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 Mechanical engineering  
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MAT 102

NO 113

1)  $x=t, y=t^2, z=t^3$ , where  $t=1$   
 $r = t\mathbf{i} + t^2\mathbf{j} + t^3\mathbf{k}$

$$\frac{dr}{dt} = 1 + 2t\mathbf{j} + 3t^2\mathbf{k}$$

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

$$\left| \frac{dr}{dt} \right| = \sqrt{1^2 + 2^2 + 3^2}$$

$$= \sqrt{14}$$

Unit vector tangent =  $\frac{dr/dt}{|dr/dt|} = \frac{1 + 2\mathbf{j} + 3\mathbf{k}}{\sqrt{14}}$

2)  $A = 4t^2\mathbf{j} + 5\mathbf{k}, B = 2t^2\mathbf{i} + 4t\mathbf{j}, C = A \times B$

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

$$C = \mathbf{i}(0 - 20t) - \mathbf{j}(0 - 10t^2) + \mathbf{k}(0 - 8t^3)$$

$$C = -20t\mathbf{i} + 10t^2\mathbf{j} - 8t^3\mathbf{k}$$

$$\int_0^1 C dt = \frac{-20t^2}{2}\mathbf{i} - \frac{10t^3}{3}\mathbf{j} - \frac{8t^4}{4}\mathbf{k}$$

$$\int C = \left( 10t\mathbf{i} - \frac{10t^3}{3}\mathbf{j} - 4t^4\mathbf{k} \right) \Big|_0^1$$

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

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