Daffodil International University

Department of Electrical and Electronic Engineering

Faculty of Engineering

Final Examination, Spring-2025

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

Section: A, B, C, D, E Level-Term: L1-T1 Teacher's Initial: SDN

Full Marks: 40 Exam Date: June 22, 2025 Time: 2 Hours

[Answer all the following questions sequentially]

Q1. (a) **Interpret** the Mean-Value theorem and **show** the function $f(x) = x - \frac{1}{x}$ satisfies the hypotheses of the Mean-Value theorem in the interval $[3, 4]$. CO-1 (C2) [3]

(b) If $u = \sin^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$ then **show** that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{1}{2}\tan u$. CO-1 (C2) [3]

(c) **Explain** Gamma function. CO-1 (C2) [2]

Q2. (a) **Construct** the solution of the following integrals using the proper techniques of integration. CO-2 (C3) [12]

i) $\int \sin^5 x\, dx$ ii) $\int_0^{\pi/2} \ln(\cos x)\, dx$ iii) $\int_0^a \int_0^x \int_0^y x^3 y^2 z\, dz\, dy\, dx$

Q3. (a) **Compute** the area of an ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$ lying above the x-axis. CO-3 (C3) [4]

(b) A wave is defined by the equation $v = E_1 \sin(\omega t) + E_3 \sin(\omega t)$. **Compute** the r.m.s. value of v over the interval $0 \le t \le \frac{\pi}{\omega}$. CO-3 (C3) [4]

(c) The electrostatic potential on all parts of a conducting circular disc of radius r is given by the equation: CO-3 (C3) [4]

$$V(R) = 2\pi\sigma \int_0^9 \frac{R}{\sqrt{R^2+r^2}}\, dR.$$

Now, **compute** the electrostatic potential.

Q4. (a) **Solve** the definite integral $\int_0^\infty x^{\frac{7}{2}} e^{-x} dx$. CO-2 (C3) [2]

(b) **Construct** the solution of the definite integral $\int_0^{\pi/2} \sin^p\theta \cos^q\theta\, d\theta$ in terms of the Gamma function. CO-2 (C3) [4]

(c) **Solve** the definite integral $\int_0^1 x^3(1-x^2)^{\frac{5}{2}} dx$ CO-2 (C3) [2]