Jaypee University of Information Technology, Waknaghat

TEST-1 Examination - August 2026

M.Tech (Data Science) - I Semester

Course Code/Credits: 22M11MA111/3 Max. Marks: 15
Course Title: Mathematical Foundations for Data Science
Course Instructor: RAD Max. Time: 1 Hour

Note: (a) ALL questions are compulsory.

(b) Scientific calculators are allowed.

(b) The candidate is allowed to make suitable numeric assumptions wherever required.

JUIT TEST EXAMINATION - AUG-2026

Q.No	Question	CO	Marks
Q1	Consider $\mathbf{W} = \{(x, y, z) \in \mathbb{R}^3 : x + y - z = 0\}$. (a) Determine whether is a subspace of $\mathbb{R}^3$. Justify your answer. (b) Find a *basis* and the *dimension* of $\mathbf{W}$.	CO-2	3
Q2	Let $\mathbf{T} : \mathbb{R}^3 \to \mathbb{R}^2$ be defined by $\mathbf{T}\begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} = \begin{pmatrix} x_1 + 2x_2 - x_3 \\ 2x_1 + 4x_2 - 2x_3 \end{pmatrix}$. (a) Find Range($\mathbf{T}$). (b) Give a *basis* for Range($\mathbf{T}$).	CO-2	3
Q3	Answer the following: (a) In a 3-dimensional warehouse, a robotic system uses the plane $3x_1 + 2x_2 - x_3 = 12$ as a safety boundary. Write the equation of this plane in the form $\mathbf{x}^{\mathrm{T}}\mathbf{n} + \mathrm{b} = 0$, and identify the normal vector $\mathbf{n}$ and the constant b. (b) Determine whether the position $\mathbf{x} = (2, 3, -2)$ lies on the safety boundary. Justify your answer.	CO-2	3
Q4	Consider the overdetermined system $\mathbf{Ax} = \mathbf{b}$: $\mathbf{A} = \begin{bmatrix} 4 & 0 \\ 0 & 2 \\ 1 & 1 \end{bmatrix}$ and $\mathbf{b} = \begin{pmatrix} 2 \\ 0 \\ 11 \end{pmatrix}$ (a) Find the *least-squares* solution of $\mathbf{Ax} = \mathbf{b}$. (b) Find the *orthogonal projection* of $\mathbf{b}$ onto Col($\mathbf{A}$).	CO-2	3
Q5	Consider 3×2 matrix $\mathbf{A} = \begin{bmatrix} 2 & 1 \\ 1 & 0 \\ 0 & 1 \end{bmatrix}$. (a) Determine the singular values of $\mathbf{A}^{\mathrm{T}}\mathbf{A}$. (b) Find the singular value decomposition (SVD) of $\mathbf{A}$.	CO-2	3

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