Reg. No……………………… Name…………………………. **25P151**

M. Sc. DEGREE END SEMESTER EXAMINATION - NOVEMBER 2025

SEMESTER 1: COMPUTER SCIENCE (ARTIFICIAL INTELLIGENCE)

COURSE: **24P1CAIT04: MATHEMATICS FOR COMPUTATIONAL INTELLIGENCE**

(For Regular 2025 Admission& Improvement/Supplementary 2024 Admission)

Time: 3 Hours Max. Weightage: 30

Qn. No.	Question	CO No.	Level
	PART A ***(Answer any 8 questions. Each question carries 1 weightage)***		
1.	Define a vector space. Give an example.	1	U
2.	Define rank of a matrix. Find the rank of $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 0 \end{bmatrix}$.	1	R
3.	Evaluate $l_1, l_{2,} l_\infty$- norms of the vector $v = (-2,3,4)$.	2	E
4.	Find the length of $C = \begin{bmatrix} 1 & 1 \\ 1 & 1 \\ 1 & 1 \end{bmatrix}$.	2	E
5.	Compute the determinant and trace of $B = \begin{bmatrix} 1 & 2 & 3 \\ 0 & -1 & 4 \\ 2 & 1 & 0 \end{bmatrix}$.	3	E
6.	Let $D = \begin{bmatrix} 2 & 0 & 0 \\ 0 & -3 & 0 \\ 0 & 0 & 7 \end{bmatrix}$. Find $\|D\|$, D^2 and D^{-1}.	3	R
7.	Find the difference quotient of $f(x) = \sqrt{x}$.	4	E
8.	Find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ if $z = x^2y + 3xy^2$.	4	E
9.	Find the gradient of $f(x, y, z) = x^2 + y^2 + z^2$.	4	E
10.	Check whether $f(x) = x^2 + 4x + 5$ is convex. Find Minimum of f(x).	5	An

PART B ***(Answer any 6 questions. Each question carries 2 weightage)***			
11.	Find the inverse of $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \\ 5 & 6 & 0 \end{bmatrix}$ using elementary row operations.	1	E
12.	Check whether the vectors $u = (3, -1, 2)$, $v = (2, 1, 1)$ in $\mathbb{R}^3$ are orthogonal. If not, find the angle between them.	2	An
13.	Write the Cholesky decomposition of $A = \begin{bmatrix} 25 & 15 \\ 15 & 18 \end{bmatrix}$.	3	E
14.	Check whether $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ is diagonalizable. If yes, determine their diagonalizes form and a basis with respect to which the transformation matrices are diagonal. If no, give reasons for why it is not diagonalizable.	3	An
15.	Define a Maclaurin series. Find the Maclaurin series expansion for $f(x) = \sin(x) + \cos(x)$.	4	A
16.	Find the Jacobian matrix of $F(x, y, z) = \begin{bmatrix} x + y + z \\ xy \\ yz \end{bmatrix}$.	4	E
17.	Minimize $f(x) = x^2 + xy + y^2$ by Gradient descent optimization.	5	A
18.	Find a global minimum for $f(x, y) = x^4 + y^4$.	5	E
PART C ***(Answer any 2 questions. Each question carries 5 weightage)***			
19.	Consider the system: $x + y + z = 6,\ 2x + 3y + z = 10, x + 2y + 3z = 13$. a) Write the matrix representation of the system. b) Write the augmented matrix of the system. c) Solve the system of linear equations by using Gauss elimination method.	2	A
20.	a) Define an orthogonal basis. b) Check whether $x = \frac{1}{\sqrt{2}}\begin{bmatrix} 1 \\ 1 \end{bmatrix}, y = \frac{1}{\sqrt{2}}\begin{bmatrix} 1 \\ -1 \end{bmatrix}$ form an orthogonal basis for $\mathbb{R}^2$.	2	A

	c) Let $x = [1 \quad 1]^T, y = [2 \quad 1]^T \epsilon \mathbb{R}^2$ and $\langle x, y \rangle = x^T \begin{bmatrix} 1 & -1/2 \\ -1/2 & 1 \end{bmatrix} y = x_1y_1 - \frac{1}{2}(x_1y_2 + x_2y_1) + x_2y_2$. Find the length of x and y. d) Find the distance between x and y.		
21.	a) Determine the eigen values and corresponding eigen vectors of $\begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}$. b) Write the multiplicities of each eigen value. c) Write the eigen decomposition of the given matrix.	3	A
22.	a) Define the terms: Lagrange multiplier and Lagrangian function. b) Find the maximum and minimum of $f(x, y) = x^2 + y^2$ subject to the constraint $x + y = 10$.	5	A

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