

Seat No.: \_\_\_\_\_

Enrolment No. \_\_\_\_\_

**NATIONAL FORENSIC SCIENCES UNIVERSITY**

Semester End Examination (December – 2024)

M. Tech Artificial Intelligence &amp; Data Science

Semester - I

**Subject Code: CTMTAIDS SI P1****Date: 05/12/2024****Subject Name: Mathematical and Computational Foundation for Artificial Intelligence.****Time: 2:30 PM – 05:30 PM****Total Marks: 100****Instructions:**

1. Write down each question on a separate page.
2. Attempt all questions.
3. Make suitable assumptions wherever necessary.
4. Figures to the right indicate full marks.

|            |   | <b>Marks</b> |
|------------|---|--------------|
| <b>Q.1</b> | <b>Attempt any three.</b>   |              |
| (a)        | Solve the following system of linear equations using the LU method:<br>$3x - 2y + z = 4$<br>$x + y + 2z = 6$<br>$5x - y + 3z = 8$             | <b>08</b>    |
| (b)        | Define Vector space and its properties.   | <b>08</b>    |
| (c)        | Let $A = \begin{bmatrix} 1 & 2 & -3 \\ -3 & -4 & 13 \\ 2 & 1 & -5 \end{bmatrix}$ . Perform LU decomposition on the matrix                     | <b>08</b>    |
| (d)        | Define Linear Independence and explain it with example.   | <b>08</b>    |
| <b>Q.2</b> | <b>Attempt any three.</b>   |              |
| (a)        | Define Orthogonal Matrices and key properties. Give one example.  | <b>08</b>    |
| (b)        | Explain the steps of the Gram-Schmidt Process.  | <b>08</b>    |
| (c)        | Solve the following system of linear equations using Gaussian Elimination<br>$-2x + 4y - z = -3$<br>$5x - 3y + 2z = -2$<br>$3x + 2y - 4z = 7$ | <b>08</b>    |
| (d)        | Explain Single Value Decomposition and its applications.  | <b>08</b>    |
| <b>Q.3</b> | <b>Attempt any three.</b>   |              |
| (a)        | Explain the basic concept of simple linear regression. How do you estimate the coefficients of the regression line?                           | <b>08</b>    |
| (b)        | What is Principal Component Analysis (PCA)? Explain the steps involved in PCA for dimensionality reduction                                    | <b>08</b>    |
| (c)        | Explain logistic regression with an example.  | <b>08</b>    |
| (d)        | Write any two methods of Parameter Estimations in Linear Regression.  | <b>08</b>    |



Q.4

Attempt any two.

- (a) Explain how a Support Vector Machine (SVM) identifies the optimal hyperplane for linearly separable data. Why is maximizing the margin important? 07
- (b) Explain any 3 common Kernel Functions in linear regression. 07
- (c) Calculate the singular value decomposition of

$$D = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

07

Q.5

Attempt any two.

- (a) Discuss covariance and correlation. Why is correlation preferred for measuring linear relationships? 07
- (b) Explain the importance of the expected value and variance of a random variable. Derive the formula for the variance of a random variable 07
- (c) Explain the normal distribution and describe the significance of its parameters. Why is it called the "bell curve"? 07

--- End of Paper---