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COURSE: ENG 281 (ENGINEERING MATHEMATICS)
DEPARTMENT: MECHANICAL ENGINEERING
MATRIC NO: 16/ENG06/021

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

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

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 ohms in R.

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

$y = \frac{Kwd^4}{t^3}$, 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%, d is increased by 2½% and t is increased by 4%.

Solu

1) $P = \frac{E^2}{R}$, $E = 200$ volts, $R = 8$ ohms, $\delta E = -5$ volts, $\delta R = 0.2$ ohms

$$\delta P = \frac{dP}{dE}\delta E + \frac{dP}{dR}\delta R$$

$$\frac{dP}{dE} = \frac{2E}{R}, \quad \frac{dP}{dR} = -\frac{E^2}{R^2}$$

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

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

$$\delta P = -250 + [-125]$$

$$\delta P = -375$$

∴ The power decreases by 375 watts

2. $y = \frac{kwd^4}{t^3}$, $\delta w = 3\%$, $\delta d = 2\frac{1}{2}\%$, $\delta t = 4\%$

$$\delta y = \frac{dy}{dw}\delta w + \frac{dy}{dd}\delta d + \frac{dy}{dt}\delta t$$

$$\frac{dy}{dw} = \frac{kd^4}{t^3}, \quad \frac{dy}{dd} = \frac{4kwd^3}{t^3}, \quad \frac{dy}{dt} = \frac{-3kwd^4}{t^4}$$

$$\delta y = \frac{kd^4}{t^3}\left(\frac{3w}{100}\right) + \frac{4kwd^3}{t^3}\left(\frac{2.5d}{100}\right) - \frac{3kwd^4}{t^4}\left(\frac{4t}{100}\right)$$

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

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

$$\delta y = \frac{kwd^4}{t^3}\left(\frac{1}{100}\right)$$

∴ y increases by 1% or 1 percent