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Daffodil International University

Faculty of Science & Information Technology
Department of Software Engineering
Midterm Examination, Spring 2026
Course Code: MAT101, Course Title: Mathematics I
Sections & Teachers: 46(A-Q) & HSA, DK, AHB, RAR, MSIM

Time: 1 Hour 30 Mins **Marks: 25**

Answer ALL Questions

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

1.	(a)	Discuss the following terms with suitable example: (i) Injective Function (ii) Parametric Equation.	[2]	CLO1 *Level-2*
	(b)	Compute the domain and range of the following function: $f(x) = \frac{1+x}{5-x}$	[3]	
2.		Given the piece-wise function $h(x)$: $h(x) = \begin{cases} 2 + \left(x - \frac{\pi}{2}\right)^2, & when\ x > \frac{\pi}{2} \\ 1, & when\ x < 0 \\ 1 + \sin x, & when\ 0 \le x \le \frac{\pi}{2} \end{cases}$ Estimate the continuity and differentiability of $h(x)$ at $x = 0$ and $x = \frac{\pi}{2}$.	[5]	
3.	a)	Derive the value of $\frac{dy}{dx}$ for $y = (\cos x)^{\ln x} \tan(5^x)$.	[4]	CLO2 *Level-3*
	b)	An autonomous planetary rover is navigating a crater on Mars. Its movement is tracked by a satellite, which records the rover's position based on a navigation parameter φ (representing the signal phase shift in radians). The distance, S, in meters, that the rover has traveled along its path is given by the function: $S = \varphi e^{\cos^{-1}\varphi}$ The time, t, in seconds, taken to reach that point in its journey is given by the function: $t = \varphi + \sqrt{1-\varphi^2}$ Determine the instantaneous velocity of the rover, in meters per second.	[4]	
4.	a)	Calculate the n^{th} derivative of $y = 2\cos(2x+4)$.	[3]	
	b)	If $u(x,y) = e^x(x\cos y - y\sin y)$, then, derive the value of $\frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial x^2}$.	[4]	