RV College of Engineering®
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Academic year 2025-2026 (Odd Semester)

DEPARTMENT OF MATHEMATICS

Date: 06.11.2025 **Time: 9.00 AM - 11.00 AM**	**CIE- I**	**Max. Marks: 10+50**
Semester: III **Branches: CS, CD, CY, IS**	**UG**	**Duration: 2 Hrs**
Course: LINEAR ALGEBRA AND PROBABILITY THEORY		**Course Code: MA231TC**

Instructions:

1. Answer all questions.
2. Answer part A in first two pages only.
3. Handbook not permitted; necessary formulas are provided at the end of the question paper.

Sl. No.	PART - A	M	BTL	CO
1	Let S be the set of all 2×2 symmetric matrices, a subspace of $M_{2\times 2}$. Then the zero vector is ________ and the inverse vector is ________.	2	1	1
2	Given $u = \begin{bmatrix}1\\2\end{bmatrix}, v = \begin{bmatrix}2\\3\end{bmatrix}, w = \begin{bmatrix}4\\7\end{bmatrix}$. If w can be expressed as a linear combination of u and v then the coefficients of u and v are respectively ________ and ________.	2	1	2
3	Let $U = \text{Span}\{(1,0,1),(0,1,1)\}$ and $W = \{(x,y,z): x = y\}$ be subspaces of $\mathbb{R}^3$. Then $\dim(U \cap W)$ is ________.	2	2	2
4	The orthogonal projection matrix for projecting a vector $[x\ y]^T$ onto the vector $\left[-1\ \sqrt{3}\right]^T$ is ________.	2	2	2
5	Column space of a matrix A of order 4×5 is a subspace of $\mathbb{R}^k$ where k is ________.	1	1	1
6	Let $T: \mathbb{R}^2 \to \mathbb{R}^2$ be a linear transformation such that $T(1,0) = (2,-3)$ and $T(0,1) = (3,0)$. Then image of $(2,5)$ is ________.	1	1	1
	PART – B	**M**	**BTL**	**CO**
1	Verify whether the following sets form a subspace of corresponding vector space. i) $S_1 = \left\{\begin{bmatrix}x\\y\\z\end{bmatrix} \in \mathbb{R}^3 : x+y+z=0,\ x,y,z \in \mathbb{Z}\right\}$. ii) $S_2 = \{[x\ \ y]^T \in \mathbb{R}^2 :\ e^{2x-3y} = 0\}$. iii) $S_3 = \{f(x) \in P_2 : 2f(0) = f(1)\}$. iv) $S_4 = \{(x,y) \in \mathbb{R}^2 : xy = 0\}$. v) $S_5 = \{\begin{bmatrix}a & b\\c & d\end{bmatrix} \in M_{2\times 2} :\ a - d = 0\}$.	10	2	2

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2	(a) Determine the values of λ such that the vectors $(1,1,2,1), (2,1,2,3), (1,4,2,1), (-1,3,5,\lambda)$ are linearly independent.	5	3	3
	(b) Check whether the polynomial $3x^2+x+5$ is in the linear span of the set $S = \{x^3,\ x^2+2x,\ x^2+2\ ,\ 1-x\}$ of the vector space of all polynomials over the field $\mathbb{R}$.	5	2	3
3	Find the basis and dimension for the four fundamental subspace of the matrix $A = \begin{bmatrix} -2 & -5 & 8 & 0 & -17 \\ 1 & 3 & -5 & 1 & 5 \\ 3 & 11 & -19 & 7 & 1 \\ 1 & 7 & -13 & 5 & -3 \end{bmatrix}$.	10	3	3
4	(a) Verify the following are linear transformation (i) $T_1: \mathbb{R}^2 \to \mathbb{R}^2$ defined by $T_1(x,y) = (3x+2y,\ 5x-y)$ (ii) $T_2: \mathbb{R}^2 \to \mathbb{R}^2$ defined by $T_2(x,y) = (xy,\ x+y)$.	5	2	2
	(b) Find the linear transformation $T: \mathbb{R}^3 \to \mathbb{R}^3$ such that $T(1,1,1) = (1,1,1)$, $T(1,2,3) = (-1,-2,3)$ and $(1,1,2) = (2,2,4)$.	5	2	2
5	(a) Let $T: \mathbb{R}^2 \to \mathbb{R}^3$ be a linear mapping such that $T(x,y) = (x+2y, 3x+y, x-y)$. Find the basis for Kernel and range space of T . Hence verify the Rank - Nullity theorem.	6	2	4
	(b) Find the linear transformation matrix which rotates the vector $\begin{bmatrix} 2 \\ 1 \end{bmatrix}$ by 30^0 clockwise and then stretches by a factor of 2. Also find the transformed vector.	4	3	4

Transformation Matrices:

Scaling: $\begin{bmatrix} c & 0 \\ 0 & c \end{bmatrix}$, Rotation: $\begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$, Projection: $\begin{bmatrix} \cos^2\theta & \sin\theta\cos\theta \\ \sin\theta\cos\theta & \sin^2\theta \end{bmatrix}$,

Reflection: $\begin{bmatrix} \cos 2\theta & \sin 2\theta \\ \sin 2\theta & -\cos 2\theta \end{bmatrix}$.

Projection matrix on a single vector u is $\frac{uu^T}{u^Tu}$.

Blooms Taxonomy, CO-Course Outcomes, M-Marks

	CO1	CO2	CO3	CO4	L1	L2	L3	L4	L5	L6
Marks Distribution	04	26	20	10	6	28	26	-	-	-

*****All The Best*****