# 4.3.13

## EE25BTECH11026-Harsha

**Question**:
Find the distance of the line $4x - y = 0$ from the point $P(4, 1)$ measured along the line making an angle of $135°$ with the positive x-axis.

**Solution:**
Let us solve the given question theoretically and then verify the solution computationally.

According to the question,

$$\textit{Equation of target line} \ : \ \begin{pmatrix} 4 & -1 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = 0 \tag{0.1}$$

and

$$\mathbf{P} = \begin{pmatrix} 4 \\ 1 \end{pmatrix} \tag{0.2}$$

As the direction of line makes an angle of $135°$ with the $+x$ axis, the unit direction vector of the line is given by

$$\mathbf{m} = \begin{pmatrix} \cos 135° \\ \sin 135° \end{pmatrix} = \begin{pmatrix} -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix} \tag{0.3}$$

Parametrize the required line using $\mathbf{P}$, yielding

$$\mathbf{x} = \mathbf{P} + \kappa\mathbf{m} \tag{0.4}$$

Inserting the parametric form in the equation of target line,

$$\begin{pmatrix} 4 & -1 \end{pmatrix}(\mathbf{P} + \kappa\mathbf{m}) = 0 \tag{0.5}$$

$$\therefore \kappa = \frac{-\begin{pmatrix} 4 & -1 \end{pmatrix}\begin{pmatrix} 4 \\ 1 \end{pmatrix}}{\begin{pmatrix} 4 & -1 \end{pmatrix}\begin{pmatrix} -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix}} \tag{0.6}$$

$$\implies \kappa = 3\sqrt{2} \tag{0.7}$$

Since **m** is a unit vector, the norm of vector **P** from the given line along the line with $\mathbf{m} = \left(-\frac{1}{\sqrt{2}} \quad \frac{1}{\sqrt{2}}\right)^\top$ is

$$\kappa = 3\sqrt{2} \ units \tag{0.8}$$

From the figure, it is clearly verified that the theoretical solution matches with the computational solution.