

Q.P Code D133863	Total Pages 3	Name 672150
		Register No.
THIRD SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2025		
(CUFYUGP)		
MAT3CJ202 / MAT3MN200 Matrix Algebra		
2024 Admission Onwards		
Maximum Time :2 Hours		Maximum Marks :70

Section A

All Question can be answered. Each Question carries 3 marks (Ceiling: 24 Marks)

1	Mark on the graph the solution of the linear equations $2x + y = 8$, $-x + 5y = 10$.
2	For what values of h, k is the system $2x - y = h$, $-6x - 3y = k$ consistent?
3	Find the set of all solutions of $2x_1 + 3x_2 + 4x_3 = 0$.
4	Determine whether the set $\left\{ \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 3 \\ 4 \end{bmatrix} \right\}$ is linearly independent.
5	Determine whether the map $\mathbf{T} : \mathbb{R}^2 \rightarrow \mathbb{R}^2$, $\mathbf{T} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} a + 2 \\ a - 2 \end{bmatrix}$ is linear.
6	Assume \mathbf{T} is linear and $\mathbf{T} : \mathbb{R}^3 \rightarrow \mathbb{R}^2$ with $\mathbf{T}(e_1) = (1, 3)$, $\mathbf{T}(e_2) = (4, -7)$, $\mathbf{T}(e_3) = (-5, 4)$. Find the standard matrix of \mathbf{T} .
7	Let $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 4 & 5 \end{bmatrix}$. Find a 3×3 matrix B , not I or 0 , such that $AB = BA$.
8	Determine whether $S = \left\{ \begin{bmatrix} a \\ b \\ c \end{bmatrix} \in \mathbb{R}^3 : a + b + c = 2 \right\}$ is a subspace of \mathbb{R}^3 .
9	Determine the eigenvalues of $A = \begin{bmatrix} 3 & -2 \\ 1 & -1 \end{bmatrix}$.
10	Let A be a 3×3 matrix with eigenvalues $1, 2, 3$. Is A diagonalizable? Give reasons.

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Section B

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All Question can be answered. Each Question carries 6 marks (Ceiling: 36 Marks)

11	Let $A = \begin{bmatrix} 1 & 3 & 4 \\ -4 & 2 & -6 \\ -3 & -2 & -7 \end{bmatrix}$, $B = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix}$. Is $A\mathbf{x} = B$ consistent for all b_1, b_2, b_3 ? Explain
12	Suppose $\{\mathbf{v}_1, \mathbf{v}_2\}$ is linearly independent in \mathbb{R}^n . Show $\{\mathbf{v}_1, \mathbf{v}_1 + \mathbf{v}_2\}$ is also linearly independent.
13	Let $\mathbf{T} : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ be linear with $\mathbf{T}(x_1, x_2) = (x_1 + x_2, 4x_1 + 5x_2)$. Find $\mathbf{x} = (x_1, x_2)$ such that $\mathbf{T}(\mathbf{x}) = (3, 8)$.
14	Find A^{-1} for $A = \begin{bmatrix} 3 & 3 & 3 \\ 2 & 3 & 1 \\ 2 & 5 & 1 \end{bmatrix}$.
15	Determine whether $\mathbf{w} = \begin{bmatrix} 1 \\ 3 \\ -4 \end{bmatrix}$ is in $\text{Nul}(A)$ for $A = \begin{bmatrix} 3 & -5 & -3 \\ 6 & -2 & 0 \\ -8 & 4 & 1 \end{bmatrix}$.
16	Find the eigenvalues of $A = \begin{bmatrix} -2 & 0 & -2 \\ 0 & 4 & 0 \\ -2 & 0 & 5 \end{bmatrix}$.
17	Find the eigenvectors of $A = \begin{bmatrix} 7 & 4 \\ -3 & -1 \end{bmatrix}$.
18	Let $\mathbf{T} : \mathbb{R}^3 \rightarrow \mathbb{R}^3$ be the linear transformation that reflects each vector through the plane $x_2 = 0$. That is, $\mathbf{T}(\mathbf{x}_1, \mathbf{x}_2, \mathbf{x}_3) = (\mathbf{x}_1, -\mathbf{x}_2, \mathbf{x}_3)$. Find the standard matrix of \mathbf{T}

Section C

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Answer any ONE. Each Question carries 10 marks (1x10=10 Marks)

19	Let $A = \begin{bmatrix} 2 & 0 & 6 \\ -1 & 8 & 5 \\ 1 & -2 & 1 \end{bmatrix}$ and $b = \begin{bmatrix} 10 \\ 3 \\ 3 \end{bmatrix}$. Denote the columns of A by $\{\mathbf{a}_1, \mathbf{a}_2, \mathbf{a}_3\}$. Show that $b \in \text{Span}\{\mathbf{a}_1, \mathbf{a}_2, \mathbf{a}_3\}$.
20	Diagonalize the matrix $A = \begin{bmatrix} 1 & 3 & 3 \\ -3 & -5 & -3 \\ 3 & 3 & 1 \end{bmatrix}$, if possible.