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Electrical/Electronics
16/ENG04/087
ENG 281

1. The power p dissipated in a resistor is given as in equation ①

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

If E = 20 volts and R = 8 ohms, find the change in p resulting from drop of 5 volts in E and an increase of 0.2 ohm in R.

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

$$\therefore \delta p = \frac{2E}{P} \times \delta E - \frac{E^2}{R^2} \delta R.$$

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

when E = 20 volts, R = 8 ohms, $\delta E = -5$ volts $\delta R = 0.2$ ohm

$$\delta p = \frac{2 \times 20}{8} \times (-5) - \frac{20^2 \times 0.2}{(8)^2}$$

$\delta p = -250 - 125 = -375$ if p increases by 375 watts
or 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

$$y = \frac{\pi w d^4}{t^3}$$ where w = total load, d = diameter, 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 percent and t by 4 percent.

Solu

$$y = \frac{\pi w d^4}{t^3}$$ recall K is a constant = 0

$$\frac{dy}{dy} = \frac{dy}{dK} \cdot dK + \frac{dy}{dw} \cdot dw + \frac{dy}{dt} \times dy + \frac{dy}{dt} \cdot dt$$

$$\therefore dy = \frac{dy}{dw} \cdot dw + \frac{dy}{dt} dy + \frac{dy}{dt} \cdot dt$$

$\frac{dy}{dw} = \frac{kd^4}{t^3}$ ; $\frac{dy}{\delta d} = \frac{4kwd^3}{t^3}$ ; $\frac{dy}{dt} = \frac{-3kwd^4}{t^4}$

$dw = +\frac{3w}{100}$ ; $\delta d = \frac{1}{40} d$ ; $\delta t = \frac{4t}{100}$

then, $dy = \frac{kd^4}{t^3} \times \left[\frac{3w}{100}\right] + \frac{4wd^3}{t^3}\left[\frac{1}{40} d\right] + \left[\frac{-3kwd^4}{t^4} \times \frac{4t}{100}\right]$

$dy = \frac{kwd^4}{t^3}\left[\frac{3}{100}\right] + \frac{kwd^4}{t^3}\left[\frac{1}{40}\right] - \frac{kwd^4}{t^3}\left[\frac{12}{100}\right]$

$dy = \frac{kwd^4}{t^3}\left[\frac{3}{100} + \frac{4}{100} - \frac{12}{100}\right]$

Recall $Y = \frac{kwd^4}{t^3}$

$dy = Y\left[\frac{3}{100} + \frac{4}{100} - \frac{12}{100}\right]$

$= Y\left[\frac{1}{100}\right]$ 1 percent of Y

i.e Y increases by 1 percent.