

MALABAR CHRISTIAN COLLEGE, CALICUT

Third Semester Internal Examination, September 2026

Major Course in Mathematics

MATRIX ALGEBRA

Time: 1 Hr

MAT3CJ202

Max Marks: 35

Name:	Marks Scored	Section A		Total Marks
		Section B		
		Section C		
Class:				

Section A

(Each question carries 3 marks, Max marks for section - 7)

- Express the vector equation $x_1 \begin{bmatrix} 1 \\ -2 \\ 3 \end{bmatrix} + x_2 \begin{bmatrix} 0 \\ 1 \\ 4 \end{bmatrix} = \begin{bmatrix} 5 \\ 2 \\ -1 \end{bmatrix}$ as a matrix equation of the form $Ax = b$.
- Suppose $\{v_1, v_2\}$ is linearly independent in $\mathbb{R}^n$. Show that $\{v_1, v_1 + v_2\}$ is also linearly independent.
- Assume T is linear and $T : \mathbb{R}^3 \rightarrow \mathbb{R}^3$ with $T(e_1) = (1, 3, -1)$, $T(e_2) = (-2, 1, 4)$, $T(e_3) = (1, -2, 5)$. Find the standard matrix of T .

Section B

(Each question carries 6 marks, Max marks for section - 18)

- Determine if the columns of the matrix $A = \begin{bmatrix} 1 & 0 & -3 \\ 0 & 1 & 3 \\ -2 & 3 & 4 \end{bmatrix}$ span $\mathbb{R}^3$.
- Describe all solution of the homogeneous system $Ax = 0$ in parametric vector form, where A is row equivalent to the given matrix

$$\begin{bmatrix} 1 & 3 & -5 \\ 1 & 4 & -8 \end{bmatrix}$$

- Determine whether the following vectors are linearly dependent or linearly independent. Give reasons

$$(a) \begin{bmatrix} 4 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ 8 \end{bmatrix}, \begin{bmatrix} 1 \\ 3 \end{bmatrix}, \begin{bmatrix} -1 \\ 3 \end{bmatrix} \quad (b) \begin{bmatrix} 1 \\ 4 \\ 8 \end{bmatrix}, \begin{bmatrix} 2 \\ 6 \\ 3 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} \quad (c) \begin{bmatrix} -16 \\ 8 \\ -12 \end{bmatrix}, \begin{bmatrix} 4 \\ -2 \\ -3 \end{bmatrix}$$

- Determine the value of h such that the matrix is the augmented matrix of a consistent linear system

$$\begin{bmatrix} 1 & h & 4 \\ 3 & 6 & 8 \end{bmatrix}$$

Section C

(Answer any one question, Each question carries 10 marks)

8. (a) Determine if the set of vectors

$$\left\{ \begin{bmatrix} 0 \\ 3 \\ -1 \\ 1 \end{bmatrix}, \begin{bmatrix} -8 \\ -7 \\ 5 \\ -3 \end{bmatrix}, \begin{bmatrix} 5 \\ 4 \\ -4 \\ 2 \end{bmatrix} \right\}$$

is linearly independent.

- (b) Let $T : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ be a linear transformation such that $T(e_1) = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$, $T(e_2) = \begin{bmatrix} -1 \\ 5 \end{bmatrix}$, where e_1, e_2 are the columns of the 2×2 identity matrix. Find the image of $\begin{bmatrix} 4 \\ -2 \end{bmatrix}$ under T .

9. Consider the system of linear equations

$$x_1 + 2x_2 - 3x_3 = 4$$

$$2x_1 + 5x_2 - 8x_3 = 7$$

$$x_1 + 3x_2 - 5x_3 = b$$

- (a) For what values of b is the system consistent
(b) Find the general solution of the system when it is consistent.