Daffodil International University

Faculty of Science & Information Technology

Department of Computer Science and Engineering

Final Examination, Fall-2024

Course Code: MAT 102, Course Title: Mathematics II

Level: 01 Term: 02 Batch: 66

Time: 2 Hours Marks: 40

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. a) Given $A = \begin{bmatrix} 3 & -2 & 1 \\ 0 & 5 & -3 \\ 2 & -7 & 4 \end{bmatrix}$. [5+3+1] CO2

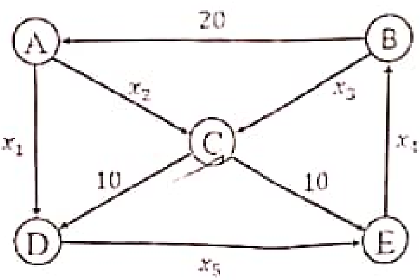
(i) Construct the inverse matrix A^{-1}.

(ii) Organize A^{-1} as a sum of a symmetric matrix and a skew-symmetric matrix.

(iii) Identify whether the matrix A is orthogonal or not.

b) Given the matrix $M = \begin{bmatrix} 3 & -2 & 4 & 7 \\ 2 & 1 & 0 & -3 \\ 2 & 8 & -8 & 2 \end{bmatrix}$, identify the Rank, construct the Reduced Row Echelon Form (RREF) and the Normal Form (NF) of M. [5]

2. The figure below shows the traffic flow (vehicles per hour) through a network of streets. [2+3+1] CO3



(i) Analyze the traffic flow in the network and construct a system of linear equations that represents this network.

(ii) Examine the relationships among the variables x_1, x_2, x_3, x_4 and x_5 by solving the system of equations.

(iii) Discover the traffic flow when $x_5 = 25$.

3. Given $M = \begin{bmatrix} -5 & 0 & 0 \\ 9 & 2 & 0 \\ -1 & 4 & -3 \end{bmatrix}$. [4+4] CO3

(i) List out the eigenvalues of M^{-2} and $(MM^{-1})^4$.

(ii) Inspect the trace of M^5 and the spectrum of $(M^{-3})^T$.

4. a) Assess the linear independence of the vectors $(1,0,2,3)$, $(0,1,4,5)$ and $(1,1,6,8)$. If they are dependent, find a linear dependence relation and verify it. [3+2] CO4

b) $P(x,y,z,t) = (4x + y - 2z - 3t, 2x + y + z - 4t, 6x - 9z + 9t)$, [4+3]

$Q(x,y) = (2xy, 5y, x)$, $R(x,y,z) = (2x - y + 3z, x + 4y - 2z, -x + 2y + z)$,

$S(x,y,z) = (4x + y, x - z, z + y)$.

(i) Examine which are LT.

(ii) Evaluate $RoSoP$ and PoS.