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Jaypee University of Information Technology, Waknaghat

Test-2 Examination, March 2026

B.Tech - VII Semester (ALL)

Course Code/Credits: 22B1WMA731/3 — Max. Marks: 25
Course Title: Linear Algebra for Data Science & Machine Learning
Course Instructor: RAD — Max. Time: 90 mins

Note: (a) ALL questions are compulsory.

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

Q.No	Question	CO	Marks
Q1	Determine whether each subset is a subgroup of the given group. (a) $\mathbf{S}_1 = \left\{ \begin{pmatrix} 1 & a \\ 0 & 1 \end{pmatrix} : a \in \mathbb{R} \right\} \subset (M_2(\mathbb{R}), +)$. (b) $\mathbf{S}_2 = \{ z \in \mathbb{C} : \lvert z \rvert = 1 \} \subset (\mathbb{C} \setminus \{0\}, \times)$.	CO-1	4
Q2	Let $\mathbf{T} : \mathbb{R}^2 \to \mathbb{R}^3$ be defined by $\mathbf{T}(\mathbf{x}) = \mathbf{A}\mathbf{x}$, where $\mathbf{A} = \mathbf{T}\begin{pmatrix} 1 & 2 \\ -3 & 4 \\ 5 & -1 \end{pmatrix}$. Find $\mathbf{x} \in \mathbb{R}^2$ such that $\mathbf{T}(\mathbf{x}) = (5\ -2\ 7)^{\mathbf{T}}$.	CO-2	4
Q3	Let $\mathbf{U} = \text{span}\{\mathbf{u}_1, \mathbf{u}_2\}$ be a subspace of $\mathbb{R}^4$ generated by $\mathbf{u}_1 = (2\ 1\ 0\ 1)^{\mathbf{T}}$ and $\mathbf{u}_2 = (1\ -1\ 2\ 0)^{\mathbf{T}}$. (a) Find a basis for $\mathbf{U}$. (b) Determine a basis for the *orthogonal complement* of $\mathbf{U}$.	CO-2	4
Q4	Consider $\mathbf{v} = (1, 2, 3)$ in $\mathbb{R}^3$. (a) Identify the subspace $\mathbf{W}$ defined by $x - y + z = 0$ $2x + y - z = 0$ (b) Find the *orthogonal projection* of $\mathbf{v}$ onto $\mathbf{W}$.	CO-2	4
Q5	Consider the linear transformation $\mathbf{T} : \mathbb{R}^3 \to \mathbb{R}^4$ defined by $\mathbf{T}(x_1, x_2, x_3) = (x_1 + 2x_2,\ 2x_1 - x_3,\ x_1 + x_2 + x_3,\ 3x_2 - 2x_3)$. (a) Find the range space of $\mathbf{T}$. (b) Determine the null space of $\mathbf{T}$.	CO-2	4
Q6	The vectors $\{u_1, u_2, u_3\}$ form a basis for a subspace $\mathbf{W}$ of $\mathbb{R}^4$: $u_1 = \begin{pmatrix} 2 \\ 1 \\ 0 \\ 1 \end{pmatrix}, \quad u_2 = \begin{pmatrix} 1 \\ 0 \\ 1 \\ 1 \end{pmatrix}, \quad u_3 = \begin{pmatrix} 0 \\ 1 \\ 1 \\ 0 \end{pmatrix}.$ (a) Use Gram–Schmidt process to obtain an *orthogonal basis.* (b) Deduce the *orthonormal basis.*	CO-3	5

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