Reg. No.															

Question Paper Code	13754

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Second Semester

Computer Science and Business Systems

20BSMA202 - LINEAR ALGEBRA

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	For Cramer's Rule to be applicable, the determinant of the coefficient matrix must be: (a) Non-zero (b) Zero (c) Equal to one (d) Greater than or equal to zero	1	K1	CO1
2	If a matrix A is invertible, then which of the following is true? (a) Inverse of A does not exist. (b) The determinant of A is zero. (c) The system Ax=B has a unique solution. (d) The rows of A are linearly dependent.	1	K1	CO1
3.	The rank of the matrix $A = \begin{pmatrix} 2 & -3 \\ 1 & 4 \end{pmatrix}$ (a) 1 (b) 2 (c) 3 (d) 4	1	K2	CO2
4.	Given vectors u = (1,1) and **v=**(2,3)**,** which of the following vectors is a linear combination of u and v? (a) (3,4) (b) (4,5) (c) (5,6) (d) (1,1)	1	K2	CO2
5.	What is the dimension of the vector space$\boldsymbol{R^3}$**?** (a) 1 (b) 2 (c) 3 (d) 4	1	K1	CO3
6.	The norm of the vector (2, -3, 4) is (a) $\sqrt{29}$ (b) 29 (c) 841 (d) 49	1	K2	CO3
7.	A matrix A is a Hermitian matrix , if (a) A =A^T (b) A =$\bar{A}^T$ (c) A = $\overline{A^T}$ (d) none of the above	1	K1	CO4
8.	Which of the following is an example of a linear transformation? (a) $T(x,y) = (x+y, y-x)$ (b) $T(x,y) = (x^2, 4y)$ (c) $T(x,y) = (x, l\,n(y))$ (d) $T(x,y) = (xy, x+y)$	1	K2	CO4
9.	Principal component analysis can be used for projecting and visualizing data in lower dimensions. (a)True (b) False (c) Partially true (d) None of the above	1	K1	CO5
10.	In SVD of a matrix A, the eigenvalues are calculated for (a) A matrix (b) A^T matrix (c) AA^T matrix (d) None of the above	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11.	What is the inverse of the matrix $A = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$?	2	K2	CO1
12.	Solve the following system of equations $3x + 4y = 2$ and $5x + 6y = 4$.	2	K2	CO1
13.	If A=$\begin{pmatrix} 3 & 2 & 2 \\ 1 & 3 & 1 \\ 5 & 3 & 4 \end{pmatrix}$,find B such that AB=$\begin{pmatrix} 3 & 4 & 2 \\ 1 & 6 & 1 \\ 5 & 6 & 4 \end{pmatrix}$.	2	K2	CO1
14.	Define rank of a matrix.	2	K1	CO2
15.	Determine whether the vectors $(1,-2,3), (5,6,-1), (3,2,1)$ form a linearly dependent or independent set in R^3.	2	K2	CO2
16.	For what value of k, the system of equations$x + 2y = 5, 3x + ky - 15 = 0$ has no solution.	2	K1	CO2
17.	Define a subspace of a Vector space.	2	K2	CO3
18.	Write down the basis for $M_2(R)$.	2	K2	CO3

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

19. Define a Linear Transformation. *2 K1 CO4*

20. Define a Positive definite matrix. *2 K1 CO4*

21. State Singular value decomposition theorem. *2 K1 CO5*

22. State any two applications of Image Processing. *2 K1 CO5*

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23. a) Solve the equations $3x + y + 2z = 3;\ 2x - 3y - z = -3;\ x + 2y + z = 4$ using Cramer's Rule. *11 K3 CO1*

OR

b) By finding A^{-1}, solve the linear equation AX=B where $A = \begin{pmatrix} 3 & 4 & 5 \\ 1 & 2 & 0 \\ 5 & 1 & 1 \end{pmatrix}$, $X = \begin{pmatrix} x \\ y \\ z \end{pmatrix}, B = \begin{pmatrix} 4 \\ -1 \\ 5 \end{pmatrix}$. *11 K3 CO1*

24. a) Calculate the rank of the matrix $\begin{pmatrix} 5 & 3 & 7 \\ 3 & 26 & 2 \\ 7 & 2 & 10 \end{pmatrix}$. *11 K3 CO2*

OR

b) Show that the equations $5x + 3y + 7z = 4, 3x + 26y + 2z = 9,$ $7x + 2y + 10z = 5$ are consistent and solve them by rank method. *11 K3 CO2*

25. a) Let $S = \{v_1, v_2, v_3\}$ where $v_1 = (1, 2, -3), v_2 = (2, 5, 1), v_3 = (-1, 1, 4)$. Verify whether S forms a basis or not. *11 K3 CO3*

OR

b) Let R^3 have the Euclidean inner product. Use Gram – Schmidt process to construct the basis $\{u_1, u_2, u_3\}$ into an orthonormal basis, where $u_1 = (1, 1, 1), u_2 = (0, 1, 1), u_3 = (0, 0,1)$. *11 K3 CO3*

26. a) Find the matrix of T in the standard basis for the transformation T : $P_2(R) \to P_2(R)$ where $T(f(x)) = f'(x)$. *11 K3 CO4*

OR

b) Prove that there exist a linear transformation $T: R^2 \to R^3$ such that $T(1, 1) = (1, 0, 2),\ T(2, 3) = (1, -1, 4)$. Find $T(8, 11)$. *11 K3 CO4*

27. a) Determine the singular value decomposition of $A = \begin{pmatrix} 3 & 0 \\ 4 & 5 \end{pmatrix}$. *11 K3 CO5*

OR

b) Apply Principal Component Analysis (PCA) to reduce the data to a 1-dimensional space. *11 K3 CO5*

4	5	6	7	8
6	7	8	9	10

28. a) (i) Let $T: R^3 \to R^2$ be defined by $T(x, y, z) = (2x - y, 3z)$. Verify whether T is linear or not. Find $N(T)$. *6 K3 CO4*

(ii) Explain Applications of matrices in Machine Learning. *5 K3 CO5*

OR

b) (i) Let $T: R^2 \to R^3$ by $T(a_1, a_2) = (a_1 + a_2,\ 0,\ 2a_1 - a_2)$. Find nullity of T and rank of T. *6 K3 CO4*

(ii) Discuss the applications of matrices with Principal Component Analysis in Image Processing. *5 K3 CO5*