Daffodil International University

Department of Electrical and Electronic Engineering

Faculty of Engineering

Final Examination, Summer – 2026

Course Code: 0541-113 | Course Title: Linear Algebra and Complex Variable
Section: A, B, C, D, E, F | Level-Term: L1-T1 | Teacher's Initial: HRP, SS
Full Marks: 40 | Date: August 24, 2026 | Time: 2 Hours

[*Answer all the following questions*]

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

[The right-most column indicates the assigned marks]

Q1. **Explain** the following with example — CO-1 (C2) [2]

i) Singularity   ii) Characteristic Polynomial

Q2. — CO-1 (C2) [8]

$$P = \begin{pmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{pmatrix} \text{ is a matrix}$$

a) **Identify** the eigenvalues of P^T, P^3, P^{-1}, P^{-3}

b) **Identify** the eigenvectors of the matrix P.

Q3. a) **Interpret** whether or not the vector (5, -3, 2, -2) as a linear combination of the vectors (1, -1, 0, 1), (0, 2, -1, -1), (2, -1, 1, 0) and (-1, 1, 2, -1) in $\mathbb{R}^4$. — CO-2 (C3) [5]

b) **Identify** the following mapping is linear or not and **discover** T^{-1} if it exists, where $T: \mathbb{R}^3 \to \mathbb{R}^3$ is given by — CO-2 (C3) [5]

$$T(x, y, z) = (2x + 3y, y - z, 4z)$$

c) **Calculate** whether or not the following vectors are linearly dependent — CO-2 (C3) [5]

$$2t^2 + t + 3, 3t^2 + 2t + 1, t^2 + t - 2 \text{ in } \mathbb{R}^3.$$

Q4. a) In Electrical and Electronic Engineering, complex analysis plays a crucial role in analyzing signals and systems, especially in frequency-domain techniques. One important result is the Cauchy's Integral Formula. **Analyze** the following integrals by identifying the singularities inside the given contours and determine their values — CO-3 (C4) [7]

i. $\oint \frac{Sin\pi z^2 + Cos\pi z^2}{(z-1)(z-2)} dz$, where the circle is $|z| = 3$

ii. $\oint \frac{9z^2 - iz + 4}{z(z^2+1)} dz$, where the circle is $|z| = 2$

b) In an Electrical Engineering context, the steady-state complex voltage (z) is represented by the following equations — CO-3 (C4) [8]

i) $z^8 - 1 = 0$ ii) $z^4 = -2\sqrt{3} - 2i$

Analyze each equation using De Moivre's theorem to obtain the roots of the complex voltage (z) along with their corresponding phase angles, and **illustrate** the roots on the complex plane by indicating the position of each root.