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17/ENG02/023
Computer Engineering
2.2

$\vec{F} = x^2 i + (3x+2) j + \sin x k$

$\frac{df}{dx} = 2x i + 3j + \cos x k$

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

$\left|\frac{dF}{dx}\right| = \sqrt{(2)^2 + (3)^2 + (1)^2} = \sqrt{4+9+1} = \sqrt{14} = 3.74$

Recall $\frac{df}{dx} = 2x i + 3j + \cos x k$

When $x = 1$, $\frac{df}{dx} = 2i + 3j + k$

d) $\frac{d}{dx}[f \cdot f)$ at $x = 1$

$\vec{F} \cdot \vec{f} = (x^2 i + (3x+2) j + \sin x k) \cdot (x^2 i + (3x+2) j + \sin x k)$

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

$x^4 i + (9x^2 + 6x + 6x + 4) j + (\sin^2 x) k$

$\vec{F} \cdot \vec{F} = x^4 i + (9x^2 + 12x + 4) j + (\sin^2 x) k$

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

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

$= 4 + 18 + 12 + 0.035$

$34.0.35$

$\frac{d}{dx}(\vec{F} \cdot \vec{F}) = 34.035$ //

QUESTION 2

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

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

b) $\frac{d^2r}{dt^2} = \frac{d}{dt}\left[\frac{dr}{dt}\right]$

$\frac{d}{dt}\left[(2t+3)i + (-6\cos 3t)j + 6e^{2t}k\right]$

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

$\left|\frac{d^2r}{dt^2}\right| = \sqrt{(2)^2 + (18\sin 3(0))^2 + 12e^{2(0)})^2}$

at $t = 0$

$= \sqrt{2^2 + (18\sin(0))^2 + (12e^0)^2}$

$= \sqrt{4 + 144}$

$= \sqrt{148}$

$= 2\sqrt{37}$

$= 12.17$ //