

# Assignment-2(EE5600)

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**Abstract—This assignment deals with basic linear form.** where

Download tex file from

<https://github.com/satyam463/EE5600Ass1/blob/main/Assignment2.tex>

## 1 PROBLEM STATEMENT

### 1.1 Vector2, Example 4, Question No 6

Sketch the loci of the following equation

$$3x = y^2 - 9 \quad (1.1.1)$$

## 2 SOLUTION

Consider given equation

$$y^2 - 3x - 9 = 0 \quad (2.0.1)$$

2.0.1 can be expressed as

$$\mathbf{x}^T \mathbf{V} \mathbf{x} + 2\mathbf{u}^T \mathbf{x} + f = 0 \quad (2.0.2)$$

with parameters

$$\mathbf{V} = \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}, \mathbf{u} = \begin{pmatrix} -\frac{3}{2} \\ 0 \end{pmatrix}, f = -9 \quad (2.0.3)$$

$$|V| = 0 \quad (2.0.4)$$

Thus, the given curve is a parabola.  $\therefore \mathbf{V}$  is diagonal and in standard form. Using

$$\mathbf{x} = \mathbf{P}\mathbf{y} + \mathbf{c} \text{ (Affine Transformation)} \quad (2.0.5)$$

such that,

$$\mathbf{P}^T \mathbf{V} \mathbf{P} = \mathbf{D} \text{ (EigenValue Decomposition)} \quad (2.0.6)$$

$$\mathbf{P} = (\mathbf{p}_1 \ \mathbf{p}_2), \mathbf{P}^T = \mathbf{P}^{-1} \quad (2.0.7)$$

The vertex of parabola can be given as  $\mathbf{c}$

$$\begin{pmatrix} \mathbf{u}^T + \eta \mathbf{p}_1^T \\ V \end{pmatrix} \mathbf{c} = \begin{pmatrix} -f \\ \eta \mathbf{p}_1 - \mathbf{u} \end{pmatrix} \quad (2.0.8)$$

$$\eta = \mathbf{p}_1^T \mathbf{u}, \mathbf{p}_1 = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \quad (2.0.9)$$

$$\begin{pmatrix} -3 & 0 \\ 0 & 1 \end{pmatrix} \mathbf{c} = \begin{pmatrix} 9 \\ 0 \end{pmatrix} \quad (2.0.10)$$

$$\begin{pmatrix} -3 & 0 \\ 0 & 1 \end{pmatrix} \mathbf{c} = \begin{pmatrix} 9 \\ 0 \end{pmatrix} \quad (2.0.11)$$

$$\mathbf{c} = \begin{pmatrix} -3 \\ 0 \end{pmatrix} \quad (2.0.12)$$

Using 2.0.5 and 2.0.7 we can write

$$\mathbf{y} = \mathbf{P}^{-1} (\mathbf{x} - \mathbf{c}) \implies \mathbf{y} = \mathbf{P}^T (\mathbf{x} - \mathbf{c}) \quad (2.0.13)$$

$$\mathbf{x} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \implies \mathbf{y} = \begin{pmatrix} 3 \\ 0 \end{pmatrix} \quad (2.0.14)$$

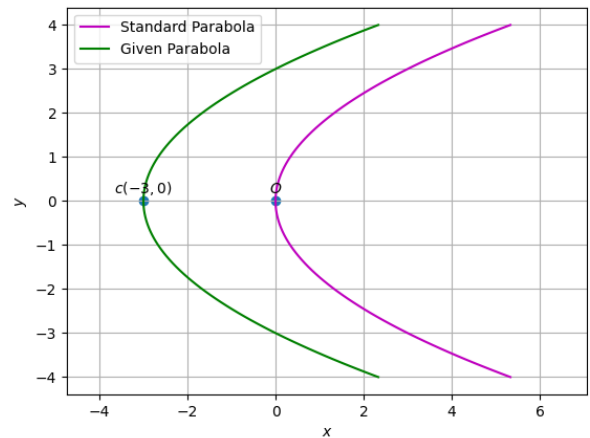


Fig. 0: Given parabola with vertex  $\mathbf{c} = \begin{pmatrix} -3 \\ 0 \end{pmatrix}$  and Standard Parabola with vertex  $\mathbf{O} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$