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MECHATRONICS ENGINEERING
19/ENG05/045

MAT102

1) If $A = \cancel{5i-7j}\ 5i-7j-6k$, $B = j+4k$; $C = 9i-4j+k$

Find : $-8(A+B)\cdot(C-A)$

Solution

$-8(A+B) = -8(5i-7j-6k + j+4k)$.

$= -8(5i-6j-2k)$

$= -40i + \cancel{8}48j + 16k$

$C(C-A) = (9i-4j+k-5i+7j+6k)$.

$= 4i+3j+7k$.

$-8(A+B)\cdot(C-A)$

$= (-40i+48j+16k)\cdot(4i+3j+7k) = -160i+144j+112k$

$-8(A+B)\cdot(C-A) = \cancel{96}\ -160i+144j+112k$

2) Find ~~the~~ a unit vector tangent to the space curve.

$x = -3t$; $y = t^2$; $z = 4t^3$; at $\cancel{t=}\ t = 1$

$r = \cancel{-3ti+2t}\ -3ti + t^2j + 4t^3k$

$\frac{dr}{dt} = -3i + 2tj + 12t^2k$

at $t=1$; $\frac{dr}{dt} = -3i + 2j + 12k$

$\left|\frac{dr}{dt}\right|_{t=1} = \sqrt{(-3)^2 + (2^2) + (12)^2} = \sqrt{9+4+144} = \sqrt{157}$

$= 12.5$

$T = \frac{3i+2j+12k}{12.5}$

3) $x = -8t^2$; $y = t^2-4t$; $z = t+1$.

find $\frac{d^2A}{dt^2}$ (acceleration)?

$$\frac{dA}{dt} = -16t\,i + (2t-4)\,j + \cancel{2t}\,k$$

$$\frac{d^2A}{dt^2} = -16i + 2j$$

4) $A = i + 2j - 4k$; $B = 2i - 3j + k$. $C = 4j - 3k$.

$(A \times B) \times C$

$$(A \times B) = \begin{vmatrix} i & j & k \\ 1 & 2 & -4 \\ 2 & -3 & 1 \end{vmatrix}$$

$$= i\begin{vmatrix} 2 & -4 \\ -3 & 1 \end{vmatrix} - j\begin{vmatrix} 1 & -4 \\ 2 & 1 \end{vmatrix} + k\begin{vmatrix} 1 & 2 \\ 2 & -3 \end{vmatrix}$$

$$= i(2-12) - j(1+8) + k(-3-4)$$

$$= i(-10) - j(9) + k(-7).$$

$$(A \times B) = -10i - 9j - 7k$$

$$(A \times B) \times C = \cancel{\begin{vmatrix} i & j & k \\ 1 & 2 & -4 \\ -10 & -9 & -7 \end{vmatrix}} \quad \begin{vmatrix} i & j & k \\ -10 & -9 & -7 \\ 0 & 4 & -3 \end{vmatrix}$$

$$= i\begin{vmatrix} -9 & -7 \\ 4 & -3 \end{vmatrix} - j\begin{vmatrix} -10 & -7 \\ 0 & -3 \end{vmatrix} + k\begin{vmatrix} -10 & -9 \\ 0 & 4 \end{vmatrix}$$

$$= i(27+28) - j(30-0) + k(-40-0).$$

$$= i(55) - j(30) + k(-40).$$

$$(A \times B) \times C = 55i - 30j - 40k$$

5) $\int_0^1 R = \int_0^1 4\sin 3t\, i + 4e^{3t} j + 7t^3 k$

$= \left| -\frac{4}{3}\cos t\, i + \frac{4}{3} e^{3t} j + \frac{7t^4}{4} k \right|_0^1$

$= \left| \frac{-4}{3}\cos(1)\, i + \frac{4}{3} e^{3(1)} j + \frac{7(1)^4}{4} k \right|$

$\int_0^1 R = -\frac{4}{3}\cos i + \frac{4}{3} e^3 j + \frac{7}{4} k$