1.10.25

EE25BTECH11059 - Vaishnavi Ramkrishna Anantheertha

Question: If a line makes angles 90°, 60°, and 30° with the positive directions of the X, Y, and Z axes respectively, find its direction cosines.

Solution:

Definition of Direction Cosines: Direction cosines are the cosine values of the angles a vector makes with the x, y, and z axes; they are the components of the unit vector along x,y,z axes

Angle (α)	$\cos(\alpha)$	Value	Axis
90°	$\cos(90^\circ) = 0$	$l = 0$	x-axis
60°	$\cos(60^\circ) = \frac{1}{2}$	$m = \frac{1}{2}$	y-axis
30°	$\cos(30^\circ) = \frac{\sqrt{3}}{2}$	$n = \frac{\sqrt{3}}{2}$	z-axis

TABLE 0: Variables Used

Let the direction cosines be l,m,n
l,m,n, which are the cosines of the angles that the line makes with the X, Y, and Z axes respectively.

$$l = \cos(90^\circ) = 0 \tag{0.1}$$

$$m = \cos(60^\circ) = \frac{1}{2} \tag{0.2}$$

$$n = \cos(30^\circ) = \frac{\sqrt{3}}{2} \tag{0.3}$$

A key property is that the sum of the squares of the direction cosines equals1:

$$l^2 + m^2 + n^2 = 1$$

$$\text{unit vector in direction of} \mathbf{x} = \begin{pmatrix} 0 \\ \frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{pmatrix} \tag{0.4}$$

Refer to Figure

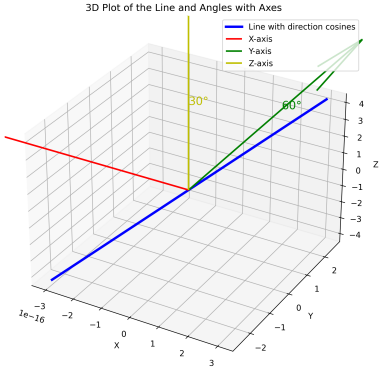
3D Plot of the Line and Angles with Axes
Line with direction cosines
X-axis
Y-axis
Z-axis
30°
60°
X
Y
Z
1e−16

Fig. 0.1