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Mechatronics Engineering
16/ENG05/014
ENG 281

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

$E = 200$ volts $\quad R = 8$ ohms

$\delta E = -5$ volts $\quad \delta R = 0.2$ ohms

Recall:

$P = F(E, R)$

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

$$\frac{\delta P}{\delta E} = \frac{2E}{R}, \quad \frac{\delta P}{\delta R} = -E^2 R^{-2} = \frac{-E^2}{R^2}$$

$$\frac{\delta P}{\delta R} = \frac{-200^2}{8^2} = -\frac{40000}{64} = -625$$

$$\therefore \delta P = \frac{2E}{R} \times \delta E + \left[\frac{-E^2}{R^2} \times \delta R\right]$$

$$\delta P = \left[\frac{2 \times 200}{8} \times -5\right] + \left[-625 \times 0.2\right]$$

$$= [50 \times -5] + [-625 \times 0.2]$$

$\delta P = -375$ watts

2. $y = \frac{kwd^4}{t^3}$

$$\frac{\delta y}{\delta w} = \frac{kd^4}{t^3}, \quad \frac{\delta y}{\delta d} = \frac{4kwd^3}{t^3}, \quad \frac{\delta y}{\delta t} = \frac{-3kwd^4}{t^4}$$

$$\delta y = \frac{\delta y}{\delta w} \cdot \delta w + \frac{\delta y}{\delta d} \cdot \delta d + \frac{\delta y}{\delta t} \cdot \delta t$$

$$= \left[\frac{kd^4}{t^3} \times \frac{3w}{100}\right] + \left[\frac{4kwd^3}{t^3} \times \frac{2.5d}{100}\right] + \left[\frac{-3kwd^4}{t^2} \times \frac{4t}{100}\right]$$

$$\delta y = \left[\frac{Kwd^4}{t^3} \times \frac{3}{100}\right] + \left[\frac{Kwd^4}{t^3} \times \frac{(4\times 2.5)}{100}\right] + \left[\frac{Kwd^4}{t^3} \times \frac{(4\times 3)}{100}\right]$$

$$\delta y = \frac{Kwd^4}{t^3}\left[\frac{3}{100} + \frac{10}{100} - \frac{12}{100}\right]$$

$$= \frac{Kwd^4}{t^3}\left[\frac{1}{100}\right]$$

where $y = \frac{Kwd^4}{t^3}$

$\therefore \delta y = 1\%$ of y.