Daffodil International University
Department of Electrical and Electronic Engineering
Faculty of Engineering
Final Examination, Spring – 2026

Course Code: 0541-121 | Course Title: Linear Algebra and Complex Variable
Section: A, B, C, D, E, F, G | Level-Term: L1-T2 | Teacher's Initial: HRP, SS
Full Marks: 40 | Date: April 27, 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) Cayley-Hamilton Theorem (ii) Analytic Function

Q2. — CO-1 (C2) [8]

$$A = \begin{pmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix} \text{ is a matrix}$$

a) **Identify** the eigenvalues of A^T, A^2, A^{-1}, A^{-2}

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

Q3. a) **Calculate** whether or not the following vectors are linearly dependent — CO-2 (C3) [5]
$$t^2 + t + 2, 2t^2 + t, 3t^2 + 2t + 2 \ in \ \mathbb{R}^3.$$

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]
$$T(x, y, z) = (3x + y, -2x - 4y + 3z, 5x + 4y - 2z)$$

c) **Interpret** whether or not the vector (12, 5, 11, 8) as a linear combination of the vectors (2, 1, 0, 1), (1, 0, 1, 1), (1, 1, 1, 0) and (3, -1, 1, 2) in $\mathbb{R}^4$. — CO-2 (C3) [5]

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) [5]

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

ii. $\oint \frac{z-3}{z^2+2z+5} dz$, Where the circle is $|z + 1 - i| = 2$

b) **List** out all the possible roots of — CO-3 (C4) [7]
i) $z^5 + 32 = 0$. ii) $z^4 + 8 - 8\sqrt{3}\, i = 0$

c) Consider the complex expression $\left(\frac{1-i}{1+i}\right)^{100}$. First, **evaluate** the expression and represent your answer in the form P+iQ, where P and Q are real numbers. Then, **classify** the resulting complex number based on its position on the complex plane by identifying the quadrant or axis it lies on. — CO-3 (C4) [3]