

# Assignment 6: 4.3.45

EE25BTECH11055 - Subhodeep Chakraborty

**Question:**

Find the coordinates of the point where the line through (5, 1, 6) and (3, 4, 1) crosses the  $YX$ -plane.

**Solution:**

Given:

$$\mathbf{A} = \begin{pmatrix} 5 \\ 1 \\ 6 \end{pmatrix} \quad (1)$$

$$\mathbf{B} = \begin{pmatrix} 3 \\ 4 \\ 1 \end{pmatrix} \quad (2)$$

We know,

$$\mathbf{x} = \mathbf{h} + k\mathbf{m} \quad (3)$$

$$= \mathbf{A} + k(\mathbf{B} - \mathbf{A}) \quad (4)$$

$$\mathbf{e}_3^\top \mathbf{x} = 0 \quad (5)$$

Thus

$$\mathbf{e}_3^\top \mathbf{A} + k\mathbf{e}_3^\top (\mathbf{B} - \mathbf{A}) = 0 \quad (6)$$

$$k = \frac{\mathbf{e}_3^\top \mathbf{A}}{\mathbf{e}_3^\top \mathbf{A} - \mathbf{e}_3^\top \mathbf{B}} \quad (7)$$

$$\mathbf{x} = \mathbf{A} + \frac{\mathbf{e}_3^\top \mathbf{A}}{\mathbf{e}_3^\top \mathbf{A} - \mathbf{e}_3^\top \mathbf{B}} (\mathbf{B} - \mathbf{A}) \quad (8)$$

Solving

$$\mathbf{e}_3^\top \mathbf{A} = 6 \quad (9)$$

$$\mathbf{e}_3^\top \mathbf{B} = 1 \quad (10)$$

$$\mathbf{x} = \begin{pmatrix} 5 - 2 \times \frac{6}{5} \\ 1 + 3 \times \frac{6}{5} \\ 6 - 5 \times \frac{6}{5} \end{pmatrix} \quad (11)$$

$$\mathbf{x} = \begin{pmatrix} 13/5 \\ 23/5 \\ 0 \end{pmatrix} \quad (12)$$

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