## **VECTOR ALGEBRA**

## **Vector and Scalar**

(i) **Scalar** quantity is a quantity having magnitude but no direction. e.g. work,volume, time, mass, length, etc.

(ii) **Vector** quantity is a quantity having both direction and magnitude. e.g. displacement, force, velocity, momentum, etc.

## **Representation of Vectors**

A vector is often denoted by two letters with an arrow over it, i.e.  $\overrightarrow{AB}$ . A is called the origin and B the terminus. Its magnitude is given by the length AB and direction is from A to B as indicated by the arrow, we write vector quantities also in Stock letter notation like **a**, **b**, **c** and the corresponding letters a, b, c shows the remaining itude.



## **Types of Vectors**

#### 1. Zero or Null vector :

A vector, whose initial and terminal points coincides is called zero or null vector. Thus, the modulus of the null vector is zero and it is denoted by  $\mathbf{0}$  or  $\mathbf{\vec{0}}$ . Vectors other than the null vector are called proper vectors.

#### 2. Unit vector:

A vector, whose magnitude is of unit length is called a unit vector. If **a** is a vector whose magnitude is *a*, then unit vector in the direction of **a** is denoted by  $\hat{\mathbf{a}}$  and is obtained by dividing the vector **a** by its magnitude  $|\hat{\mathbf{a}}|$ .

Thus, 
$$\hat{\mathbf{a}} = \frac{\mathbf{a}}{|\mathbf{a}|}$$

#### 3. Coinitial vectors:

Vectors having the same initial point are called coinitial vectors.

#### 4. Collinear or parallel vectors:

The vectors which are parallel to the same straight line.

#### 5. Coplanar vectors:

Three or more vectors are said to be coplanar when they are parallel to the same plane otherwise they are said to be non-coplanar vector whatever their magnitudes be.

#### 6. Coterminous vectors:

7. Negative of a vector:

Vectors having the same terminal points are called coterminors octors.

#### 8. Reciprocal of a vector:

A vector having the same direction as that of a given vector **a** but magnitude is equal to the reciprocal of the given vector, **a** and is denoted by **a**<sup>-1</sup>.

If 
$$|a| = a$$
, then  $|a^{-1}| = \frac{1}{a}$ 

## Addition of Vectors

The addition of two vectors **a** and **b** is denoted by **a+b** and it is known as resultant of **a** and **b**.

There are three methods of addition of vectors

## Coplanarity of Four points

Four points with position vectors **a**, **b**, **c** and **d** are coplanar, if and only if there exist scalars x, y, z, w not all zero such that

xa+yb+zc+wd=0, where x+y+z+w=0.

## Distance between Two points

Let  $P(x_1, y_1, z_1)$  and  $Q(x_2, y_2, z_2)$  be two points. Then, the distance between two points is given by

$$PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

# Section Formulae Let A and B be two points with position vectors are bacespectively and let C be a point dividing (i) AB internally in the ratio min. Then, the position vector of C is given by Page

(ii) AB externally in the ratio m:n. Then, the position vector of C is given by

$$\mathbf{OC} = \frac{\mathbf{mb} - \mathbf{na}}{\mathbf{m} - \mathbf{n}}$$

(iii) If C is the midpoint of AB, then it divides AB in the ratio 1:1. Then position vector of C is given by

$$0C = \frac{a+b}{2}$$