A **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code:R2M08

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Second Semester

Computer Science and Business systems

R21UMA208- LINEAR ALGEBRA AND NUMERICAL TECHNIQUES

(Regulations R2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. If 0,3,4 are the Eigen value of a matrix A then $|A| =$ ______ CO1- App

(a)12 (b)0 (c)3 (d) 4

2. If $A = \begin{pmatrix} a & 1 \\ 3 & b \end{pmatrix}$ has Eigen values of 2,-2 then a and b are_______ CO1- App

(a) 1,-1 (b) -1,-1 (c) 1,1 (d) 0,1

3. By Gauss elimination method, solve $x + y = 2$, $2x + 3y = 5$ CO2- App

(a)1,2 (b) 1,1 (c) 1,0 (d) 0,1

4. The principle of triangularisation method is _________ CO2-U

(a) A=LU (b) L=AU (c) U=LA (d) A=UI

5. Newton –Raphson method is used to find the root of the equation $x^2 - 2 = 0$ CO3- App

(a)-1 (b) $\sqrt{2}$ (c) -$\sqrt{2}$ (d) 0

6. The nth divided difference of nth degree polynomial is CO6- U

(a) constant (b) variable (c) equal (d) unequal

7. Any linear transformation $T : V \to W$ can be represented by a ______ CO6- U

(a) Line (b) Circle (c) square (d) matrix

8. A vector field in R^n is a function CO6- U

(a) F vector $\to 0$ (b) F vector $\to R^n: R^n$ (c) F vector $\to R^n$ (d) F vector: $R^n \to R^n$

9. In a vector space find $\|\alpha x\| =$ ____

CO6- U

(a) $|\alpha| + \|x\|$ (b) $|\alpha| - \|x\|$ (c) $|\alpha|\|x\|$ (d) $|\alpha| / \|x\|$

10. The norm of $(3,-4,0)$ is ________ CO5- App

(a) -4 (b) 3 (c) 0 (d) 5

PART – B (5 x 2= 10 Marks)

11. Explain the Cayley Hamilton theorem and its uses CO6 -U

12. Apply Gauss-Jordan method calculate the inverse of CO2-App

$$A = \begin{pmatrix} 1 & 3 \\ 2 & 7 \end{pmatrix}$$

13. Show that newton's Raphson formula to find $\sqrt{N}$ can be expressed in the form $x_{n+1} = \frac{1}{2}\left[x_n + \frac{N}{x_n}\right]$. CO3-App

14. State any two properties of linear transformation CO6 -U

15. Verify triangle inequality for the following data $\|x + y\| = 6, \|x\| = 3$ *and* $\|y\| = 4$ CO6- U

PART – C (5 x 16= 80 Marks)

16. (a) (i) Find all the eigenvalues and eigenvectors of the matrix CO1-App (8)

$$\begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$$

(ii) Using Cayley Hamilton theorem find A^{-1} when CO1-App (8)

$$A = \begin{pmatrix} 1 & 1 & 1 \\ 1 & 2 & -3 \\ 2 & -1 & 3 \end{pmatrix}.$$

Or

(b) Apply the orthogonal transformation reduce the following quadratic forms into canonical form $Q = 6x^2 + 3y^2 + 3z^2 - 4xy - 2yz + 4zx$, find its rank, index, signature and nature CO1-App (16)

17. (a) (i) Apply Gauss elimination method to solve5x-2y+3z=18,x+7y-3z=-22,2x-y+6z=22. CO2-App (8)

(ii) Solve the following system of equations by Gauss Jordan method x+y+z=6,3x+3y+4z=20,2x+y+3z=13 CO2-App (8)

Or

(b) Solve by using LU decomposition method CO2-App (16)

2x+5y+2z=18;x+2y+3z=14;3x+y+5z=20

18. (a) (i) Apply Newton Raphson Method Calculate a root of $x \log_{10} x - 1.2 = 0$ correct to 3 decimals. CO3- App (8)

(ii) Solve by using Gauss Seidal CO3-App (8)

3x-y+z=1,3x+6y+2z=0,3x+3y+7z=4

Or

(b) (i) Using Lagrange's interpolation formula find f(3) for the following data CO3- App (8)

X	0	1	2	5
Y	2	3	12	147

(ii) From the following data find y at x=84 CO3-App (8)

X	40	50	60	70	80	90
Y	184	204	226	250	276	304

19. (a) (i) Verify the vectors (1,2,0) , (2,3,0) ,(8,13,0) in R^3 is a basis of R^3 CO4- App (8)

(ii) Find the dimension of the subspace spanned by the vectors (1,2,-3), (0,0,1) ,(-1,2,1) in $V_3(R)$ CO4- App (8)

Or

(b) (i) If T: $R^2 \rightarrow R^3$ be linear transformation defined by $T(a_1, a_2) = (a_1 - a_2, 0,0)$ then find nullity (T) ,rank(T), Is T one-to-one? Is T onto? Also check the rank nullity theorem. CO4- App (8)

(ii) Find the matrix of the linear transformation $T : V_2(R) \rightarrow V_3(R)$ defined by T(a,b) = (a-b,2a,3a+2b) for the standard basis of $V_2(R)$ CO4-App (8)

20. (a) Apply Gram-Schmidt process to construct an orthonormal basis for $V_3(R)$ with the standard inner product for the basis$\{v_1, v_2, v_3\}$ where $v_1 = (2,-1,0)$, $v_2 = (4,-1,0)$ and $v_3 = (4,0,-1)$ CO5- App (16)

Or

(b) (i) Show that the following function defines an inner product on $V_2(R)$ where $x = (x_1, x_2)$ and $y = (y_1, y_2)$ and CO5- App (8)

$\langle x, y\rangle = x_1 y_1 + x_2 y_1 + x_1 y_2 + 4x_2 y_2$

(ii) If $x = (2, 1 + i, i)$ and $y = (2 - i, 2, 1 + 2i)$ then verify triangle inequality. CO5- App (8)