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Daffodil International University

Department of Electrical and Electronic Engineering

Faculty of Engineering

Midterm Examination, Summer-2026

Course Code: 0541-111 | Course Title: Differential and Integral Calculus

Section: A, B, C, D, E, F | Level-Term: L1-T1 | by- TanviR

Full Marks: 25 | Exam Date: June 27, 2026 | Time: 1.5 Hours

[Answer all the following questions sequentially]

[The second right-most column indicates the COs with the respective Bloom's level]

[The right-most column indicates the assigned marks]

Q1. (a) **Define** continuity. CO-1 2

(b) If $u = \tan^{-1}\left(\frac{y}{x}\right)$ then **find** $\frac{\partial^2 u}{\partial x^2}, \frac{\partial^2 u}{\partial y^2}$ and $\frac{\partial^2 u}{\partial y \partial x}$ C(1) 3

Q2. A function is defined as follows CO-1 3

C(2)

$$f(x) = \begin{cases} 1, & x < 0 \\ 1 + sinx, & 0 \le x < \pi/2 \\ 2 + \left(x - \frac{\pi}{2}\right)^2, & x \ge \pi/2 \end{cases}$$

Discuss the continuity at $x = \frac{\pi}{2}$ and differentiability at $x = 0$.

Q3. (a) **Determine** the values of c that satisfy the mean value theorem for $f(x) = x^3 - x^2 + x + 8$ on $[-3, 4]$ and **explain** the geometrical meaning of that point. CO-2 3 C(3)

(b) For $y = \left(x + \sqrt{1 + x^2}\right)^m$, **show** that $(1 + x^2)y_{n+2} + (2n + 1)xy_{n+1} + (n^2 - m^2)y_n = 0$ using the Leibnitz theorem. CO-2 4 C(3)

Q4. (a) In a signal processing application, the instantaneous voltage of an AC signal is given by CO-3 5 C(3)

$$v(t) = V_m sin(\omega t)$$

where $V_m = 10\ V$ and $\omega = 100\ rad/s$.

(i) **Construct** a fifth-order Maclaurin polynomial.

(ii) **Calculate** $v(t)$ at $t = 0.01$s with error.

(iii) **Calculate** the upper bound of the error using Lagrange's form of remainder.

(b) The power developed in a resistor R by a battery of emf E and internal resistance r is given by $P(R) = \frac{E^2 R}{(R+r)^2}$. **Calculate** the maximum power developed in the resistor. CO-3 5 C(3)