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15/ENG07/012

Petroleum-Engr

Assignment III [ENG 281 → maths 1]

(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 ohm in R.

Soln

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

E = 200 volts, R = 8 ohms, ΔE = −5, ΔR = 0.2 ohms

$$\delta p = \frac{dp}{dE} dE + \frac{dp}{dR} \cdot dR$$

$$\frac{dp}{dE} = \frac{2E}{R}$$

$$dE = -5V$$

$$= \frac{-5}{200} \times 100\% = -2.5\% \times E$$

$$= \frac{-2.5E}{100}$$

$$\frac{dp}{dR} = -\frac{E^2}{R^2}$$

dR + + 0.2 ohms

$$= \frac{0.2}{8} \times 100 = 2.5\% \times R$$

$$= \frac{+2.5R}{100}$$

Substituting all eqns....

$$dp = \frac{2E}{R}\left(\frac{-2.5E}{100}\right) + \left(\frac{-E^2}{R^2}\right)\left(\frac{+2.5R}{100}\right)$$

$$dp = \frac{E^2}{R}\left(\frac{-2.5\times 2}{100} - \frac{2.5}{100}\right)$$

$$dp = \frac{E^2}{R}\left[\frac{-5-2.5}{100} = \frac{E^2}{R}\left[\frac{-7.5}{100}\right]\right]$$

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

$$dp = \frac{-7.5P}{100}$$

Since $E = 200\,V$, $R = 8$ ohms

$$dp = \frac{-7.5P}{100} = \frac{-7.5\times E^2}{100R}$$

$$dp = \frac{-7.5}{100} \times \frac{200^2}{8} = -375 \text{ watts}$$

Since the result is -375 watt, this means there was a decrease in the power P dissipated by the resistor.

(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, Thickness and k is a constant. calculate the approximate percentage change in y if w is increased by 3 per cent, d is increased by 2½ per cent and t is increased by 4 percent.

Soln

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

Recall that;

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

$$\frac{dy}{dw} = \frac{kd^4}{t^3} = \frac{kd^4}{t^3}$$

$$dw = \frac{+3}{100} \times w = \frac{+3w}{100}$$

$$\frac{dy}{dd} = \frac{4kwd^3}{t^3}$$

$$yd = \frac{+2.5}{100} \times d = \frac{+2.5d}{100}$$

$$\frac{dy}{dd} = \frac{4kwd^3}{t^4}$$

$$\frac{dy}{dt} = \frac{3kwd^4}{t^4}$$

$$dt = \frac{+4}{100} \times t = \frac{+4}{100}$$

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Substituting the eqns - - -

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

But $y = \frac{kwd^4}{t^3}$

$$dy = y\left(\frac{3+10-12}{100}\right)$$

$$dy = y\left(\frac{3+2}{100}\right)$$

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

$$dy = \frac{+1}{100} + y$$

∴ There was an approximate percentage increase in ~~the~~ deflection where w is increased by 3 percentage, d is increase by 2.5 percentage and t is increased by 4 percent.