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17/ENG07/019
Petroleum Engineering
ENG 281 (Assignment II)

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

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

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

c. $\left|\frac{dF}{dx}\right|$ at 1 $= 2(1)i + 3j + \cos(1)\, k$.

$2i + 3j + 0.999k$.

$= \sqrt{2^2 + 3^2 + (0.999)^2}$

$= \sqrt{13.998} = 3.74$,

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

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

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

$\frac{d(\sin^2 x)}{dx} = \sin^2 x = \sin x \cdot \sin x$

$u = \sin x$, $v = \sin x$

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

Using product rule

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

$= \sin(\cos x) + \sin(\cos x)$

$\sin x \cos x + \sin x \cos x$

$\frac{d}{dx}\sin^2 x = 2\sin x \cos x$

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

at $x = 1$

$4(1) + 18(1) + 12 + 2\sin(1)\cos(1)$

$4 + 18 + 12 + 0.03489$

$= 34.03$,

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

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

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

at 0

$$2i + 18\sin(3\times 0)\, j + 12e^{2(0)}\, k$$

$$2i + 0 + 12k$$

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

$$\sqrt{148}$$

$$= 12.165$$

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