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Chemical Engineering
17/ENG01/011
ENG 282
Assignment 3

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

a.) $\frac{dF}{dx}$ b.) $\frac{d^2F}{dx^2}$ c.) $\left|\frac{df}{dx}\right|$ and $\frac{(\hat{f}\cdot f)}{dx}$ at $x = 4$

Solution

a. $\frac{dF}{dx} = 2xi + 3j + \cos x\, k$ at $x = 1$

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

$= 2i + 3k + 0.9998k$

b. $\frac{d^2f}{dx^2} = 2i - \sin x\, k$ at $x = 1$

$\left.\frac{d^2f}{dx^2}\right|_{x=1} = 2i - \sin(1)k$

$= 2i - 0.0175k$

c. $\left|\frac{df}{dx}\right| = 2i + 3j + 0.998k$

$= \sqrt{2^2 + 3^2 + (0.998)^2}$

$= \sqrt{13.996}$

$= 3.74$

d. $\frac{d}{dx}(f \cdot 1)$

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

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

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

at $x = 1$

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

$= 4+30+0.035$

$= 34.035$

2. If

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

determine

(a.) $\frac{dr}{dt}$ (b.) $\frac{d^2r}{dt^2}$ & (c.) The value of $\frac{d^2r}{dt^2}$ at $t=2$

a. $\frac{dr}{dt}$ at $t = 0$

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

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

$= 3i - 6j + 6k$

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

at $t = 0$

$\left.\frac{d^2r}{dt^2}\right|_{t=0} = 2i + 18\cos 3(0) j + 6e^{2(0)} k$

$= 2i + 12k$

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

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

$= \sqrt{4 + 144}$

$= \sqrt{148}$

$= \sqrt{4 \times 37}$

$= 2\sqrt{37}$ //