

# EE5609 Assignment 5

SHANTANU YADAV, EE20MTECH12001

## 1 PROBLEM

Find the value of  $k$  so that the following equation may represent pairs of straight lines.

$$12x^2 + xy - 6y^2 - 29x + 8y + k = 0$$

## 2 EXPLANATION

The general equation of second degree is given by

$$ax^2 + 2bxy + cy^2 + 2dx + 2ey + f = 0 \quad (2.0.1)$$

and can be expressed as

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

where

$$\mathbf{V} = \mathbf{V}^T = \begin{pmatrix} a & b \\ b & c \end{pmatrix} \quad (2.0.3)$$

$$\mathbf{u}^T = \begin{pmatrix} d & e \end{pmatrix} \quad (2.0.4)$$

(2.0.1) represents a pair of straight lines if

$$\begin{vmatrix} \mathbf{V} & \mathbf{u} \\ \mathbf{u}^T & f \end{vmatrix} = 0 \quad (2.0.5)$$

## 3 SOLUTION

From (2.0.1) and (2.0.5)

$$\begin{vmatrix} 12 & 0.5 & -14.5 \\ 0.5 & -6 & 4 \\ -14.5 & 4 & k \end{vmatrix} = 0 \quad (3.0.1)$$

$$\Rightarrow 12 \begin{vmatrix} -6 & 4 \\ 4 & k \end{vmatrix} - 0.5 \begin{vmatrix} 0.5 & 4 \\ -14.5 & k \end{vmatrix} - 14.5 \begin{vmatrix} 0.5 & -6 \\ -14.5 & 4 \end{vmatrix} = 0 \quad (3.0.2)$$

$$\Rightarrow k = 14 \quad (3.0.3)$$