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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: $A = \begin{pmatrix} 1 & -2 & 5 \\ -3 & 0 & 2 \end{pmatrix}$, $B = \begin{pmatrix} -5 & 1 \\ 6 & -1 \\ 0 & 7 \end{pmatrix}$, 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.	$A = \begin{pmatrix} 1 & 2 & 1 & 3 \\ 2 & 5 & 0 & 4 \\ 3 & 7 & 1 & 7 \\ -1 & 0 & -3 & -1 \end{pmatrix}$ $B = \begin{pmatrix} 1 & -1 & 1 \\ 1 & 2 & 0 \\ 1 & -1 & 3 \end{pmatrix}$ **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

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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 must 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

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