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17/ENG02/063
COMPUTER ENGINEERING

ENG 282 ASSIGNMENT 2.

Question One.

Given that $F = x^2 i + (3x+2) j + \sin x\, k$

Find:

a. $\frac{dF}{dx} = \frac{d}{dx}(x^2) i + \frac{d}{dx}(3x+2) j + \frac{d}{dx}(\sin x) k$

$\frac{dF}{dx} = 2x i + 3j + \cos x\, k$

b. $\frac{d^2F}{dx^2} = \frac{d}{dx}\left[\frac{dF}{dx}\right] = 2i + 0 + (-\sin x) k$

$\therefore \frac{d^2F}{dx^2} = 2i - (\sin x) k$

c. $\left|\frac{dF}{dx}\right|$ at $x = 1$

$= 2(1) i + 3j + \cos(1) k$

$2i + 3j + 0.99k$

$\left|\frac{dF}{dx}\right| = \sqrt{(2)^2 + (3)^2 + (0.99)^2} = 3.74$

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

$F \cdot F = (x^2 i + (3x+2) j + \sin x\, k) \cdot (x^2 i + (3x+2) j + \sin x\, k)$

$F \cdot F = x^2 i\,[x^2 i + (3x+2) j + \sin x\, k] + (3x+2) j\,[x^2 i + (3x+2) j + \sin x\, k] + \sin x\, k\,[x^2 i + (3x+2) j + \sin x\, k]$

$F \cdot F = (x^4 + 0 + 0) + (0 + (3x+2) j \cdot (3x+2) j + 0) + (0 + 0 + \sin^2 x)$

$F \cdot F = x^4 + 9x^2 + 12x + 4 + \sin^2 x$

$\frac{d}{dx}(F \cdot F) = \frac{d}{dx}(x^4) + \frac{d}{dx}(9x^2) + \frac{d}{dx}(12x) +$

$\frac{d}{dx}(4) + \frac{d}{dx}(\sin^2 x)$ +

$\therefore \frac{d}{dx}(F \cdot F) = 4x^3 + 18x + 12 + 0 + 2\sin x \cos x$

At $x = 1$,

$\frac{d}{dx}(F \cdot F) = 4(1)^3 + 18(1) + 12 + 0 + 2\sin(1)\cos(1)$

$\frac{d}{dx}(F \cdot F) = 34.035$

Question 2

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

a. $\frac{dr}{dt} = i\frac{d}{dt}(t^2+3t) - \frac{d}{dt}(2\sin 3t)j + \frac{d}{dt}(3e^{2t})k$

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

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

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

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

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

c. $\left|\frac{d^2r}{dt^2}\right|$ at $t = 0$

$= 2i + (18\sin 3(0))j + [12e^{2(0)}]k$

$= 2i + 12k$

$\therefore \left|\frac{d^2r}{dt^2}\right| = \sqrt{2^2 + 12^2}$

$\Rightarrow \sqrt{148} = 12.165$