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17/ENG04 (04)

ELECTRICAL/ELECTRONICS ENGINEERING

ENG 282

Assignment 2

1) Given that $f = x^2i + (3x+2)j + \sin \pi x k$ find df/dx

$$a) \frac{df}{dx} = \frac{d(x^2)}{dx}i + \frac{d(3x+2)}{dx}j + \frac{d(\sin \pi x)}{dx}k$$

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

$$b) \frac{d^2f}{dx^2} = \frac{d}{dx} \left[\frac{df}{dx} \right] = 2i + 0 + (-\sin \pi x)k$$

$$\therefore \frac{d^2f}{dx^2} = 2i - (\sin \pi x)k$$

$$c) \left| \frac{df}{dx} \right| \text{ at } x=1$$

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

$$\text{at } x=1 \Rightarrow 2(1)i + 3j + \cos(\pi)k$$

$$= 2i + 3j + 0.99k$$

$$\left| \frac{df}{dx} \right| = \sqrt{(2i)^2 + (3j)^2 + (0.99k)^2} \Rightarrow \sqrt{2^2 + 3^2 + 0.99^2}$$

$$\left| \frac{df}{dx} \right| = 3.74$$

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

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

$$f \cdot f = x^2i(x^2i) + 0 + 0 + (3x+2)^2 + 0 + (3x+2)j \cdot (3x+2)j$$

$$+ 0 + 0 + 0 + (\sin \pi x)k \cdot (\sin \pi x)k$$

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

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

$$\text{at } x=1$$

$$\frac{d(f \cdot f)}{dx} \bigg|_{x=1} = 4(1)^3 + 18(1) + 12 + 2(\cos(\pi) \sin(\pi))$$

$$= 4 + 18 + 12 + 0.035$$

$$= 24.035$$

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

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

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

$$4) \frac{d^2r}{dt^2} = \frac{d}{dt}\left(\frac{dr}{dt}\right)$$

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

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

$$= 2i + 18\sin 3tj + (12e^{2t})k$$

$$5) \left| \frac{d^2r}{dt^2} \right|_{t=0}$$

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

$$= 2i + 12k$$

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

$$= \sqrt{148}$$

$$= 12.165$$