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 Mechanical Engineering  
 19/ENGG06/012  
 MAT 102.

1)  $x=t, y=t^2, z=t^3$  where  $t=1$   
Solution.

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

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

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

$$\begin{aligned} \left| \frac{dr}{dt} \right| &= \sqrt{1^2 + 2^2 + 3^2} \\ &= \sqrt{1+4+9} \\ &= \sqrt{14} \end{aligned}$$

$$\text{Unit tangent vector} = \frac{dr/dt}{|dr/dt|} = \frac{i + 2j + 3k}{\sqrt{14}}$$

2)  $A = 4t^3j + 5k, B = 2t^2i + 4tj, C = A \times B$

$$C = \begin{vmatrix} i & j & k \\ 0 & 4t^3 & 5 \\ 2t^2 & 4t & 0 \end{vmatrix}$$

$$C = i \begin{vmatrix} 4t^3 & 5 \\ 4t & 0 \end{vmatrix} - j \begin{vmatrix} 0 & 5 \\ 2t^2 & 0 \end{vmatrix} + k \begin{vmatrix} 0 & 4t^3 \\ 2t^2 & 4t \end{vmatrix}$$

$$C = i(0 - 20t) - j(0 - 10t^2) + k(0 - 8t^5)$$

$$C = -20ti + 10t^2j - 8t^5k$$

$$\int_0^1 C dt = \frac{-20t^2}{2}i + \frac{10t^3}{3}j - \frac{8t^6}{6}k$$

$$\int G = \left[ -10t^2 i + \frac{10t^3}{3} j - \frac{4t^4}{3} k \right] \Big|_0^1$$

$$= \left[ -10(1)^2 i + \frac{10(1)^3}{3} j - \frac{4(1)^4}{3} k \right] - \left[ -10(0)^2 i + \frac{10(0)^3}{3} j - \frac{4(0)^4}{3} k \right]$$

$$= -10i + \frac{10}{3}j - \frac{4}{3}k - 0$$

$$\int_0^1 G dt = -10i + \frac{10}{3}j - \frac{4}{3}k$$