CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

March 2021

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 10 questions on 2 pages.

Time: 3 hours

Q. No		Marks Value	Earned
1.	a) Evaluate the series $\sum_{n=1}^{\infty} \frac{1}{n+2}$. If it diverges, say why. b) Consider the series $\sum_{n=1}^{\infty} \frac{1}{n^2}$. Does it converge or diverge? Justify your answer.	10	
2.	a) What is the Maclaurin series expansion for $(1-x)^{-1}$? b) Where does this expansion converge?	10	
3.	John wants to get to the bus stop, the bus stop is across a grassy park, 2000 feet west and 600 feet north of his starting position. John can walk west along the edge of the park on the sidewalk at a speed of 6 ft/sec and 4 ft/sec through the grass. How far should he walk on the sidewalk before veering off onto the grass if he wishes to get to the bus stop in exactly 7 min 30 sec?	10	
4.	Find an invertible matrix P such that $P^{-1}AP$ is diagonal. Hint: use eigen-decomposition. $A = \begin{bmatrix} 4 & 0 & 0 \\ 3 & 2 & 0 \\ 0 & 2 & 1 \end{bmatrix}$	10	
5.	a) Find trace and determinant of $\begin{bmatrix} a & 1 & -1 \\ 2 & 3 & b \\ 0 & -c & -2 \end{bmatrix}$. b) Find the determinant for the following Hermitian matrix: $\begin{bmatrix} 4 & 3-2i & -3i \\ 3+2i & 1 & -5+2i \\ 3i & -5-2i & 2 \end{bmatrix}$	10	
6.	Consider the following system of linear equations: $x - 3y = 8$ $5x + 3y = 5$ $4x + y = -2$ If the system is consistent, solve it. If it is inconsistent, find the best non-solution using the least-squares method.	10	

7.	a) Given the function $f(x, y, z) = \sin(x)\cos(y)e^z$, what are the corresponding partial derivatives f_x, f_y and f_z? b) For the same function $f(x, y, z)$, what is the corresponding Laplacian?	10	
8.	a) What is the equation for a circle of unit radius at the origin of the complex z-plane? b) What is the equation for an ellipse of semi-major axis a and semi-minor axis b at the origin of the complex z-plane?	10	
9.	a) Find the real and the imaginary part of i^i, where i is the complex number for which $i^2 = -1$. Show all steps. Hint: write i in polar form $re^{i\theta}$. b) Find the three cube roots of $-2028 + 845i$ in polar form. Clearly indicate the radius and the angle (in degrees) of your solutions.	10	
10.	a) Given an ellipse as $\alpha x^2 + \beta y^2 = 1$ in the Cartesian (x, y) plane, set up the integral for its interior area, assuming the parameters α and β are positive. b) For the same ellipse, what is the integral to compute the complete arc length around the ellipse?	10	
	Total Marks:	100	