Daffodil International University
Department of Electrical and Electronic Engineering
Faculty of Engineering
Final Examination, Fall – 2025

Course Code: 0541-121 Course Title: Linear Algebra and Complex Variable
Section: A, B, C, D Level-Term: L1-T2 Teacher's Initial: HRP
Full Marks: 40 Date: December 22, 2025 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]
(a) Analytic Function (b) Spectrum
(c) Algebraic Multiplicity (d) Linear Transformation

Q2. — CO-1 (C2) [8]

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

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

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

Q3. a) **Calculate** whether or not the following vectors are linearly dependent — CO-2 (C3) [5]
$$t^2 + 2t + 3, 3t^2 - t + 2, 5t^2 + 3t + 8 \text{ in } \mathbb{R}^3.$$

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

c) **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]

Q4. (a) **List** out all the possible roots of — CO-3 (C4) [5]
i) $z^3 = -1 + i$ ii) $z^4 = -2\sqrt{3} - 2i$

(b) Consider the complex expression $\frac{(2+i)^2}{(3-i)^2}$ .First, **evaluate** the expression and represent your answer in the form A+iB, where A and B 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) [4]

(c) Using Cauchy's integral formula, **analyze** — CO-3 (C4) [6]

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

ii. $\oint \frac{2z-1}{z(z+2)(2z+1)} dz$, Where the circle is $|z| = 1$

iii. $\oint \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)(z-2)} dz$, Where the circle is $|z| = 3$

$-2+2$
$9-2^2$
$9-(i)^2$
$-3+3$