CHAPTER-10
VECTOR ALGEBRA

# Excercise 10.3

Q10.If $\mathbf{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}, \mathbf{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\mathbf{c} = 3\hat{i} + \hat{j}$ are such that $\mathbf{a} + \lambda\mathbf{b}$ is perpendicular to $\mathbf{c}$, then find the value of $\lambda$.

**Solution:**

Now we know,

$$(\mathbf{a} + \lambda\mathbf{b})^\top \mathbf{c} = 0 \tag{1}$$
$$\mathbf{a}^\top \mathbf{c} + \lambda\mathbf{b}^\top \mathbf{c} = 0 \tag{2}$$
$$\lambda\mathbf{b}^\top \mathbf{c} = -\mathbf{a}^\top \mathbf{c} \tag{3}$$
$$\lambda(\mathbf{b}^\top \mathbf{c})(\mathbf{b}^\top \mathbf{c})^{-1} = -(\mathbf{a}^\top \mathbf{c})(\mathbf{b}^\top \mathbf{c})^{-1} \tag{4}$$
$$\lambda = -(\mathbf{a}^\top \mathbf{c})(\mathbf{b}^\top \mathbf{c})^{-1} \tag{5}$$

Now substituting the values

$$\mathbf{a}^\top \mathbf{c} = \begin{pmatrix} 2 & 2 & 3 \end{pmatrix} \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix} = 8 \tag{6}$$

$$\mathbf{b}^\top \mathbf{c} = \begin{pmatrix} -1 & 2 & 1 \end{pmatrix} \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix} = -1 \tag{7}$$

$$\tag{8}$$

Hence,

$$\lambda = -(\mathbf{a}^\top \mathbf{c})(\mathbf{b}^\top \mathbf{c})^{-1} \tag{9}$$
$$= -(8)(-1)^{-1} \tag{10}$$
$$= 8 \tag{11}$$