

IBINAME DANIEL TOLUNASE 17/SC114/013 Civil Engg.

1 Given that

$$F = K^2 i + (3K+2)j + \sin x K \text{ find}$$

$$(a) \frac{dF}{dK} \quad (b) \frac{d^2 F}{dK^2} \quad (c) \left| \frac{dF}{dK} \right| \text{ and } (F \cdot F) \text{ at } x=1$$

$$(a) \frac{dF}{dK} = 2xi + 3j + \cos x K$$

at  $x=1$

$$\left. \frac{dF}{dK} \right|_{x=1} = 2(1)i + 3j + \cos(1)K$$

$$= 2i + 3j + 0.9998K$$

$$(b) \frac{d^2 F}{dK^2} = 2i - \sin x K \text{ at } x=1$$

$$\left. \frac{d^2 F}{dK^2} \right|_{x=1} = 2i - \sin(1)K$$

$$= 2i - 0.0175K$$

$$(c) \left| \frac{dF}{dK} \right| = 2i + 3j + 0.9998K$$

$$= \sqrt{2^2 + 3^2 + (0.9998)^2}$$

$$= 3.74$$

$$(d) \frac{d(F \cdot F)}{dK}$$

$$= \left[ \frac{d}{dK} (K^2 i + (3K+2)j + \sin x K) \right] \cdot \left[ K^2 i + (3K+2)j + \sin x K \right]$$

$$K^4 + (9K^2 + 12K + 4) + (\sin 2K)$$

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

at  $K=1$

$$\frac{d(F \cdot F)}{dK} = 4 + 18 + 12 + 2 \sin(1) \cos(1)$$

$$= 4 + 30 + 0.035$$

$$= 34.035$$

2 If

$$r = (t^2 + 3t)i - 2 \sin 3t j + 3e^{2t} k$$

determine

$$(a) \frac{dr}{dt}, \quad (b) \frac{d^2 r}{dt^2} \quad \& \quad (c) \text{ the value of } \frac{d^2 r}{dt^2} \text{ at } t=20$$

Soln

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

at  $t=0$

$$\left. \frac{dr}{dt} \right|_{t=0} = (2(0)+3)i - 6\cos 3(0)j + 6e^{2(0)}k$$
$$= 3i - 6j + 6k$$

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

at  $t=0$

$$\left. \frac{d^2r}{dt^2} \right|_{t=0} = 2i + 18\cos 3(0)j + 12e^{2(0)}k$$
$$= 2i + 12k$$

$$(c) \left| \frac{d^2r}{dt^2} \right| = 2i + 12k$$
$$= \sqrt{2^2 + 12^2}$$
$$= \sqrt{4 + 144}$$
$$= \sqrt{148}$$
$$= \sqrt{4 \times 37}$$
$$= 2\sqrt{37}$$