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Assignment-5

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Problem Statement:

Construct the family of circles with fixed radius 5 units and center on the line y=2.

SOLUTION:

Given:

Radius of a circle is

r = 5

Center of circle lies on y=2

So,

$\beta = 2$

To Find

Constructing the family of circles with different values of α

STEP-1

Let r be the radius of circles which is given r=5 Let **O** be the center of circle and the coordinates are,

$$\mathbf{O} = \begin{pmatrix} \alpha \\ \beta \end{pmatrix} \tag{3}$$

From given, we know that $\beta = 2$

So,

$$\mathbf{O} = \begin{pmatrix} \alpha \\ 2 \end{pmatrix}$$

Let X be the any point on the circle

$$\mathbf{O} = \begin{pmatrix} \alpha \\ 2 \end{pmatrix}$$

$$\mathbf{X} = r \begin{pmatrix} \cos \theta \\ \sin \theta \end{pmatrix}$$

$$\mathbf{X} = r \begin{pmatrix} \cos \theta \\ \sin \theta \end{pmatrix}$$

STEP-2

The equation of circle is given by,

$$\|\mathbf{X} - \mathbf{O}\| = r$$

$$\sqrt{(\mathbf{X} - \mathbf{O})^{\top}(\mathbf{X} - \mathbf{O})} = r$$

Squaring on both the sides

$$(\sqrt{(\mathbf{X} - \mathbf{O})^{\top}(\mathbf{X} - \mathbf{O})})^2 = r^2$$

$$(\mathbf{X} - \mathbf{O})^{\top} (\mathbf{X} - \mathbf{O}) = r^2$$

Expanding the above equation,

$$\|\mathbf{X}\|^2 - 2\mathbf{X}^{\mathsf{T}}\mathbf{O} + \|\mathbf{O}\|^2 = r^2 \tag{7}$$

(1) **STEP-3**

Let θ be any angle from 0 to 2π

$$\theta \in [0, 2\pi) \tag{8}$$

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$$\theta = \frac{2\pi}{3}$$
 Using equation (5) any point on circle $\mathbf{X} = \begin{pmatrix} x \\ y \end{pmatrix}$ is,

Here,

$$x = r cos \theta \tag{10}$$

$$y = rsin\theta \tag{11}$$

$$\mathbf{X} = \begin{pmatrix} -2.5\\ 4.3301 \end{pmatrix} \tag{12}$$

Let α be any values ranging from 0 to 10 with the (4) incrementation of +2So,

$$\alpha = 0, 2, 4, 6, 8 \tag{13}$$

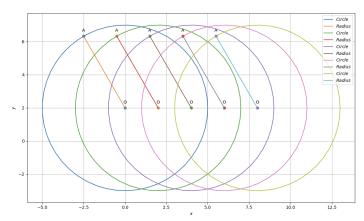
(5) If $\alpha = 0$,

$$\mathbf{O} = \begin{pmatrix} 0\\2 \end{pmatrix} \tag{14}$$

when $\alpha = 2$ and so on till $\alpha = 8$,

$$\mathbf{O} = \begin{pmatrix} 8\\2 \end{pmatrix} \tag{15}$$

(6)



${\bf Construction}$

vertex	coordinates
О	$\begin{pmatrix} \alpha \\ 2 \end{pmatrix}$
X	$\begin{pmatrix} x \\ y \end{pmatrix}$

Download the code Github link: Assignment-5.