x_o, y_o) on a unit circle centered at the origin of a two-dimensional Cartesian system?	5	
3.	a)	For the quadratic equation $x^2 + x + 1$, what are its roots explicitly?	5	
	b)	The cubic equation $x^3 + x^2 + x + 1$ obviously has x = -1 as a root, what are the others?	5	
4.	a)	What is the total derivative $df(x, y, z)$ for $f(x, y, z) = e^x \sin y \cos z$?	5	
	b)	For Cartesian coordinates, what is the gradient $\nabla f(x, y, z)$ for the same $f(x, y, z) = e^x \sin y \cos z$?	5	
5.	a)	Given a small rectangular matrix $A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}$, what are $A^T A$ and AA^T ?	5	
	b)	What are the determinants of the previous $A^T A$ and AA^T ?	5	
6.	a)	A general complex number z has Cartesian and polar representations, what are they in the complex plane?	5	
	b)	For a general complex number z in the complex plane, what are its magnitude and its natural logarithm log z?	5	
7.	a)	What is the inverse function of $f(x) = e^{3x + 1}$?	5	
	b)	What are the first three terms in the series expansion of $f(x) = e^{3x + 1}$ about x = 1?	5	
8.	a)	Given the linear equations $x + y + z = 5$, $x - y - z = 1$, $x + 2y + 3z = 8$, what are x, y and z by Gaussian elimination?	5	
	b)	For the previous linear equations, verify the obtained x, y and z by Cramer's rule.	5	
9.	a)	Set up a simple ordinary differential equation for $f(x) = e^{\sin x}$?	5	
	b)	Set up a simple partial differential equation for $f(x, y) = e^{\sin x \cos y}$?	5	
10.		The solution for the area of a spherical triangle given its interior angles is a simple function of the so-called spherical excess. Explain with examples.	10	
		Total Marks:	100	