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Mechanical Engineering

16/ENG 06 / 041

ENG 281

① $P = \frac{E^2}{R}$; $P = E^2 R^{-1}$

$$\delta P = \frac{\partial P}{\partial E} \cdot \delta E + \frac{\partial P}{\partial R} \cdot \delta R$$

$$\frac{\partial P}{\partial E} = 2ER^{-1} = \frac{2E}{R} , \quad \frac{\partial P}{\partial R} = -E^2 R^{-2} = \frac{-E^2}{R^2}$$

$$\delta P = \frac{2E}{R} \delta E + \frac{-(E^2)}{R^2} \delta R$$

$$\delta P = \frac{2 \times 200}{8} \cdot (-5) + \frac{-(200)^2}{8^2} \cdot 0.2$$

$$\delta P = \frac{-2000}{8} - \frac{8000}{64} = -250 - 125$$

$$= -375$$

$\therefore \delta P$ (change in P) = -375 watts

2.) $y = \frac{K \omega d^4}{t^3}$; $y = K \omega d^4 t^{-3}$

$$\delta y = \frac{\partial y}{\partial K} \cdot \delta K + \frac{\partial y}{\partial \omega} \cdot \delta \omega + \frac{\partial y}{\partial d} \cdot \delta d + \frac{\partial y}{\partial t} \cdot \delta t$$

$$\frac{\partial y}{\partial K} = \frac{\omega d^4}{t^3} \quad \frac{\partial y}{\partial \omega} = \frac{K d^4}{t^3} \quad \frac{\partial y}{\partial d} = \frac{4 K \omega d^3}{t^3}$$

$$\frac{\partial y}{\partial t} = -3 K \omega d^4 t^{-4} = \frac{-3 K \omega d^4}{t^4}$$

$$\delta \omega = \frac{3}{100} \text{ of } \omega = \frac{3 \omega}{100}$$

$$\delta d = \frac{5}{2} \cdot 100 \text{ of } d = \frac{5}{2} \times \frac{1}{100} = \frac{5}{200} = \frac{\delta d}{500}$$

$$\delta t = \frac{4}{100} \text{ of } t = \frac{4t}{100}$$

$$\delta y = 0 + \frac{K d^4}{t^3} \times \frac{3 \omega}{100} + \frac{4 K \omega d^3}{t^3} \times \frac{\delta d}{500} + \frac{-3 K \omega d^4}{t^4} \times \frac{4t}{100}$$

$$\delta y = \frac{K d^4}{t^3} \times \frac{3}{100} + \frac{K d^4}{t^3} \times \left(\frac{20}{200} \right) = \frac{K d^4}{t^3} \times \left(\frac{12}{100} \right)$$

$$\delta y = \frac{K d^4}{t^3} \left(\frac{3}{100} + \frac{20}{200} = \frac{12}{100} \right)$$

$$\delta y = \frac{K d^4}{t^3} \left(\frac{12}{100} \right) = \frac{K d^4}{t^3} \left(\frac{1}{10} \right)$$

$$\delta y = \frac{1}{10} \left(\frac{1}{100} \right)$$

Percentage change in $y = \pm 1$ percentage