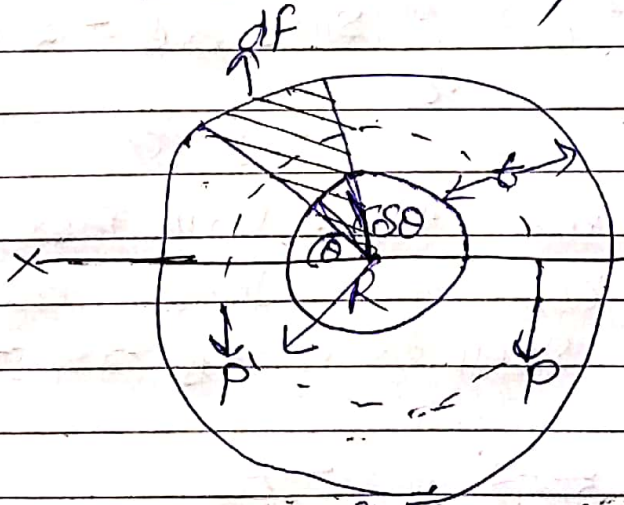
Section - 4

Ans 1.

Let D = mean diameter of rim
R = mean radius of rim
A = cross-sectional area of rim
ρ = Density of rim material
N = speed of fly wheel.
ω = Angular velocity of fly wheel
σ = Tensile (or hoop) stress due to centrifugal force and

V = Linear velocity at the mean radius



Rim of flywheel.

2. Consider a small element of rim which subtends an angle $\delta\theta$ at the centre of the flywheel.

3. Volume of the small element = $AR\,\delta\theta$
and mass of the small element.

dm = Density × volume
= $\rho AR\,\delta\theta$

4. Centrifugal force that acts radially outwards

$$dF = dm\omega^2 R$$
$$= \rho A R^2 \omega^2 \delta\theta$$

5. Vertical component of $dF = dF \sin\theta$
$$= \rho A R^2 \omega^2 \delta\theta \sin\theta$$

6. Total vertical upward force tending to burst the rim across the diameter xy,

$$F = \rho A R^2 \omega^2 \int_0^{\pi} \sin\theta \, d\theta = 2\rho A R^2 \omega^2 \quad \text{---(1)}$$

7. This vertical upward force will produce hoop stress (or centrifugal stress or circumferential stress) and it is resist by $2P$ such that

$$2P = 2\sigma A \quad \text{---(2)}$$

8. on equating (1) and (2)

[$\because v = R\omega$]

$$2\sigma A = 2\rho A R^2 \omega^2$$
$$\sigma = \rho R^2 \omega^2$$
$$\sigma = \rho v^2$$

$$\boxed{v = \sqrt{\frac{\sigma}{\rho}}} \quad \text{---(3)}$$

The mass of rim m = volume x density
= π·D·A·ρ

$$A = \frac{m}{\pi D \rho} \quad \text{——— (4)}$$

10. Using eq^{n} (3) and (4) we can find the value of the mean radius and cross-sectional area of the rim.

11. If the cross section area of the rim is rectangular then,

where $A = bt$

b = width of the rim and
t = thickness of rim