Ogeneyin Dapo Salim
16/ENG04/050
Elect / Elect
ENG 281 Assignment

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

Solution

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

$$\therefore \frac{dP}{dR} = -\frac{E^2}{R^2} \text{ and } \frac{dP}{dE} = \frac{2E}{R}$$

$$dP = \frac{dP}{dR} \cdot dR + \frac{dP}{dE} \cdot dE$$

where $\frac{dP}{dR} = -\frac{E^2}{R^2} = -\frac{200^2}{8^2} = \frac{40000}{64} = 625$

$$\frac{dP}{E} = \frac{2E}{R} = \frac{2(-200)}{8} = \frac{-400}{8} = -50$$

$dR = 0.2\Omega$, $dE = 5V$

$$\therefore dP = \frac{dP}{dR} \cdot dR + \frac{dP}{dE} \cdot dE$$

$$-(625 \times 0.2) + (-50 \times 5)$$

$$-125 - 250$$

$$dP = -375$$

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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 of plate, $t$ = 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 $t$ is increased by 4 percent

Solution

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

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

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

$$= \frac{3kwd^4}{100t^3} + \frac{10kwd^4}{100t^3} - \frac{12kwd^4}{100t^3}$$

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

$$= \frac{1}{100} \frac{kwd^4}{t^3}$$

$dy$ = 1% of $y$

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