

Equation of Unit Vector

1 12th Maths - Chapter 11

This is Problem-2 from Exercise 3.2

1. Find the vector equation of a plane which is at a distance of 7 units from the origin and normal to the vector $3\hat{i} + 5\hat{j} - 6\hat{k}$

2 Solution

Normal vector to the plane is

$$\mathbf{c} = \begin{pmatrix} 3 \\ 5 \\ -6 \end{pmatrix} \quad (1)$$

unit vector

$$\hat{\mathbf{c}} = \frac{1}{\|\mathbf{c}\|} \mathbf{c} \quad (2)$$

$$\|\mathbf{c}\| = \sqrt{\mathbf{c}^\top \mathbf{c}} \quad (3)$$

$$= \sqrt{(3 \ 5 \ -6) \begin{pmatrix} 3 \\ 5 \\ -6 \end{pmatrix}} \quad (4)$$

$$= \sqrt{70} \quad (5)$$

$$\hat{\mathbf{c}} = \frac{1}{\sqrt{70}} \begin{pmatrix} 3 \\ 5 \\ -6 \end{pmatrix} \quad (6)$$

The vector equation of a plane Perpendicular to vector $3\hat{i} + 5\hat{j} - 6\hat{k}$ and at a distance of 7 units from origin is

$$\mathbf{r} \cdot \mathbf{n} = d \quad (7)$$

$$(8)$$

Where,

$$\mathbf{r} = \begin{pmatrix} x \\ y \\ z \end{pmatrix} \quad (9)$$

$$\hat{\mathbf{n}} = \frac{1}{\sqrt{70}} \begin{pmatrix} 3 \\ 5 \\ -6 \end{pmatrix} \quad (10)$$

$$d = 7 \quad (11)$$

$$(12)$$

Hences,

$$(x \ y \ z) \begin{pmatrix} 3 \\ 5 \\ -6 \end{pmatrix} = \sqrt{70} \times 7 \quad (13)$$