Daffodil International University

Department of Electrical and Electronic Engineering

Faculty of Engineering

Final Examination, Fall 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, HRP, TRS

Full Marks: 40 | Exam Date: December 14, 2025 | Time: 2 Hours

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[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) **Describe** Euler's theorem on homogeneous function. If $u = \frac{x}{y} + \frac{y}{x} + \frac{z}{x}$, then **show** that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$ — **CO-1 (C2)** **[4]**

(b) If $u = e^x(xcosy - ysiny)$ then **show** that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$. — **CO-1 (C2)** **[5]**

Q2. (a) **Solve** the following indefinite integrals: — **CO-2 (C3)** **[8]**

(i) $\int e^{2x} cos3x\, dx$ (ii) $\int \frac{2x^2+x+1}{x^3+x}\, dx$

(b) **Solve** the following definite integrals: — **CO-2 (C3)** **[8]**

(i) $\int_0^1 \frac{\ln(1+x)}{1+x^2} dx$ (ii) $\int_0^{\frac{\pi}{2}} \frac{1}{a^2\cos^2 x + b^2 \sin^2 x} dx$

Q3. (a) **Compute** the area bounded by the curves $y = x^2$ and $x^2 = y$. — **CO-3 (C3)** **[3]**

(b) A Capacitor has capacitance $C(t) = C_0(1 + \beta t)$ and is driven by the voltage $v(t) = v_0 \sin(\omega t)$. The instantaneous current is $i(t) = C(t)\frac{dv(t)}{dt} + v(t)\frac{dC(t)}{dt}$. — **CO-3 (C3)** **[4]**

Compute the energy delivered to the capacitor, $W = \int_0^{\frac{\pi}{\omega}} v(t)i(t)dt$ when $C_0 = 1.0 \times 10^{-6}F$, $\beta = 0.1s^{-1}$, $v_0 = 10V$ and $\omega = 100\, rad/s$.

(c) The Magnetic flux through a rectangular surface is given by — **CO-3 (C3)** **[3]**

$$\int_0^3 \int_0^1 B_0 e^{-\alpha x} y\, dydx$$

Now, **compute** the magnetic flux if $B_0 = 0.1\, T$ and $\alpha = 0.5\, m^{-1}$.

Q4. (a) **Solve** the integral $\int_0^\infty e^{-x}\, x^{\frac{7}{3}}\, dx$ if $\Gamma\left(\frac{1}{3}\right) = \frac{27}{10}$. — **CO-2 (C3)** **[2]**

(b) **Solve** the integral $\int_0^\infty \frac{x^3}{(1+x^2)^{\frac{9}{2}}} dx$ — **CO-2 (C3)** **[3]**