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### 18/SCI01/074

#### **QUESTIONS**

- 1). Explain with 2 examples what you understand by linear transformation.
- 2). Given a linear transformation of a matrix operator A on a vector x, compute T(x) if A=(1,9,3), (-2,6,7), (0,-1,3) and

x= 1

4

-8

3). Define completely with mathematical examples what you understand by Rank of a matrix.

### SOLUTION

1. A linear transformation is a unction from one vector space to another that respects the underlying (linear) structure of each vector pace. It is also known as a linear operator or map.

#### Examples

(a.) The **expected value** of a random variable( which is in fact a function, and a member of a vector space)

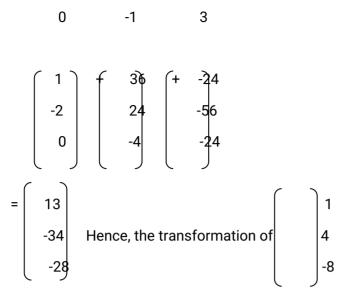
$$E(X + Y) = E(x) + E(Y)$$
 and  $E[aX] = aE[X]$ .

(b.) An identity map on any module is a linear transformation.

2. 
$$\begin{pmatrix} 1 & 9 & 3 \\ -2 & 6 & 7 \\ 0 & -1 & 3 \end{pmatrix} \qquad X = \begin{pmatrix} 1 & 1 & 1 \\ 4 & 1 & 1 \\ -8 & 1 & 1 \end{pmatrix}$$

$$T(x) = A(x)$$

$$T(x) = 1 \begin{pmatrix} 1 \\ -2 \end{pmatrix} + 4 + 9 & -8 \\ 6 & 6 \end{pmatrix} = 7$$



3. The rank of a matrix is defined as the maximum number of linearly independent column vector in the matrix or maximum number of linearly independent roe vector in the matrix.

# Example

Since  $|A| \neq 0$ , The Rank of A is 3

Note: But if the determinant of the matrix is equal to 0 then we delete arrow and column of the 3  $\times$  3 matrix forming a 2  $\times$  2 matrix then we find the determinant of the matrix. If we get an answer not equal to 0 then the matrix of rank 2