20/10/17

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MATRIC NO: 16/ENG04/018
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COURSE: ENG 281 [ASSIGNMENT]

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

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

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 ohm in R.

Soln

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

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

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

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

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

$$\delta P = -250 - 125 = -375$$ i.e. P decreases by 375 watts

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(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, 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.

Soln

$$y = \frac{1Kwd^4}{t^3}$$ recall it is a function of

$$dy = \frac{dy}{dK}dK + \frac{dy}{dw}dw + \frac{dy}{dd}dy + \frac{dy}{dt}dt$$

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

$$\Rightarrow \frac{dy}{dw} = \frac{1Kd^4}{t^3} \; ; \; \frac{dy}{dd} = \frac{4KwK^3}{t^3} \; ; \; \frac{dy}{dt} = \frac{-3KwK^4}{t^4}$$

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

then

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

$$dy = \frac{1Kwd^4}{t^3}\left(\frac{3}{100}\right) + \frac{Kwd^4}{t^3}\left(\frac{4}{40}\right) - \frac{Kwd^4}{t^3}\left(\frac{12}{100}\right)$$

$$dy = \frac{1Kwd^4}{t^3}\left(\frac{3}{100} + \frac{4}{40} - \frac{12}{100}\right)$$ recall $y = \frac{1Kwd^4}{t^3}$

$$dy = y\left(\frac{3}{100} + \frac{4}{40} - \frac{12}{100}\right) = y\left(\frac{1}{100}\right)$$

1 percent of y

i.e. y increases by 1 percent