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17/ENG04/1057

Electrical Electronics Engineering.

ENG 282 Assignment 2.

Question 1.

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

(a) $df/dx$

(b) $d^2F/dx^2$

(c) $|df/dx|$

(d) $d/dx(F \cdot F)$ at $x = 1$.

Solution:

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

(b) $d^2F/dx^2 = 2i - \sin x k$.

(c) $|df/dx|$ at $x = 1$.

∴ where $df/dx = 2xi + 3j + \cos x k$.

$= 2(1)i + 3j + \cos(1)k$

$= 2i + 3j + 0.99k$

∴ $|df/dx| = \sqrt{(2)^2 + (3)^2 + (0.99)^2}$

$= \pm\sqrt{4 + 9 + 0.98}$

$= \sqrt{13.99}$

$= \pm\sqrt{13.99}$

$= \pm 3.74$

(d) $\frac{d}{dF}(F \cdot F)$ at $x = 1$

where $F = x^2 i + (3x+2)j + \sin x k$.

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

$F \cdot F = x^4 + (3x+2)(3x+2) + \sin x \cdot \sin x$ where $i \cdot i = j \cdot j = k \cdot k = 1$

$F \cdot F = x^4 + 9x^2 + 12x + 4 + \sin^2 x$.

∴ $\frac{d}{dF}(F \cdot F) = x^4 + (9x^2 + 12x + 4 + \sin^2 x)$

Differentiating $\sin^2 x$.

Using the Product;

$dy/dx = u\,dv/dx + v\,du/dx$.

$\sin^2 x = \sin x \cdot \sin x$ $\quad u = \sin x$, $v = \sin x$

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

$\therefore dy/dx = \sin x \cdot \cos x + \sin x \cos x$

$= 2 \sin x \cos x$.

$\therefore \frac{d(F \cdot F)}{dF} \Rightarrow$ From;

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

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

$\therefore$ at $x = 1$

$\therefore \frac{d(F \cdot F)}{dF} = 4(1)^3 + 18(1) + 12 + 2\sin(1)\cos(1)$.

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

$= 34 + 0.0349$

$= 34.0349$

$\frac{d(F \cdot F)}{dF} \simeq 34.03$.

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

(a) $dr/dt$

(b) $d^2r/dt^2$

(c) $|d^2r/dt^2|$ at $t = 0$.

Solution;

(a) $dr/dt$.

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

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

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

(c) at $t = 0$, $d^2r/dt^2 \Rightarrow 2i + 18\sin t\,j + 12e^{2t}k$

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

$\Rightarrow 2i + 0j + 12k$

$\therefore \left|\frac{d^2r}{dt^2}\right|$ at $t=0$.

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

$= \sqrt{4+144}$

$= \sqrt{148}$

$= 12.165$

$\simeq 12.17$.