ENG282

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Assignment II

1. Given that

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

(a) $\frac{df}{dk}$; (b) $\frac{d^2f}{dk^2}$ (c) $\left|\frac{df}{dx}\right|$ and $\frac{d(f \cdot f)}{dx}$ at $x=1$

Solution

(a) $\frac{df}{dk} = 2xi + 3j + \frac{d}{dk}\cos x\, k$

at $k=1$

$\frac{df}{dx}\Big|_{x=1} = 2(1)i + 3j + \cos(1)k$

$\frac{df}{dx}\Big|_{x=1} = 2i + 3j + 0.9948k$

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

at $x=1$

$\frac{d^2f}{dk^2}\Big|_{x=1} = 2i - \sin(1)k$

$= 2i - 0.0175k$

(c) $\left|\frac{df}{dx}\right| = 2i + 3j + 0.9948k$

$= \sqrt{2^2 + 3^2 + (0.9948)^2}$

$= \sqrt{13.994}$

$= 3.74$

(d) $\frac{d}{dk}(f \cdot f)$

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

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

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

at $x = 1$

$d(f \cdot f) = 4 + 18 + 12 + 2\sin(1)\cos(1)$

$= 4 + 30 + 0.095$

$= 34.035$

2 If

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

Determine

(a) $\frac{dr}{dt}$, (b) $\frac{d^2r}{dt^2}$ and (c) the value of $\frac{d^2r}{dt^2}$ at $t = 0$

Solution

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

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

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) $\left|\frac{d^2r}{dt^2}\right| = 2i + 12k$

$= \sqrt{[2^2 + 12^2]}$

$= \sqrt{4 + 144}$

$= \sqrt{148}$

$= \sqrt{4 \times 37}$

$= 2\sqrt{37}$