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~~And~~ Course Lecturers: Mr. Okunlola and Dr. Oyelami's Group

ANIUZUNKO CHUKWUEBUKA OLIVER

MECHATRONICS ENGINEERING

19/ENG05/014

1 A particle moves along a curve $x = 7t^2$, $y = 6t^2 - 4t$, $z = t - 5$; where t is time. Find its velocity.

$$r = 7t^2 i + (6t^2 - 4t)j + (t-5)k$$

$$dr/dt = v$$

$$\frac{dr}{dt} = 14t i + (12t - 4)j + k$$

$$v = 14t i + (12t - 4)j + k$$

2 If $\bar{A} = i + 2j - 4k$, $\bar{B} = 2i - 3j + k$, $\bar{C} = 4j - 3k$, find $\bar{A} \times (\bar{B} \times \bar{C})$

$$\bar{B} \times \bar{C} = \begin{array}{ccc} + & - & + \\ \end{array}$$
$$\begin{vmatrix} i & j & k \\ 2 & -3 & 1 \\ 0 & 4 & -3 \end{vmatrix}$$

$$i\begin{vmatrix} -3 & 1 \\ 4 & -3 \end{vmatrix} - j\begin{vmatrix} 2 & 1 \\ 0 & -3 \end{vmatrix} + k\begin{vmatrix} 2 & -3 \\ 0 & 4 \end{vmatrix}$$

$$i(9-4) - j(-6-0) + k(8-0)$$

$$(\bar{B} \times \bar{C}) = 5i + 6j + 8k$$

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

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

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

$$40i$$

$$\bar{A} \times (\bar{B} \times \bar{C}) = 40i - 28j - 4k$$

3 $R = 4\sin 3t\, i + 4e^{3t} j + 7t^3 k$, find the integral of R with respect to t

$$\int 4\sin 3t\, i\, dt + \int 4e^{3t} j\, dt + \int 7t^3 k\, dt$$

$$-\frac{4\cos 3t}{3} i + \frac{4e^{3t}}{3} j + \frac{7t^4}{4} k + C$$

4 If $\bar{A} = 7i + 2j - k$, $\bar{B} = 2i + j + 4k$, $\bar{C} = i + j + k$
find $(\bar{A} + \bar{C}) \cdot (\bar{B} - \bar{A})$

$(\bar{A} + \bar{C}) = (7i + 2j - k) + (i + j + k)$
$= 8i + 3j + 0k$

$(\bar{B} - A) = (2i + j + 4k) - (7i + 2j - k)$
$= -5i - j + 5k$

$(\bar{A} + \bar{C}) \cdot (\bar{B} - \bar{A}) = (8i + 3j + 0k) \cdot (-5i - j + 5k)$
$= -40 - 3 + 0$
$= -43$

5 find a unit vector tangent to the space curve
$x = t$ $y = t^2$ $z = t^3$ at the point where $t = 1$

$$T = \frac{dr/dt}{|dr/dt|}$$

$r = ti + t^2 j + t^3 k$

$dr/dt = i + 2tj + 3t^2 k$

at $t = 1$

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

$$\frac{dr}{dt} = i + 2j + 3k$$

$|dr/dt| = \sqrt{1^2 + 2^2 + 3^2} = \sqrt{14}$

$$T = \frac{dr/dt}{|dr/dt|} = \frac{i + 2j + 3k}{\sqrt{14}}$$