LATEXASSIGNMENT1

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Question 1.3.3 D_1 is a point on BC such that The equation of line CF_1 $AD_1 \perp BC$ and AD_1 is defined to be the altitude. Find the equations of the altitude BE_1 and CF_1 to the sides AC and AB respectively.

Solution:

Given:

$$\mathbf{A} = \begin{pmatrix} 1 \\ -1 \end{pmatrix} \mathbf{B} = \begin{pmatrix} -4 \\ 6 \end{pmatrix} \mathbf{C} = \begin{pmatrix} -3 \\ -5 \end{pmatrix} \tag{1}$$

Direction vector

$$\mathbf{m}_{AB} = \mathbf{B} - \mathbf{A} \tag{2}$$

$$= \begin{pmatrix} 1 \\ -1 \end{pmatrix} - \begin{pmatrix} -4 \\ 6 \end{pmatrix} \tag{3}$$

$$= \begin{pmatrix} 5 \\ -7 \end{pmatrix} \tag{4}$$

$$\mathbf{m}_{AC} = \mathbf{C} - \mathbf{A} \tag{5}$$

$$= \begin{pmatrix} 1 \\ -1 \end{pmatrix} - \begin{pmatrix} -3 \\ -5 \end{pmatrix} \tag{6}$$

$$= \begin{pmatrix} 4\\4 \end{pmatrix} \tag{7}$$

Normal vector

$$\mathbf{n} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \mathbf{m} \tag{8}$$

$$\mathbf{n}_{AB} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} 5 \\ -7 \end{pmatrix} \tag{9}$$

$$= \begin{pmatrix} 7 \\ 5 \end{pmatrix} \tag{10}$$

$$\mathbf{n}_{AC} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} 4 \\ 4 \end{pmatrix} \tag{11}$$

$$= \begin{pmatrix} 4 \\ -4 \end{pmatrix} \tag{12}$$

Equation of line is represented by:

$$\mathbf{n}^{\mathsf{T}}(\mathbf{x} - \mathbf{p}) = 0 \tag{13}$$

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$$\mathbf{n}_{AB}^{\mathsf{T}}(\mathbf{x} - \mathbf{C}) = 0 \tag{14}$$

$$\begin{pmatrix} -7 \\ 5 \end{pmatrix}^{\mathsf{T}} (\mathbf{x} - \begin{pmatrix} -3 \\ -5 \end{pmatrix}) = 0 \tag{15}$$

$$\left(-7 \quad 5\right)\left(\mathbf{x} - \begin{pmatrix} -3\\ -5 \end{pmatrix}\right) = 0 \tag{16}$$

The equation of line BE_1

$$\mathbf{n}_{AC}^{\mathsf{T}}(\mathbf{x} - \mathbf{B}) = 0 \tag{17}$$

$$\begin{pmatrix} 4 \\ -4 \end{pmatrix}^{\mathsf{T}} (\mathbf{x} - \begin{pmatrix} -4 \\ 6 \end{pmatrix}) = 0 \tag{18}$$

$$\left(4 \quad -4\right)\left(\mathbf{x} - \begin{pmatrix} -4\\6 \end{pmatrix}\right) = 0 \tag{19}$$