CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS   March 2019

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

Time: 3 hours

Q. No		Marks Value	Marks Earned
1.	a) A mathematical function y of a variable x in some interval [a, b] is generally different from a simple relation between x and y. Briefly explain with example.	5	
	b) A Dirac delta function $\delta(x_o)$ is often described as being 1 at some point x_o and 0 elsewhere on the real line. Is this an acceptable mathematical function? Why?	5	
2.	a) Given two distinct points (x_1, y_1) and (x_2, y_2) in the plane, what is the equation of a straight line defined by these two points? Give a simple example.	5	
	b) Given two distinct points (x_1, y_1, z_1) and (x_2, y_2, z_2) in space, what is the corresponding situation for the straight line defined by these two points? Briefly explain with simple examples.	5	
3.	a) Expand the exponential function e^{5x} as a series about $x = 0$. Give 3 terms only.	5	
	b) Expand the exponential function e^{5x} as a series about $x = 1$. Give 3 terms only.	5	
4.	a) For a square matrix M, what are A and B if $M = A + B$ with $A = A^T$ and $B = - B^T$ where the superscript T denotes transposed. Give a simple example.	5	
	b) For a square matrix $M = A^T \cdot A$ where A and its transposed A^T are also square, show that for their determinants, $\text{Det } M = (\text{Det } A)^2$. Give a simple example.	5	
5.	a) Given three linear algebraic equations $a_i\, x + b_i\, y + c_i\, z = d_i$, i = 1, 2 3, briefly explain how to solve for x, y and z using Cramer's rule. Use a simple example.	5	
	b) Given three linear algebraic equations $a_i\, x + b_i\, y + c_i\, z = 0$, i = 1, 2 3, briefly explain how to solve them for x, y and z. Use a simple example.	5	
6.	a) For an arbitrary square matrix A, how do you evaluate its eigenvalues? Use a small matrix of order 3 to illustrate the procedure.	5	
	b) For the preceding matrix A, how do you evaluate the eigenvectors corresponding to the eigenvalues? Use the same small matrix of order 3.	5	
7.	a) A unit circle at the origin of a Cartesian plane can be specified by an algebraic equation or parametric equations. What are they explicitly?	5	
	b) A unit circle at the origin of a complex plane can also be specified using complex numbers. Illustrate the situation using polar coordinates.	5	
8.	a) Given two vectors $(2, 3, 5)^T$ and $(1, 4, 6)^T$ in three-dimensional Cartesian space, what is their dot or scalar product? What is the angle between the two vectors?	5	
	b) For the same two vectors, what is their cross or vector product? Show the result graphically and briefly explain.	5	
9.	a) What is the gradient of a function e^{xyz} in (x, y, z) Cartesian space?	5	
	b) What is the total derivative of a function e^{x+y+z} in (x, y, z) Cartesian space?	5	
10.	Given the interior angles A, B and C of a spherical triangle, what are the lengths of the corresponding sides a, b and c ? Assume a sphere of radius R.	10	
	Total Marks:	100	