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16/ENG04/043
Electrical Electronics
ENG281

1.) The power P dissipated in a resistor is given by

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

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

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

$$\frac{\delta P}{\delta E} = \frac{2E}{R}; \quad \frac{\delta P}{\delta R} = \frac{-E^2}{R^2}$$

$$\therefore dP = \frac{2E}{P} \times \det\left[\frac{-E^2}{R^2} \times \delta R\right]$$

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

When $E = 200$ volts, $R = 8$ ohm, $\delta E = -5$ volts $dR = 0.2$ ohms

$$\therefore \delta P = \frac{2 \times 200 \times -5}{8} - \frac{200^2}{8^2} \times 0.2$$

$$\delta P = -250 - 125 = -375$$

∴ P decreases by 375 watts

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

$$y = \frac{K w d^4}{t^3}$$ where w = total load
d = diameter
t = thickness
K is a constant.

Calculate the approximate percentage change in

y if w is increased by 3 per cent, d is increased by 2.5% and t by 4%

Soln.

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

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

$$\Rightarrow \frac{dy}{\delta w} = \frac{Kd^4}{t^3} \; ; \; \frac{\delta y}{\delta d} = \frac{4Kwd^3}{t^3} \; \frac{\delta y}{\delta t} = \frac{-3Kwd^4}{t^4}$$

$$\delta w = \frac{+3w}{100} \; ; \; \delta d = \frac{2.5d}{100} \; , \; \delta t = \frac{4t}{100}$$

$$dy = \frac{Kd^4}{t^3} \times \frac{3w}{100} + \frac{4wd^3}{t^3}\left(\frac{1 \times d}{40}\right) + \left(\frac{-3Kwd^4}{t^4} \times \frac{4t}{100}\right)$$

$$dy = \frac{+Kwd^4}{t^3}\left(\frac{3}{100}\right) + \frac{Kwd^4}{t^3}\left(\frac{4}{40}\right) - \frac{Kwd^4}{t^3}\left(\frac{12}{100}\right)$$

$$dy = \frac{Kwd^4}{t^3}\left(\frac{+3}{100} + \frac{4}{40} - \frac{12}{100}\right)$$

recall $y = \frac{Kwd^4}{t^3}$

$$dy = y\left(\frac{4}{40} + \frac{3}{100} - \frac{12}{100}\right) =$$

$$\frac{25 + 6 - 24}{200} = \frac{7}{200}$$

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

$$dy = y \times 1\%$$

$\therefore$ y increases by 1%