BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP2025)

CLASS: IMSc. **SEMESTER: II**
BRANCH: QEDS **SESSION: SP 2025**

SUBJECT: ED24117 LINEAR ALGEBRA, VECTORS AND MATRICES

TIME: 02 Hours **FULL MARKS: 25**

INSTRUCTIONS:

1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**
5. All the notations used in the question paper have usual meanings.

		Marks	CO	BL
Q.1(a)	Find the value(s) of λ for which the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & \lambda \end{bmatrix}$ has rank exactly 2.	[2]	CO2	3
Q.1(b)	Compute the value of a such that the system of equations $x_1 + x_2 + x_3 = 1$, $2x_1 + 3x_2 + 2x_3 = 1$ and $2x_1 + 3x_2 + (a^2 - 1)x_3 = a + 1$ has (i) no solution (ii) unique solution and (iii) infinite number of solutions.	[3]	CO2	2
Q.2	Solve the system $Ax = b$, where $A = \begin{bmatrix} 2 & -1 & 1 \\ 3 & 3 & 9 \\ 3 & 3 & 5 \end{bmatrix}$, $x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ and $b = \begin{bmatrix} 2 \\ -1 \\ 5 \end{bmatrix}$ by LU decomposition technique.	[5]	CO2	4
Q.3	Let A be matrix satisfying the matrix equation $A^3 - 6A^2 + 11A - 5I = O$. (a) Find the eigenvalues of A. (b) Express A^{-1} and A^4 in terms of A and A^2.	[5]	CO3	3
Q.4	Find the singular value decomposition of the 2×2 matrix $A = \begin{bmatrix} 4 & 0 \\ 3 & -4 \end{bmatrix}$.	[5]	CO1	2
Q.5(a)	Consider the set $S = \{(x, y) \in \mathbb{R}^2 : xy = 0\}$. Determine whether S is a vector space under usual vector addition and scalar multiplication.	[3]	CO1	3
Q.5(b)	Consider the set $W = \{(x, y, z) \in \mathbb{R}^3 : x + y + z = 0\}$. Determine whether W is a subspace of $\mathbb{R}^3$.	[2]	CO1	

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