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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2024 Supplementary Examinations

Programme: B.E. | **Semester: IV**
Branch: CS / IS / AIML | **Duration: 3 hrs.**
Course Code: 22MA4BSLIA | **Max Marks: 100**
Course: LINEAR ALGEBRA

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - 1	CO	PO	Marks
1	a)	Check whether $b = \begin{bmatrix} 3 \\ -7 \\ -3 \end{bmatrix}$ can be expressed as a linear combination of the columns of $A = \begin{bmatrix} 1 & -4 & 2 \\ 0 & 3 & 5 \\ -2 & 8 & -4 \end{bmatrix}$.	1	1	**6**
	b)	Let $v_1 = \begin{bmatrix} 1 \\ -3 \\ 4 \end{bmatrix}, v_2 = \begin{bmatrix} 6 \\ 2 \\ -1 \end{bmatrix}, v_3 = \begin{bmatrix} 2 \\ -2 \\ 3 \end{bmatrix}$ and $v_4 = \begin{bmatrix} -4 \\ -8 \\ 9 \end{bmatrix}$. Find a basis for the subspace W spanned by $\{v_1, v_2, v_3, v_4\}$.	1	1	**7**
	c)	Given $B = \{t^3 + t^2,\ t^2 + t,\ t + 1, 1\}$ is an ordered basis of vector space $P_3(t)$. Find the co-ordinate vector of $f(t)$ relative to B where $f(t) = 2t^3 + t^2 - 4t + 2$.	1	1	**7**
		UNIT - 2			
2	a)	Find the matrix of the linear transformation $T: V_2(R) \to V_3(R)$ defined by $T(x, y) = (x + y,\ x,\ 3x - y)$ with respect to $B_1 = \{(1,1),\ (3,1)\}$ and $B_2 = \{(1,1,1),\ (1,1,0), (1,0,0)\}$.	1	1	**6**
	b)	Find the basis and dimension of the Image and Kernel of the linear transformation $F: R^4 \to R^3$ defined by $F(x,y,z,t) = (x - y + z + t,\ 2x - 2y + 3z + 4t,\ 3x - 3y + 4z + 5t)$.	1	1	**7**
	c)	Verify rank-nullity theorem for the linear transformation defined by the matrix $A = \begin{bmatrix} 1 & 1 & 2 & 3 \\ 3 & 4 & -1 & 2 \\ -1 & -2 & 5 & 4 \end{bmatrix}$.	1	1	**7**
		OR			
3	a)	Find the linear transformation $T: V_3(R) \to V_4(R)$ which maps $T(1,0,0) = (0,1,0,2), T(0,1,0) = (0,1,1,0)$ and $T(0,0,1) = (0,1,-1,4)$.	1	1	**6**
	b)	Show that $T: P_1(t) \to P_3(t)$ is a linear transformation if $T(at + b) = at^3 + bt^2 + at + b$ and hence find the image of $p(t) = 2 - t$.	1	1	**7**

		c)	Determine the basis and dimension of the null space of the linear transformation defined by $A = \begin{bmatrix} 1 & 4 & -1 & 3 \\ 2 & 9 & -1 & 7 \\ 2 & 8 & -2 & 6 \end{bmatrix}$.	1	1	**7**
			UNIT - 3			
4		a)	Find the eigenvalues and the corresponding eigenspaces of the linear operator $A = \begin{bmatrix} 5 & 0 \\ 2 & 1 \end{bmatrix}$.	1	1	**6**
		b)	Find the characteristic and minimal polynomial of the matrix $A = \begin{bmatrix} 2 & 5 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 & 0 \\ 0 & 0 & 4 & 2 & 0 \\ 0 & 0 & 3 & 5 & 0 \\ 0 & 0 & 0 & 0 & 7 \end{bmatrix}$.	1	1	**7**
		c)	Determine the Jordan canonical form for the matrix $\begin{bmatrix} 1 & 2 & 0 & 0 \\ 2 & 4 & 0 & 0 \\ 0 & 0 & -1 & 2 \\ 0 & 0 & 2 & -4 \end{bmatrix}$.	1	1	**7**
			OR			
5		a)	Find the eigenvalue and the corresponding eigenvectors of the linear transformation $T: V_2(R) \rightarrow V_2(R)$, given $A = \begin{pmatrix} 3 & 3 \\ 1 & 5 \end{pmatrix}$.	1	1	**6**
		b)	Apply Cayley-Hamilton theorem to find A^{-1} if $A = \begin{bmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -1 \end{bmatrix}$.	1	1	**7**
		c)	Compute the Jordan canonical form for the matrix $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & -2 \\ 0 & 1 & 3 \end{bmatrix}$.	1	1	**7**
			UNIT - 4			
6		a)	Find the projection of $(1,2,3)$ on to the subspace W spanned by $S = \{u_1, u_2\}$ where $u_1 = (2,5,-1)$ and $u_2 = (-2,1,1)$.	1	1	**5**
		b)	Find the equation of line that will be best approximation of the points $(-3,70), (1,21), (-7,110)$ and $(5,-35)$ using the method of least squares.	2	1	**7**
		c)	Determine the QR-decomposition of the matrix $A = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 0 & 3 \\ 1 & -1 & 4 \end{bmatrix}$.	2	1	**8**
			UNIT- 5			
7		a)	Orthogonally diagonalize the matrix $A = \begin{bmatrix} 3 & -2 & 4 \\ -2 & 6 & 2 \\ 4 & 2 & 3 \end{bmatrix}$.	2	1	**10**
		b)	Find the singular value decomposition of $A = \begin{bmatrix} 4 & 11 & 14 \\ 8 & 7 & -2 \end{bmatrix}$.	2	1	**10**

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