Name: Olukoya Ismail
Course: Mechatronics
Dept: Engr Mathematics
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1) The power P dissipated in a resistor is given as

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

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

Solution

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

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

So when $E = 200V$ $R = 8$ ohm

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

$$= \frac{2[200]}{80}(-5) - \frac{200^2}{80^{-2}}[0.2]$$

$$= -25 - \frac{8000}{1.5625 \times 10^{-4}}$$

$$= -5120025$$

$$= -5 \times 10^7$$

∴ Power decreases by -5×10^7 J

2) The deflection y at the centre of a circular plate suspended at the edge and uniformly loaded is is given in Eq^n (2)

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

w = total load d = diameter of plate t = thickness

Find the percentage in y if w is increased by 3 percent, d is increased by 2½ per cent and t is increased by 4 per cent

Solution

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

$$\frac{\delta y}{\delta k} = \frac{wd^4}{t^3}, \quad \frac{\delta y}{\delta w} = \frac{kd^4}{t^3}, \quad \frac{\delta y}{\delta d} = \frac{3kwd^3}{t^3}, \quad \frac{\delta y}{\delta t} = \frac{-3kwd^4}{t^4}$$

$$\delta w = \frac{3}{100} \cdot w \qquad \delta d = \frac{2\frac{1}{2}}{100} \cdot d \qquad \delta t = \frac{4}{100} \cdot t$$

$$= \frac{3w}{100}, \qquad \frac{2\frac{1}{2}d}{100}, \qquad \frac{4t}{100}$$

$$\delta y = \frac{wkd^4}{t^3} \cdot \frac{kd^4}{t^3} \delta w + \frac{3kwd^3}{t^3} \delta d + \frac{-3kwd^4}{t^4} \delta t$$

$$\delta y = \frac{kd^4}{t^3}\left[\frac{3w}{100}\right] + \frac{3kwd^3}{t^3}\left[\frac{2\frac{1}{2}d}{100}\right] + \frac{-3kwd^4}{t^4}\left[\frac{4}{100}t\right]$$

$$\delta y = \frac{wkd^4}{t^3}\left[\frac{3}{100}\right] + \frac{3kwd^4}{t^3}\left[\frac{2\frac{1}{2}}{100}\right] - \frac{3kwd^4k}{t^4}\left[\frac{4}{100}\right]$$

$$\delta y = \frac{3wkd^4}{t^3}\left[\frac{3}{100}\right] + \frac{3kwd^4}{t^3}\left[\frac{2\frac{1}{2}}{100}\right] - \frac{3kwd^4}{t^3}\left[\frac{4}{100}\right]$$

$$= \frac{wkd^4}{t^5}\left[\frac{3}{100} + \frac{2.5}{100} - \frac{12}{100}\right]$$

$$= y\left[\frac{3+2.5-12}{100}\right]$$

$$= y\left[\frac{-1.5}{100}\right]$$

$$= -1.5 \text{ percent of } y$$

$$\frac{-3kwd^4}{t^4}$$