

1-1.11-3

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Question: If a line makes 60° and 45° angles with the positive directions of the X-axis and Z-axis respectively, then find the angle that it makes with the positive direction of the Y-axis. Hence, write the direction cosines of the line.

Solution: Let α , β and γ be the angles made by the line with the X, Y and Z axes respectively. Now the unit direction vector \mathbf{x} can be expressed as

$$\mathbf{x} = \begin{pmatrix} \cos \alpha \\ \cos \beta \\ \cos \gamma \end{pmatrix}$$

Now, since \mathbf{x} is a unit vector

$$\begin{aligned} \|\mathbf{x}\| &= 1 \\ \sqrt{\mathbf{x}\mathbf{x}^T} &= 1 \end{aligned}$$

Substituting value of \mathbf{x}

$$\begin{aligned} \cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma &= 1 \\ \frac{1}{4} + \cos^2 \beta + \frac{1}{2} &= 1 \\ \cos^2 \beta &= \frac{1}{4} \\ \beta &= 60^\circ \end{aligned}$$

Hence the direction cosines are

$$\mathbf{x} = \begin{pmatrix} \cos \alpha \\ \cos \beta \\ \cos \gamma \end{pmatrix} = \begin{pmatrix} \cos 60^\circ \\ \cos 60^\circ \\ \cos 45^\circ \end{pmatrix} = \begin{pmatrix} \frac{1}{2} \\ \frac{1}{2} \\ \frac{1}{\sqrt{2}} \end{pmatrix}$$

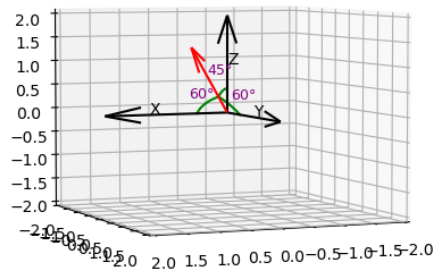


Fig. 0: Plot of the described vector

Console output:

```
/mnt/Data/Classwork/EE1030/Question_5/Codes> python3 main.py
Taking angle between
vector and X-axis as alpha = 60 degrees
vector and Z-axis as gamma = 45 degrees
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Found cosines to be:

Cos alpha: 0.5000007660251953

Cos beta: 0.4999985705747263

Cos gamma: 0.7071072502792263

Code for this plot can be found at:

Codes/main.py
Codes/main.c