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DEPT: MECHATRONICS ENGINEERING

SUBJECT: MAT 102 ASSIGNMENT

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(1) $x = 7t^2$, $y = 6t^2$, $z = t - 5$ where t = time. find velocity.

$$\text{Velocity} = \frac{dr}{dt}$$

where r = displacement and $r = x\hat{i} + y\hat{j} + z\hat{k}$

$$\therefore r = 7t^2 i + 6t^2 j + (t-5)K$$

$$\therefore \text{Velocity} = \frac{dr}{dt} = 14ti + 12tj + K$$

$$\therefore \text{Velocity} = (14t)i + (12t)j + K_4$$

(2) $A = i + 2j - 4K$

$B = 2i - 3j + K$

$C = 4j - 3K$

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

$B \times C =$

i (+)	j (−)	K (+)
2	−3	1
0	4	−3

$$= i\begin{bmatrix} -3 & 1 \\ 4 & -3 \end{bmatrix} - j\begin{bmatrix} 2 & 1 \\ 0 & -3 \end{bmatrix} + K\begin{bmatrix} 2 & -3 \\ 0 & 4 \end{bmatrix}$$

$$= i[9-4] - j[-6-0] + K[8-0]$$

$$B \times C = 5i + 6j + 8K$$

$$\therefore A \times (B \times C) = \begin{vmatrix} i & j & k \\ 1 & 2 & -4 \\ 5 & 6 & 8 \end{vmatrix}$$

$$= i\begin{bmatrix} 2 & -4 \\ 6 & 8 \end{bmatrix} - j\begin{bmatrix} 1 & -4 \\ 5 & 8 \end{bmatrix} + k\begin{bmatrix} 1 & 2 \\ 5 & 6 \end{bmatrix}$$

$$= i[16-(-24)] - j[8-(-20)] + k[6-10]$$

$$\therefore A \times (B \times C) = 40i - 28j - 4k_{\#}$$

(3) Given that $R = 4\sin 3t\, i + 4e^{3t} j + 7t^3 k$

Find $\int R\,dt$

$$\therefore \int R\,dt = 4(-3\cos 3t)i + 4\left(\tfrac{1}{3}e^{3t}\right)j + 7\left(\tfrac{t^4}{4}\right)k + C$$

$$\therefore \int R\,dt = -12\cos 3t\, i + 4/3\, e^{3t} j + 7t^4/4\, k + C_{y}$$

(4) $A = 7i + 2j - k$

$B = 2i + j + 4k$

$C = i + j + k$

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

$$A + C = [7i + 2j - k] + [i + j + k]$$

$$= (7i + i) + (2j + j) + (-k + k)$$

$$A + C = 8i + 3j_{\#}$$

$$B - A = [2i + j + 4k] - [7i + 2j - k]$$

$$= (2i - 7i) + (j - 2j) + [4k - (-k)]$$

$$B - A = -5i - j + 5k_{\#}$$

$$\therefore (A+C)\cdot(B-A) = (8i + 3j)\cdot(-5i - j + 5k)$$

$$= -40 - 3$$

$$(A+C)\cdot(B-A) = -43_{\#}$$

(5) $x = t$, $y = t^2$, $z = t^3$ find Unit tangent vector.

Unit tangent vector $(\bar{T}) = \dfrac{dr/dt}{|dr/dt|}$

$r = x\hat{i} + y\hat{j} + z\hat{k}$

$r = t\,i + t^2 j + t^3 k$

$\dfrac{dr}{dt} = i + 2t\,j + 3t^2 k$

$dr/dt = \dot{i} + 2(1)\dot{j} + 3(1)^2 k$

$t=1$

$dr/dt = \dot{i} + 2\dot{j} + 3k$,

$|dr/dt| = \sqrt{1^2 + 2^2 + 3^2}$

$= \sqrt{1+4+9}$

$= \sqrt{14}$

$|dr/dt| = 3.74$ Units,

$\therefore$ T (Unit tangent vector) $= \dfrac{\dot{i} + 2\hat{j} + 3k}{3.74}$ U