



QP CODE: 25050819



25050819

Reg No :

Name :

MSc DEGREE (CSS) EXAMINATION, DECEMBER 2025

First Semester

M Sc Artificial Intelligence

Core Courses - AI010104 - MATHEMATICAL FOUNDATIONS OF AI

2020 Admission Onwards

99B4B302

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

Answer any **eight** questions.

Weight **1** each.

1. Can cosine similarity be more than 1? Justify.
2. How do you know whether two solutions are independent or not?
3. Every vectors be written as a linear combination. Justify your answer.
4. Define Affine subspace .
5. For the matrix $A = \begin{pmatrix} 1 & 5 \\ 6 & 7 \end{pmatrix}$ verify that
 - (a) $(A + A^T)$ is a symmetric matrix
 - (b) $(A - A^T)$ is a skewsymmetric matrix
6. Define identity matrix . Give an example for order 2 and order 3 identity matrix.
7. Define Constant function rule. Explain with the help of an example.
8. Find $\partial z / \partial x$ and $\partial z / \partial y$

$$x^3 z^2 - 5xy^5 z = x^2 + y^3$$
9. $f(x_1, x_2) = x_1^2 x_2 + x_1 x_2^3$. Find ∇f
10. Explain Quasi – Newton method.

(8×1=8 weightage)

Part B (Short Essay/Problems)

Answer any **six** questions.

Weight **2** each.

11. Calculate the cross product between $a = (3, -3, 1)$ and $b = (4, 9, 2)$.





12. Find all unit vectors in the plane $a = [x, y]$ orthogonal to $[4, 3]$
13. Orthonormalize the given set of vectors.
- $$V_1 = \begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}, V_2 = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}, V_3 = \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix}$$
14. If $A = \begin{bmatrix} 3 & 2 & 2 \\ 1 & 3 & 1 \\ 5 & 3 & 4 \end{bmatrix}$ compute $\text{adj}(A)$ and hence find the inverse of the matrix.
15. Find the Eigen values and Eigen vectors of the matrix $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$
16. What are the applications of principal component analysis.
17. Reduce the dimension
- | | | | | |
|---|----|---|----|----|
| x | 4 | 8 | 13 | 17 |
| y | 11 | 4 | 5 | 14 |
18. $x = r \sin \theta \cos \phi$; $y = r \sin \theta \sin \phi$; $z = r \cos \theta$. Find Jacobian.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight **5** each.

19. Solve the system of linear equations using row echelon form.
- $$\begin{aligned} x - y + z &= 8 \\ 2x + 3y - z &= -2 \\ 3x - 2y - 9z &= 9 \end{aligned}$$
20. Express the vector $u = (-4, 2, -5, -2)$ as a linear combination of the vectors.
- $$\{ (1, -4, 1, 2), (4, -8, 4, 4), (-4, 4, -5, -3), (2, -2, 3, 2) \}$$
21. Determine the rank of the matrix $\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 10 \end{bmatrix}$
22. Find the Taylor series for $f(x) = x^3 - 10x^2 + 6$ about $x = 3$

(2×5=10 weightage)

