

Jaypee University of Information Technology, Waknaghat
Test-1 Examinations, September 2022

B.Tech - VII Semester (ALL)

Course Code/Credits: 22B1WMA731/3

Max. Marks: 15

Course Title: Linear Algebra for Machine Learning & Data Science

Course Instructor: RAD

Max. Time: 1 Hour

Instructions: All questions are compulsory. Marks are indicated against each question.

1. Show that $\left\{ \begin{pmatrix} a & b & 0 \\ a+b & 0 & c \end{pmatrix} \mid a, b, c \in \mathbb{R} \right\}$ is a *subspace* of $\mathcal{M}_{2 \times 3}$. (3 Marks) [CO-1]

2. Consider the following set of vectors in \mathbb{R}^3 : (3 Marks) [CO-1]

$$\left\{ \begin{pmatrix} x-8 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} -7 \\ x-1 \\ 0 \end{pmatrix}, \begin{pmatrix} 13 \\ 5 \\ 30 \end{pmatrix} \right\}$$

For what values of x is the set *linearly dependent*?

3. Let $\mathbf{v}_1 = (1, 2, 1)$, $\mathbf{v}_2 = (3, -1, 0) \in \mathbb{R}^3$. Let $\mathbf{w} = (5, 3, 2)$ $\mathbf{u} = (7, 0, 0)$. (3 Marks) [CO-1]

(a) Show that $\mathbf{w} \in \text{span}(\{\mathbf{v}_1, \mathbf{v}_2\})$.

(b) Show that $\mathbf{u} \notin \text{span}(\{\mathbf{v}_1, \mathbf{v}_2\})$.

4. Consider the *subspace* $\mathbf{U} = \left\{ \begin{pmatrix} r \\ s \\ r \end{pmatrix} \mid r, s \in \mathbb{R} \right\}$ of \mathbb{R}^3 . (3 Marks) [CO-1]

(a) Find a *basis* for \mathbf{U} .

(b) What is the *dimension* of \mathbf{U} ?

5. Consider the matrix representing a rotation of a drone in 3D space. (3 Marks) [CO-2]

$$\mathcal{R} = \begin{pmatrix} \frac{\sqrt{3}}{2} & 0 & -0.5 \\ 0 & 1 & 0 \\ -0.5 & 0 & \frac{\sqrt{3}}{2} \end{pmatrix}$$

(a) Determine the *characteristic polynomial* of \mathcal{R} .

(b) Find the *eigenvector* associated with the *eigenvalue* $\lambda = 1$ (its *axis of rotation*).

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