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Electrical Electronics
19/ENG01/002
MAT 102

$A = 2i - j,\ B = 3i + j - 11k,\ C = 4i + 4j - 5k$

(i) $-3(A) + 7B - 8C$

$-3(2i - j) + 7(3i + j - 11k) - 8(4i + 4j - 5k)$

$= -6i + 3j + 21i + 7j - 77k - 32i - 32j + 40k$

$= -20i - 22j - 37k$

ii) $K = 2A + 4B - C$

$= 2(2i - j) + 4(3i + j - 11k) - (4i + 4j - 5k)$

$= 4i - 2j + 12i + 4j - 44k - 4i - 4j + 5k$

$K = \dfrac{12i - 2j - 39k}{|K| = \sqrt{(12)^2 + (-2)^2 + (-39)^2}}$

$|K| = 40.85$

$\cos x = \dfrac{12}{40.85}$

$$\cos\beta = \frac{-2}{40.85}$$

$$\cos\gamma = \frac{-39}{40.85}$$

(iii) $A \times (B \times C)$

$$B \times C = \begin{vmatrix} i & j & k \\ 3 & 1 & -11 \\ 4 & 4 & -5 \end{vmatrix}$$

$$= i\begin{vmatrix} 1 & -11 \\ 4 & -5 \end{vmatrix} - j\begin{vmatrix} 3 & -11 \\ 4 & -5 \end{vmatrix} + k\begin{vmatrix} 3 & 1 \\ 4 & 4 \end{vmatrix}$$

$= i(-5-(-44)) - j(-15-(-44)) + k(12-4)$

$= 39i - 29j + 8k$

$A \times (B \times C) = \begin{vmatrix} i & j & k \\ 2 & -1 & 0 \\ 39 & -29 & 8 \end{vmatrix}$

$= i\begin{vmatrix} -1 & 0 \\ -29 & 8 \end{vmatrix} - j\begin{vmatrix} 2 & 0 \\ 39 & 8 \end{vmatrix} + k\begin{vmatrix} 2 & -1 \\ 39 & -29 \end{vmatrix}$

$= i(-8-0) - j(16-0) + k(-58-(-39))$

$= -8i - 16j - 19k$

iv) $3A = 3(2i - j) = 6i - 3j$

$$3A \times B = \begin{vmatrix} i & j & k \\ 6 & -3 & 0 \\ 3 & 1 & -11 \end{vmatrix}$$

$$= i\begin{vmatrix} -3 & 0 \\ 1 & -11 \end{vmatrix} - j\begin{vmatrix} 6 & 0 \\ 3 & -11 \end{vmatrix} + k\begin{vmatrix} 6 & -3 \\ 3 & 1 \end{vmatrix}$$

$$= i(33 - 0) - j(-66 - 0) + k(6 + 9)$$

$$= 33i + 66j + 15k$$

$2B = 2(3i + j - 11k) = 6i + 2j - 22k$

$$A \times 2B = \begin{vmatrix} i & j & k \\ 2 & -1 & 0 \\ 6 & 2 & -22 \end{vmatrix}$$

$$= i\begin{vmatrix} -1 & 0 \\ 2 & -22 \end{vmatrix} - j\begin{vmatrix} 2 & 0 \\ 6 & -22 \end{vmatrix} + k\begin{vmatrix} 2 & -1 \\ 6 & 2 \end{vmatrix}$$

$$= i(22 - 0) - j(-44 - 0) + k(4 + 6)$$

$$= 22i - 44j + 10k$$

$$(3A \times B) \cdot (A \times 2B) = (33\hat{i} + 66\hat{j} + 15\hat{k}) \cdot (22\hat{i} - 44\hat{j} + 10\hat{k})$$

$$= 726 - 2904 + 150$$

$$= -2028$$

v. $A - 2B - C$

$= 2i - j + 2(3i + j - 11k) - (4i + 4j - 5k)$

$= 2i - j - 6i - 2j + 22k - 4i - 4j + 5k$

$= -8i - 7j + 27k$

2. i) Two vectors are said to be perpendicular when their dot product is equal to zero.

ii) Vectors are said to be co-planar if their scalar triple product is equal to zero.