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(1) The power P dissipated in a reactor is given as in Equation (i)

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

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.

Soln

$$\delta p = \frac{\partial p}{\partial E}\delta E + \frac{\partial p}{\partial R}\delta R$$

$E = 200V$, $R = 8\Omega$ $\delta p = P$ $E_{drop} = 5V$, $R_{increase} = 0.2\Omega$

$$\frac{\partial p}{\partial E} = \frac{2E}{R} \qquad \frac{\partial p}{\partial R} = -E^2R^{-2} = \frac{-E^2}{R^2}$$

$$\delta E = -5V \qquad \delta R = +0.2V$$

$$\delta p = \left(\frac{2E}{R}\right)(-5V) + \left(\frac{-E^2}{R^2}\right)(+0.2\Omega)$$

$$\delta p = \left(\frac{2\times200}{8}\right)(-5) + \left(\frac{-(200)^2}{8^2}\right)((0.2)(8))$$

$$\delta p = -250 + (-125)$$

$$\delta p = -375 \text{ Watts}$$

∴ P decreases by 375 Watts.

2) The deflection y at the Centre of a Circular plate Sus pended at the edge and Uniformly loaded is given In Equation (2)

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

where W = 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.

Soln

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

$W = +3\%$ $d = 2\frac{1}{2}\% \approx 5\%$ $t = 4\%$

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

$$\frac{\partial y}{\partial w} = \frac{Kd^4}{t^3}, \quad \frac{\partial y}{\partial d} = \frac{4KWd^3}{t^3}, \quad \frac{\partial y}{\partial t} = -\frac{3KWd^4}{t^4}$$

$$\delta w = \frac{3}{100} \text{ of } W \quad \delta d = \frac{5/2}{100} \text{ of } d \quad \delta t = \frac{4}{100} \text{ of } t$$

$$\delta y = \left(\frac{Kd^4}{t^3}\right)\left(\frac{3W}{100}\right) + \left(\frac{4KWd^3}{t^3}\right)\left(\frac{5/2\, d}{100}\right) + \left(\frac{-3Wd^4}{t^4}\right)\left(\frac{4t}{100}\right)$$

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

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

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

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

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

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

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

Therefore y Increases by 1 percent.