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Petroleum Engineering.
ENG 281.
Assignment 3.

1) The power P dissipated in a resistor is given as in Equation (1).

$$P = \frac{E^2}{R} \quad ---(1)$$

If E = 200 volts and R = 8 ohms, find the change in P resulting from a drop of 5 volts in E and an increase of 0.2 Ohm in R.

Solution:

$$P = \frac{E^2}{R} \quad \text{ie} \quad P = f(E, R)$$

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

$$\frac{\partial P}{\partial E} = \frac{2E}{R} \quad \text{and} \quad \frac{\partial P}{\partial R} = \frac{-E^2}{R^{+2}} = -\frac{(200)^2}{8^2}$$

$$\frac{\partial P}{\partial E} = \frac{2 \times 200}{8} = 50 \quad \text{and} \quad \frac{\partial P}{\partial R} = -625$$

$$\delta E = -5, \quad \delta R = +0.2$$

$$\delta P = (50 \times -5) - (625 \times 0.2)$$

$$= -250 - 125$$

$$\delta P = -375$$

Therefore, P decreases by 375 Watts.

2) The deflection y at the centre of a circular plate suspended at the edge and uniformly loaded is given in Equation (2),

$$y = \frac{K w l d^4}{t^3}$$

where wl = total load, d = diameter of plate, t = thickness and K is a constant.

Calculate the approximate percentage change in y if w is increased by 3 percent, d is increased by 2½ per cent and t is increased by 4 per cent.

Solution:

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

But $y = \frac{K wl d^4}{t^3}$ where K is constant

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

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

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

$\delta wl = \frac{3}{100}$ of wl, $\delta d = \frac{5}{200}$ of d, $\delta t = \frac{4}{100}$ of t

$$\delta wl = \frac{3wl}{100}, \quad \delta d = \frac{5d}{200}, \quad \delta t = \frac{4t}{100}$$

$$\delta y = \frac{k d^4}{t^3}\left[\frac{3kl}{100}\right] + \frac{4k^2 l d^3}{t^3}\left[\frac{5d}{200}\right] + \left[\frac{-3k^2 l d^4}{t^4}\right]\frac{4t}{100}$$

$$= \frac{3kl k d^4}{100 t^3} + \frac{20 k^2 l d^4}{200 t^3} - \frac{3 \cdot 4 k^2 l d^4}{100 t^3}$$

$$= \frac{kkl d^4}{t^3}\left[\frac{3}{100} + \frac{20}{200} - \frac{12}{100}\right]$$

$$= \frac{kkl d^4}{t^3}\left[\frac{6+20-24}{200}\right]$$

$$= \frac{kkl d^4}{t^3}\left[\frac{2}{200}\right]$$

$$= y\left[\frac{1}{100}\right]$$

$$\delta y = y\left[\frac{1}{100}\right]$$

Therefore, y increases by 1 per cent.