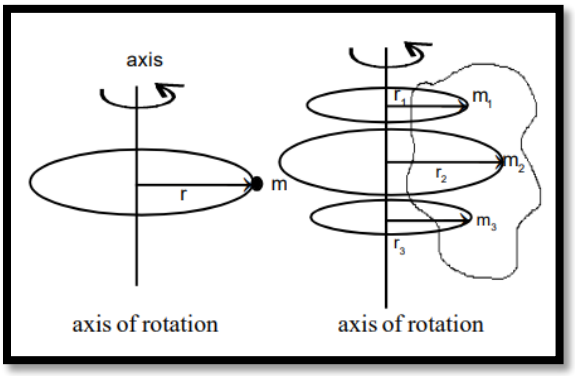
SYSTEM OF PARTICLES AND ROTATIONAL MOTION

MOMENT OF INERTIA

MOMENT OF INERTIA (ROTATIONAL INERTIA)



a. The virtue, by which a body revolving about an axis opposes the change in rotational motion, is known as moment of inertia.

b. The moment of inertia of a particle with respect to an axis of rotation is equal to the product of mass of the particle and square of distance from the axis, hence $I = mr^2$

c. The moment of inertia of a system about an axis of rotation is equal to the sum of moment of inertia of all the particles of the system about the axis of rotation.

$$I = m_1r_1^2 + m_2r_2^2 + \cdots = \sum m_i r_i^2 = \int r^2 dm$$

d. It is a scalar quantity

e. Unit: In M.K.S = kg - m^2,

In C.G.S = gm-cm2

f. Dimension: $[M^1L^2T^0]$

g. Moment of inertia depends on the following factors.

$i^{1/2}$ Mass of body

ii$^{1/2}$ Mass distribution of body or shape, size, density of body.

iii$^1/2$ On the position of axis of rotation.

Note

& The more is the distribution of mass with respect to axis of rotation the more will be moment of inertia.

h. Moment of inertia does not depend on the following factors.

i) Angular velocity (ω)

ii) Angular Acceleration (α)

iii) Torque (τ)

iv) Angular Momentum (J)

Radius of Gyration - (K)

a. The distance, from the axis of rotation where, the entire mass of the body is supposed to be concentrated and the value of moment of inertia is same as that due to actual distribution of masses of body, is called radius of gyration.

b. The radius of gyration of a body about different axes is different

c. If K be the radius of gyration, $I = mK^2$

$$K = \sqrt{\frac{I}{m}}$$

$$K = \sqrt{\frac{m_1 r_1^2 + m_2 r_2^2 + - - - m_n {r_n}^2}{m_1 + m_2 + - - - m_n}}$$

d. For a symmetrical body, the radius of gyration is equal to the root mean square of distances of all the particles from the axis of rotation.

if, $m_1 = m_2 =$ ---------- $= m_n$

$$K = \sqrt{\frac{r_1^2 + r_2^2 + - - - + {r_n}^2}{n}} = r_{rms}$$

e. The value of radius of gyration depends upon the axis of rotation and mass distribution with respect to it

f. Radius of gyration does not depend upon mass of body.