

**ENGR121 Assignment 8 (Final Marked Assignment, asst 9 is not marked)**

**DUE: 11:59pm Wednesday 29 May 2024**

$$\mathbf{u} = \begin{bmatrix} 1 \\ -3 \end{bmatrix} \quad \mathbf{v} = \begin{bmatrix} 4 \\ 2 \end{bmatrix} \quad \mathbf{a} = \begin{bmatrix} 2 \\ 2 \\ 6 \end{bmatrix} \quad \mathbf{b} = \begin{bmatrix} -2 \\ 1 \\ -3 \end{bmatrix} \quad A = \begin{bmatrix} 2 & -1 & 6 \\ -4 & 2 & 3 \end{bmatrix} \quad B = \begin{bmatrix} 2 & -2 & 1 \\ 0 & -1 & -3 \end{bmatrix} \quad C = \begin{bmatrix} 1 & -3 \\ -1 & 3 \end{bmatrix}$$

1. Find (where possible) the following:

(a)  $|\mathbf{u}|$

(g)  $\mathbf{a} \cdot \mathbf{b}$

(b)  $|\mathbf{b}|$

(h)  $\mathbf{a} \cdot \mathbf{v}$

(c)  $\mathbf{u} - \mathbf{v}$

(i)  $\mathbf{u} \cdot \mathbf{v}$

(d)  $\mathbf{u} + \mathbf{b}$

(j) angle between  $\mathbf{u}$  and  $\mathbf{v}$

(e)  $\mathbf{a} + \mathbf{b}$

(k) Unit vector in the direction of  $\mathbf{a}$

(f)  $3\mathbf{a} - 2\mathbf{b}$

2. What is a vector equation for the line containing the point  $P(2, 3)$  which is parallel to the line

$$\mathbf{a}(t) = \begin{bmatrix} -1 \\ 0 \end{bmatrix} + t \begin{bmatrix} -2 \\ 1 \end{bmatrix}?$$

3. What is the perpendicular distance between the point  $P(2, 3)$  and the line

$$\mathbf{a}(t) = \begin{bmatrix} 2 \\ 1 \end{bmatrix} + t \begin{bmatrix} -1 \\ 1 \end{bmatrix}?$$

4. What is the normal equation of the plane containing point  $A(2, 1, 3)$  with the normal vector

$$\mathbf{n} = \begin{bmatrix} 3 \\ -4 \\ 2 \end{bmatrix}?$$

5.  $\mathbf{c} = \begin{bmatrix} 2 \\ 0 \\ 9 \end{bmatrix}$  and  $\mathbf{d} = \begin{bmatrix} -3 \\ 2 \\ -2 \end{bmatrix}$ . Find the cross product of  $\mathbf{c}$  and  $\mathbf{d}$ .

6.  $\mathbf{e} = \begin{bmatrix} 5 \\ -8 \\ 12 \end{bmatrix}$  and  $\mathbf{f} = \begin{bmatrix} -15 \\ 24 \\ -36 \end{bmatrix}$ .

Find the cross product of  $\mathbf{e}$  and  $\mathbf{f}$ . Why should this answer not surprise us?

7. What is the area of the parallelogram with sides given by  $4\mathbf{i} + 5\mathbf{j} + 2\mathbf{k}$  and  $7\mathbf{i} + 1\mathbf{j} - 9\mathbf{k}$ ?

8.  $X = \begin{bmatrix} 3 & 2 \\ -4 & 5 \end{bmatrix}$  Find  $\det(X)$  and hence  $X^{-1}$ .

9. Find (where possible) the following (show working where appropriate):

(a)  $A + B$

(g)  $CB$

(b)  $3B$

(h)  $B\mathbf{u}$

(c)  $A^T + B^T$

(i)  $C\mathbf{u}$

(d)  $(A + B)^T$

(j)  $\det(C)$

(e)  $CA$

(k)  $C^{-1}$

(f)  $AC$