Name: Eluoba Daniel Chidubem
Matric No: 16/ENG07/011
Dept: Petroleum Engineering
Course: ENG 281
Assignment

1) The power P dissipated on a resistor is given as an equation

①

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

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 ohms in R

Solution

$$P = \frac{E^2}{R} \; ; \; P = f(E, R)$$

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

$$\frac{\partial P}{\partial E} = \frac{2E}{R} \text{ and } \frac{\partial P}{\partial R} = \frac{-E^2}{R^2}$$

$$\frac{\partial P}{\partial E} = \frac{2 \times 200}{8}, \quad \frac{\partial P}{\partial R} = \frac{-(200)^2}{(8)^2}$$

$$\frac{\partial P}{\partial E} = 50, \quad \frac{\partial P}{\partial R} = -625, \quad \delta E = -5, \quad \delta R = 0.2$$

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

$$\delta P = -250 - 125$$

$$\delta P = -375$$

$\Rightarrow$ P decreases by 375 Watts

2) The deflection y at the centre of a circular plate suspended at the end and uniformly loaded is given in equation ②

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

where w = total load
d = diameter of plate
t = thickness
k is a constant

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

Solution

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

from equation 2

$$y = \frac{kwd^4}{t^3}$$ and k is constant

$$\frac{\partial y}{\partial w} = kwd^4t^{-3} \therefore \frac{\partial y}{\partial w} = \frac{kd^4}{t^3}$$

$$\frac{\partial y}{\partial d} = kwd^4t^{-3} \therefore \frac{\partial y}{\partial d} = \frac{4kwd^3}{t^3}$$

$$\frac{\partial y}{\partial t} = kwd^4t^{-3} \therefore \frac{\partial y}{\partial t} = \frac{-3kwd^4}{t^4}$$

$$\delta w = \frac{3}{100}, \quad \delta d = \frac{2\frac{1}{2}}{100} = \frac{5}{200}, \quad \delta t = \frac{4}{100}$$

$$\delta y = \frac{3}{100} \text{ of } w, \quad \delta d = \frac{5}{200} \text{ of } d, \quad \delta t = \frac{4}{100} \text{ of } t$$

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

$$\delta y = \frac{kd^4}{t^3}\left(\frac{3w}{100}\right) + \frac{4kwd^3}{t^3}\left(\frac{5d}{200}\right) - \frac{3kwd^4}{t^4}\left(\frac{4t}{100}\right)$$

$$\delta y = \frac{3kwd^4}{100t^3} + \frac{20kwd^4}{200t^3} - \frac{12kwd^4}{100t^3}$$

$$\delta y = \frac{3kwd^4}{100t^3} + \frac{10kwd^4}{100t^3} - \frac{12kwd^4}{100t^3}$$

$$\delta y = \frac{kwd^4}{t^3}\left(\frac{3}{100} + \frac{10}{100} - \frac{12}{100}\right)$$

$\frac{kwd^4}{t^3} \rightarrow y$

So

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

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

Therefore y increases by 1 percent.