Reg. No.																

Question Paper Code	14285

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 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

	Question	Marks	K – Level	CO
1.	Inverse of a matrix is ……… (a) unique (b) disjoint (c) both (a) & (b) (d) None of the above	1	K1	CO1
2.	Determinant of A and determinant of A^T are …………. different (b) same (c) may be unequal (d) All of these	1	K2	CO1
3.	The rank of a matrix is the largest order of a non -zero ……………of matrix. major (b) minor (c) either major or minor (d) neither major nor minor	1	K1	CO2
4.	Which of the following step is not involved in Gauss elimination method? Eliminations of unknowns (b) Reduction to an upper triangular system (c) Finding unknowns by back substitution (d) Evaluation of co-factors	1	K1	CO2
5.	If W is a subspace of a finite – dimensional vector space V, then (a)$dim\ (W) \leq dim\ (V)$ (b) $dim\ (W) > dim\ (V)$ (c) $dim\ (W) \geq dim\ (V)$ (d) None of theabove.	1	K1	CO3
6.	If u & v are orthogonal vectors in a real inner product space V, then $\|\|u+v\|\|^2 = \|\|u\|\|^2 + \|\|v\|\|^2$ (b) $\|\|u+v\|\|^2 = \|\|u\|\|^2 > \|\|v\|\|^2$ (c) $\|\|u+v\|\|^2 < \|\|u\|\|^2 + \|\|v\|\|^2$ (d) $\|\|u+v\|\|^2 = \|\|u\|\|^2.\|\|v\|\|^2$	1	K1	CO3
7.	Let A be the Hermitian matrix. Then which of the following statements is false? (a) The diagonal entries of A are real (b) There exists a unitary U such that $U^*AU = D$ (c) If $A^3 = I$,then $A = I$ (d) If $A^2 = I$, then $A = 1$	1	K2	CO4
8.	If T is a linear transformation then T satisfies (a) $T(x+y) = T(x) + T(y)$ (b) $T(x-y) = T(x) - T(y)$ (c) $T(cx) = cT(x)$ (d) All of these	1	K2	CO4
9.	Singular value decomposition can be used to …………… minimize the least square error maximize the highest square error either minimize the least square error or maximize the higher square error none of above	1	K1	CO5
10.	Which of the following is an example of deterministic algorithm? (a) PCA (b) $K-$ means (c) neither PCA nor $K-$ means (d) both (a) & (b)	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

	Question	Marks	K – Level	CO
11.	Find the values of x,y,z and a which satisfy the matrix equation $\begin{pmatrix} x+3 & 2y+x \\ z-1 & 4a-6 \end{pmatrix} = \begin{pmatrix} 0 & -7 \\ 3 & 2a \end{pmatrix}$.	2	K1	CO1
12.	State singular and non-singular Matrix.	2	K1	CO1
13.	Find the determinant value of $A = \begin{bmatrix} 2 & -4 & 3 \\ 3 & 1 & 2 \\ 7 & 6 & 1 \end{bmatrix}$ by expanding second row.	2	K2	CO1
14.	Whether the first polynomial can be expressed as linear combination of other two. $x^3 - 3x + 5;\ x^3 + 2x^2 - x + 1;\ x^3 + 3x^2 - 1$.	2	K2	CO2
15.	Find the rank of the matrix $A = \begin{bmatrix} 1 & 5 & 4 \\ 0 & 3 & 2 \\ 2 & 3 & 10 \end{bmatrix}$.	2	K2	CO2

16.	Define LU Decomposition.	2	K1	CO2
17.	Is $W = \{(a, 0, b): a, b \in R\}$ a subspace of $R^3(R)$?	2	K2	CO3
18.	Whether the set of vectors $S = \{(1,2,3), (2,3,4), (3,4,5)\}$ is a basis for $R^3(R)$.	2	K2	CO3
19.	If T is linear, then prove that $T(0) = 0$.	2	K2	CO4
20.	Define positive definite matrix.	2	K2	CO4
21.	What is Principal Components Analysis?	2	K1	CO5
22.	Define Singular Value Decomposition.	2	K1	CO5

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23. a) Solve the system of equations using Cramer's rule. *11 K3 CO1*
$x + y + z = 11;$
$2x - 6y - z = 0;$
$3x + 4y + 2z = 0.$

OR

b) Find the inverse of the linear system $x_1 + x_2 + 2x_3 = 4$; $2x_1 + 5x_2 - 2x_3 = 3$; $x_1 + 7x_2 - 7x_3 = 5$. *11 K3 CO1*

24. a) Solve the following system of equations by triangularization: *11 K3 CO2*
$8x - 3y + 2z = 20$; $4x + 11y - z = 33$; $6x + 3y + 12z = 36$.

OR

b) Solve by LU Decomposition method. *11 K3 CO2*
$3x - 6y - 3z = -3$; $2x + 6z = -22$; $-4x + 7y + 4z = 3$

25. a) Determine whether the set of vectors (4, 1, 2, 0), (1, 2, –1, 0), (1, 3, 1, 2) and (6, 1, 0, 1) is linearly independent. *11 K3 CO3*

OR

b) Apply the Gram-Schmidt process to the given subset $S = \{(1, 0, 1), (0, 1, 1), (1, 1, 3)\}$ and $x = (1, 1, 2)$ of the inner product space $V = R^3$ to obtain an orthogonal basis for span S. *11 K3 CO3*

26. a) Let L be a linear transformation from R^3 to R^3 whose matrix representation A with respect to the standard basis is given below. Find the eigenvalues and eigenvectors $A = \begin{pmatrix} 1 & 3 & -3 \\ 3 & 1 & -3 \\ -3 & -3 & 1 \end{pmatrix}$. *11 K3 CO4*

OR

b) Show that $T: R^2 \to R^2$ defined by $T(a, b) = (2a - 3b, a + 4b)$ is a linear transformation. Find N(T) and R(T). Is T one -to –one and onto? *11 K3 CO4*

27. a) Find a singular value decomposition for $A = \begin{bmatrix} 1 & 0 & 1 \\ -1 & 1 & 0 \end{bmatrix}$. *11 K3 CO5*

OR

b) Compute the principal components to the matrix $A = \begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$. *11 K3 CO5*

28. a) (i) If $T: R^2 \to R^3$ is a linear transformation such that T(1,1)=(1,0,2), T(2,3)=(1,-1,4).Determine (i) T (ii) T(2,5). *6 K3 CO4*

(ii) Discuss the application of Linear Algebra in Machine Learning. *5 K3 CO5*

OR

b) (i) Let T: V→ W be a linear transformation. Then T is one to one if and only if N(T) = {0}. *6 K3 CO4*

(ii) Write the short notes on application of Linear Algebra in Image Processing. *5 K3 CO5*

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