



Daffodil International University

Faculty of Science & Information Technology

Department of Software Engineering

Midterm Examination, Summer 2026

Course Code: MAT102; Course Title: Mathematics II

Sections: 46 (A-O), Teachers Initial: DK, ZT, DMMK, SST, MSIM

Time: 1 Hour 30 Minutes

Marks: 25

Answer ALL Questions

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

1.	Explain Orthogonal, Sparse, Skew-Hermitian, Idempotent, and Lower Triangular matrix with an example.	5×1=5	CLO-1 L-2
2.	Given the following three matrices: $A = \begin{pmatrix} 1 & -2 & 5 \\ -3 & 0 & 2 \end{pmatrix}, B = \begin{pmatrix} -5 & 1 \\ 6 & -1 \\ 0 & 7 \end{pmatrix}, \text{ and } C = \begin{pmatrix} 2 & -6 \\ 4 & -4 \end{pmatrix}$ Analyze the dimensions of the given matrices and test all 6 pairwise multiplication combinations (AB, BA, BC, CB, AC, and CA). For each, state whether the multiplication is possible or impossible. In each impossible case, explain the exact mathematical reason for its failure.	3	CLO-2 L-4
3.	$A = \begin{pmatrix} 1 & 2 & 1 & 3 \\ 2 & 5 & 0 & 4 \\ 3 & 7 & 1 & 7 \\ -1 & 0 & -3 & -1 \end{pmatrix} \quad B = \begin{pmatrix} 1 & -1 & 1 \\ 1 & 2 & 0 \\ 1 & -1 & 3 \end{pmatrix}$ a. Derive the row echelon form (REF) of matrix A and determine its rank from the REF. b. Examine the validity of the Cayley-Hamilton theorem for the matrix B and also compute B^{-1}. c. Determine the eigenvector corresponding to the largest eigenvalue of the matrix B and also determine the spectrum of B^{-3}.	2+1 2+3 4	CLO-3 L-3

4.	Formulate a system of linear equations from the scenario below and calculate the number of requests per minute routed to each microservice. Explain how this solution ensures system stability. Scenario: A backend system processes 1,400 requests per minute through an API gateway. The gateway routes traffic to three distinct microservices: Authentication (x), Database Query (y), and Image Processing (z). • All 1,400 requests <u>must</u> be routed to one of the three services. • The Authentication service (x) handles exactly three times as much traffic as the Database Query service (y). • The Image Processing service (z) is configured to handle exactly 150 more requests than the Database Query service (y).	2+2+1	CLO-4 L-4
----	--	-------	--------------