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Assignment II

1) Given That $f = x^2 i + (3x+2)j + \sin x\, k$

find (a) df/dx (b) d^2f/dx^2 (c) $|df/dx|$ (d) $d/dx(f \cdot f)$ at $x = 1$

(a) $df/dx = 2xi + 3j + \cos x\, k$

(b) $\frac{d^2f}{dx^2} = 2i - \sin x\, k$

(c) $|df/dx|$ at $x = 1$

$|df/dx| = \sqrt{(2)^2 + (3)^2 + (0.99)^2} = \sqrt{4+9+0.9801} = \sqrt{13.98} = 3.738$

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

$f \cdot f = x^4 + (9x^2 + 12x + 4) + \sin^2 x$

$\sin^2 x = \sin x \sin x$ (using product Rule)

$\frac{du}{dx} = \cos x$ $\frac{dv}{dx} = \cos x$

$\frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$

$\frac{dy}{dx} = \sin x \cdot \cos x + \sin x \cdot \cos x$

$= 2\sin x \cos x$

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

at $x = 1 \Rightarrow 4(1)^3 + (18(1) + 12) + 2\sin(1)\cos(1)$

$= 4 + 18 + 12 + 2(0.017 \times 0.99)$

$= 34 + 0.03366$

$= 34.03$

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

(a) dr/dt (b) d^2r/dt^2 and (c) the value of $|d^2r/dt^2|$ at $t = 0$

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

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

(c) at $t = 0$ $|d^2r/dt^2| = 2i + 18\sin 3(0)\, j + 12e^{2(0)} k$

$= 2i + 12k$

$|d^2r/dt^2|$ at $t = 0 = \sqrt{2^2 + 12^2} = \sqrt{4 + 144}$

$= \sqrt{148}$

$= 12.17$