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) value of $\left|\frac{d^2r}{dt^2}\right|$ at 0

Solution

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

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

At $t=0$ $\quad 2i + 18\sin 3(0)\,j + 12e^{2(0)}k$

$= 2i + 12k$.

$\left|\frac{d^2r}{dt^2}\right|^{t=0} = \sqrt{2^2+12^2}$

$= \sqrt{4+144}$

$= \sqrt{148}$

$= 12.17$ //

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17/ENG06/072
MECHANICAL ENGINEERING
ENG 282
ASSIGNMENT 2

1) $F = x^2 i + (3x+2)j + \sin x\, k$, Find :
a) $\frac{dF}{dx}$, b) $\frac{d^2F}{dx^2}$ c) $\left|\frac{dF}{dx}\right|_{x=1}$ d) $\frac{d}{dx}(F \cdot F)$ at $x = 1$.

Solution

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

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

c) $\left|\frac{dF}{dx}\right|_{x=1}$; $dF/dx_{x=1} = 2(1)i + 3j + \cos(1)\, k$

$= 2i + 3j + 0.99k$

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

$\sqrt{4 + 9 + 0.99}$

$= \sqrt{10.99}$

$= 3.32$

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

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

using product rule to differentiate $\sin^2 x$

$\sin^2 x = \sin x \cdot \sin x$

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

$\frac{dy}{dx} = U\frac{dv}{dx} + V\frac{du}{dx} = \sin x \cdot \cos x + \sin x \cdot \cos x$

$= 2\sin x \cos x$

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

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

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

$= 34 + 0.03366$

$= 34.03$