CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

October 2013

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

Time: 3 hours

Q. No		Value	Earned
1.	a) Given a curve y = f(x) in a Cartesian (x, y) plane, describe the evaluation of its slope at any point $x_{o.}$	5	
	b) Given a curve y = f(x) in a Cartesian (x, y) plane, describe the evaluation of its curvature at any point $x_{o.}$	5	
2.	a) For a function $f(x) = 2^{2x}$, what is df(x) / dx or f'(x) ?	5	
	b) For a function $f(x,y) = 2^{x+y}$, what is the total derivative df(x, y) ?	5	
3.	a) What is the dot or scalar product of two vectors **a** = (1, 3, 5) and **b** = (2, 4, 6) ?	5	
	b) What is the cross or vector product of the same vectors **a** and **b** ?	5	
4.	a) What is the inner product of two arbitrary vectors **c** = (1, 2, 3, 4, 5) and **d** = (6, 7, 8, 9, 10) ?	5	
	b) What is the outer product of the same two vectors **c** and **d** ?	5	
5.	a) What is an orthogonal matrix? Give an example of a simple application.	5	
	b) What is a unitary matrix? Give an example of a simple application.	5	
6.	a) What is a Taylor expansion of a function f(x) at an arbitrary point x_o ?	5	
	b) Give the first few terms of the expansion of $f(x) = e^x$ at $x_o = 1$.	5	
7.	a) Illustrate Gaussian elimination for solving a system of three linear equations.	5	
	b) Given five linear equations for three unknowns, illustrate the least-squares approach to estimate the three unknowns.	5	
8.	a) What is a quadratic form for the residuals of an overdetermined system of linear equations solved by least squares?	5	
	b) What are a few simple properties of such quadratic forms?	5	
9.	a) Finite differences are often used for modeling and solving differential equations. What are they? Illustrate with simple examples.	5	
	b) Finite elements are also used for similar purposes such as in geophysics. What are they? Illustrate with simple examples.	5	
10.	a) For an arbitrary spherical triangle, its area is computed in terms of the spherical excess quantity. What is a spherical excess? Illustrate with simple examples.	5	
	b) Although the Earth is often said to be spherical, it is known to be better approximated by a spheroid, or an ellipsoid of revolution, or a triaxial ellipsoid. What are these?	5	
	Total Marks:	100	