

# LINEAR ALGEBRA AND ITS APPLICATIONS UE19MA251

#### **Linear Transformations**



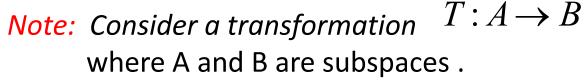
#### **Definition**:

A transformation T is said to be linear if it satisfy the rule of linearity.

i.e., A(cx+dy) = c A(x) + d A(y) for any scalar c,d are real constants.

#### **Linear Transformations**

**Example:** In linear system of equations Ax = b, Matrix A is a transformation from  $R^n$  to  $R^m$ .



- 1. A is the domain of the transformation.
- 2. B is the co domain of the transformation.
- 3. For any x in A, there exist Tx in B, here Tx is the image of T and x is the pre image of Tx



#### **Linear Transformations**



- 4. The set of all images is the subset of B is called Range of the transformation.
- 5. For all x in A such that Tx = 0 is called the Kernel of the transformation.
- 6. Dimension of the range is called rank and dimension of Kernel is called nullity.

#### **Linear Transformations**



# **Definition**:

The space of all polynomials in t of degree n is a vector space called the *polynomial space* denoted by  $P_n$ .  $P_n = \{ \text{ Its basis is } 1, t, t^2, ...., t^n \text{ and dimension is } n+1 .... \}$ 

#### **Linear Transformations**

Example 1: The operation of differentiation is linear. It takes  $P_{n+1}$  to  $P_n$ . The column space is the whole of  $P_n$  and the null space is  $P_0$ , the 1-dimensional space of all constants.



is linear. It takes  $P_n$  to  $P_{n+1}$ . The column space is a subspace of  $P_{n+1}$  and the null space is just the zero vector.



#### **Linear Transformations**

### Example 3:

Multiplication by a fixed polynomial, say 3 + 4t is also a linear transformation.

Let p(t) = 
$$a_0 + a_1 t + a_2 t^2 + .... + a_n t^n$$
 then

A p(t) = 
$$(3+4t)$$
 p(t) =  $3a_0 + ... + 4a_n t^{n+1}$ .

This A sends  $P_n$  to  $P_{n+1}$ .





# **THANK YOU**