Assignment 3

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***Abstract*—This document explains the equation of a straight line, making an angle with the x-axis and passing through a given point.**

Download all python codes from

https://github.com/subhasishsaikia22/EE5609−Matrix−theory

and latex-tikz codes from

https://github.com/subhasishsaikia22/EE5609−Matrix−theory

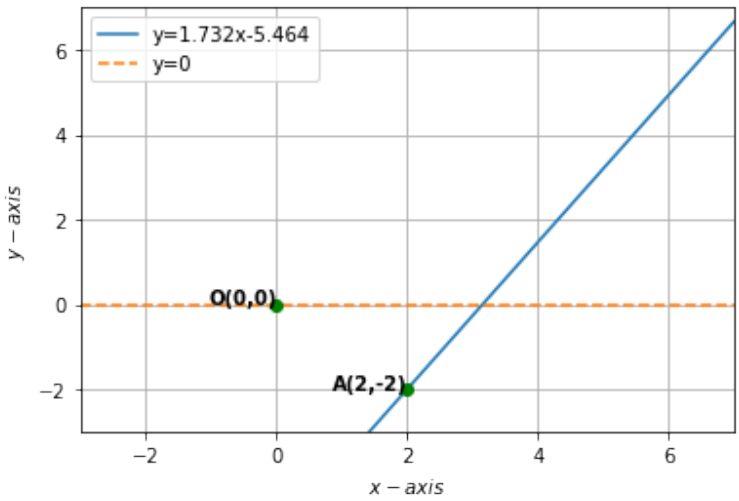

Fig. 1: This is the 2D diagram of the straight line passing through $\begin{pmatrix}2\\-2\end{pmatrix}$ and at an angle of 60° with the x axis

1 Problem

Find the equation of a straight line making an angle of 60° with OX and passing through the point $\begin{pmatrix}2\\-2\end{pmatrix}$. Transform the equation to the form

$$\begin{pmatrix}cos\alpha & sin\alpha\end{pmatrix}x = p \tag{1.0.1}$$

2 Explanation

Let the straight line pass through the point $\mathbf{A} = \begin{pmatrix}2\\-2\end{pmatrix}$ and makes an angle of 60° with x-axis. So slope of the line, $m = \tan 60° = \sqrt{3}$ and the direction vector $\begin{pmatrix}1\\m\end{pmatrix} = \begin{pmatrix}1\\\sqrt{3}\end{pmatrix}$.

The vector form of the line passing through the point $\mathbf{A} = \begin{pmatrix}2\\-2\end{pmatrix}$ along the direction vector $\begin{pmatrix}1\\\sqrt{3}\end{pmatrix}$ is given by:

$$\mathbf{X} = \begin{pmatrix}2\\-2\end{pmatrix} + \lambda_1\begin{pmatrix}1\\\sqrt{3}\end{pmatrix} \tag{2.0.1}$$

The normal vector

$$\mathbf{n} = \begin{pmatrix}0 & -1\\1 & 0\end{pmatrix}\begin{pmatrix}1\\m\end{pmatrix} = \begin{pmatrix}-\sqrt{3}\\1\end{pmatrix} \tag{2.0.2}$$

The equation of the line in terms of the normal vector is obtained as

$$\mathbf{n}^{\mathbf{T}}\left(x - A\right) = 0 \tag{2.0.3}$$

$$\begin{pmatrix}-\sqrt{3} & 1\end{pmatrix}x = \begin{pmatrix}-\sqrt{3} & 1\end{pmatrix}A \tag{2.0.4}$$

$$\begin{pmatrix}-\sqrt{3} & 1\end{pmatrix}x = \begin{pmatrix}-\sqrt{3} & 1\end{pmatrix}\begin{pmatrix}2\\-2\end{pmatrix} \tag{2.0.5}$$

$$\begin{pmatrix}-\sqrt{3} & 1\end{pmatrix}x = -2\sqrt{3} - 2 \tag{2.0.6}$$

$$\begin{pmatrix}\sqrt{3}/2 & -1/2\end{pmatrix}x = \sqrt{3} + 1 \tag{2.0.7}$$

$$\begin{pmatrix}cos330° & sin330°\end{pmatrix}x = 2.732 \tag{2.0.8}$$