OKEREKE GIKWUMA
16/ENG04/042
ELECTRICAL/ELECTRONICS ENGINEERING

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

$$P = \frac{E^2}{R} \quad \text{— (i)}$$

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

Solution

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

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

where $\frac{\delta P}{\delta R} = \frac{-E^2}{R^2} = \frac{-200^2}{8^2} = \frac{40,000}{8} = 625\Omega$

$$\frac{\delta P}{E} = \frac{2E}{R} = \frac{2 \times -200}{8} = \frac{-400}{8} = -50$$

$\delta R = 0.2\Omega$, $\delta E = 5V$

$\therefore \delta P = \frac{\delta P}{\delta R} \cdot \delta R + \frac{\delta P}{\delta E} \cdot \delta E$

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

$= -125 - 250$

$\delta P = -375$

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

$$Y = \frac{Kwd^4}{t^3} \therefore \frac{\delta y}{\delta w} = \frac{kd^4}{t^3}, \frac{\delta y}{\delta t} = \frac{4wd^3}{t^3}, \frac{\delta w}{dt} = \frac{-4Kwd^4}{t^4}$$

$$\delta y = \left(\frac{kd^4}{t^3} \times \frac{3w}{100}\right) + \left(\frac{4wd^3}{t^3} \times \frac{2.5t}{100}\right) + \left(\frac{-3Kwd^4}{t^4} \times \frac{1t}{100}\right)$$

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

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

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

$$\delta y = 1\% \text{ of } Y$$