

OLADIPO TOMI ISAAC

17/ENG05/030

MECHATRONICS ENGINEERING

1)  $F = x^2i + (3x+2)j + \sin xk$

a)  $\frac{dF}{dx} = 2xi + 3j + \cos xk$

b)  $\frac{d^2F}{dx^2} = 2i - \sin xk$

c)  $\left| \frac{dF}{dx} \right| = \sqrt{(2)^2 + (3)^2 + (1)^2} \quad ; \quad 2xi + 3j + \cos xk \text{ at } x=1$   
 $= \sqrt{4+9+1}$   
 $= \sqrt{14}$   
 $= 3.74$

d)  $\frac{d}{dx} (F \cdot F) \text{ at } x=1$

$$F \cdot F = (x^2i + (3x+2)j + \sin xk) \cdot (x^2i + (3x+2)j + \sin xk)$$
$$= x^4i + (9x^2 + 12x + 4)j + (\sin^2 x)k$$

$$\frac{d}{dx} (F \cdot F) = 4x^3 + 18x + 12 + \sin(2x)$$

$$= 4 + 18 + 12 + 0.035 \quad \text{at } x=1$$

$$= 34.034$$

$$\therefore \frac{d}{dx} (F \cdot F) = 34.034$$

2)  $r = (t^2 + 3t)i - 2 \sin 3tj + 3e^{2t}k$   
 $\frac{dr}{dt} = (2t + 3)i - 6 \cos 3tj + 6e^{2t}k$

$$\frac{d^2r}{dt^2} = \frac{d}{dt} \left[ \frac{dr}{dt} \right]$$

$$= \frac{d}{dt} \left[ (2t+3)i + (-6 \cos 3t)j + 6e^{2t}k \right]$$

$$\frac{d^2r}{dt^2} = 2i + (18 \sin 3t)j + 12e^{2t}k$$

$$\left| \frac{d^2 r}{dt^2} \right| = \sqrt{(2)^2 + (18 \sin 3(0))^2 + (12e^{2(0)})^2}$$

$$= \sqrt{4 + 144}$$

$$= 2\sqrt{37}$$

$$= 12.17 //$$