

Int. M.Sc. (DS) (NEP) Sem.-3 Examination

MDC-DTSC-234T

Matrix Algebra and Discrete Maths

November-2025

Time : 2-00 Hours]

[Max. Marks : 50

Instructions: All questions are compulsory. Use of non-programmable scientific calculator is allowed.

- Q.1 (a)** Find the inverse of A for the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 2 \\ 3 & 1 & 4 \end{bmatrix}$ using the Vedic sutra "Urdhya Tiryak". (05)

- (b)** Solve the system of the following equations by using the sutra "Anurupye Sunayamanyat" (05)

$$\begin{aligned} 12x + 8y &= 7 \\ 16x + 16y &= 14 \end{aligned}$$

OR

- (a)** Solve the following system of linear equations using sutra "Paravartya" (05)

$$\begin{aligned} -3x - 2y + 4z &= -15 \\ 2x + 5y - 3z &= 3 \\ 4x - y + 7z &= 15 \end{aligned}$$

- (b)** Solve the system of the following equations by using sutra "Sankalan-Vyavakalanabhyam" (05)

$$\begin{aligned} 23x - 13y &= 270 \\ 13x - 23y &= 90 \end{aligned}$$

- Q.2 (a)** Define the rank of the matrix. Also, find out the rank of the matrix (05)

$$A = \begin{bmatrix} 2 & 4 & 8 & 16 \\ 16 & 8 & 4 & 2 \\ 4 & 8 & 16 & 2 \\ 2 & 16 & 8 & 4 \end{bmatrix}$$

- (b)** Find the solution of the following system of linear equations using the Gauss-Elimination method. (05)

$$\begin{aligned} 4x - 8y + 3z &= 16 \\ -x + 2y - 5z &= -21 \\ 3x - 6y + z &= 7 \end{aligned}$$

OR

- (a)** Find out the inverse of the matrix B using row operations: (05)

$$B = \begin{bmatrix} 1 & 2 & 5 \\ 0 & -1 & 2 \\ 2 & 4 & 11 \end{bmatrix}$$

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- (b) Find the solution of the following system of linear equations using the Gauss-Elimination method. (05)

$$\begin{aligned} -4w + x + y &= -10 \\ w - 4x + z &= 1 \\ w - 4y + z &= -7 \\ x + y - 4z &= 10 \end{aligned}$$

- Q.3 (a) Find the solution of the following system of linear equations using the Gauss-Jacobi method up to 4 decimal places and show step-by-step iterations for each variable. (05)

$$\begin{aligned} 3x + 6y + 2z &= 0 \\ 3x - y + z &= 1 \\ 3x + 3y + 7z &= 4 \end{aligned}$$

- (b) Solve the following linear system by Cholesky's method. (05)

$$\begin{aligned} x + 3z &= 14 \\ 16y + 8z &= 16 \\ 3x + 8y + 14z &= 54 \end{aligned}$$

OR

- (a) Find the solution of the following system of linear equations using the Gauss-Seidel method up to 4 decimal places, and show step-by-step iterations for each variable. (05)

$$\begin{aligned} 4x + y - z &= 5 \\ -x + 3y + z &= -4 \\ 2x + 2y + 5z &= 1 \end{aligned}$$

- (b) Solve the following linear system by Doolittle's method, showing the details, in particular the LU-factorization. (05)

$$\begin{aligned} 2x + 2y + 4z &= -2 \\ 4x + 5y + 13z &= -7 \\ 10x + 14y + 43z &= -25 \end{aligned}$$

- Q.4 (a) Using Euclidean algorithm, find the greatest common divisor of the numbers 125 and 220. (05)

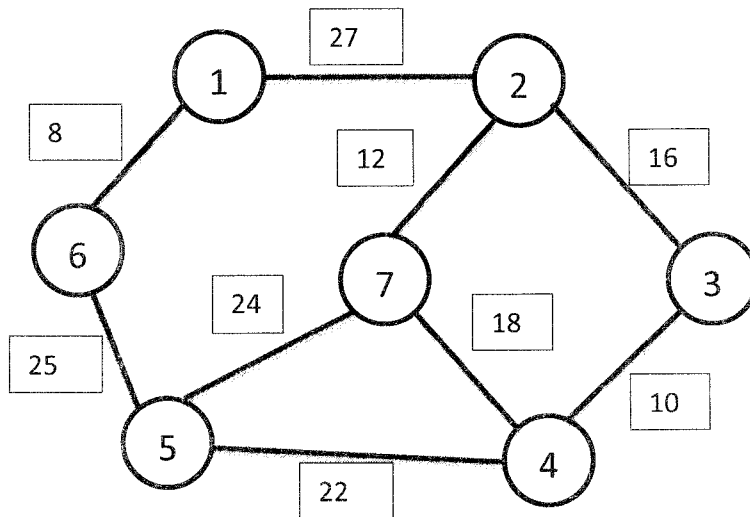
- (b) Let G be a self-complementary graph with n vertices. Prove that G must have exactly $\frac{n(n-1)}{4}$ edges. (05)

OR

- (a) Prove that identity of a group is unique and inverse of an element in the group is unique. (05)

- (b) Construct the minimum spanning tree (MST) for the given graph using Prim's Algorithm: (05)

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Q.5 Attempt any FIVE out of SEVEN:

(10)

- (1) Define a Nilpotent matrix. Also, find out order k for matrix D such that $D^k = 0$.

$$D = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 0 \\ 2 & 0 & 0 \end{bmatrix}$$

- (2) Define a Diagonal matrix and a Scalar matrix with an example.
- (3) For the following system of linear equations, what is the value of (x, y, z) in the second iteration?

$$\begin{aligned} 4x + y - z &= 5 \\ -x + 3y + z &= -4 \\ 2x + 2y + 5z &= 1 \end{aligned}$$

- (4) Define: Compliment of the graph
- (5) Check whether the following system is diagonally dominant or not? Justify your answer.
 $10x - 4y + z = 7, x + 5y - 2z = 5, 8x - 4y - 3z = 6$
- (6) A graph has 6 vertices with degrees: 2,3,2,4,3 and one unknown degree. If the graph has 9 edges, find the missing degree.
- (7) State (only) Lagrange's theorem
