

MIECHANICS SUB. CODE-BSPH11102 For B.Sc.(Physics & Chemistry) (Rotational Dynamics)

### Rotation about a fixed axis. Moment of Inertia

By Mr. G. K. Sahu Assistant Professor, CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT, ODISHA



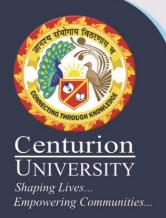
# Moment of Inertia

*Empowering Communities...* Moment of Inertia of a rigid body about a given axis of rotation is the sum of the products of the masses of the various particles of the body and the squares of their respective distances from the axis.

Moment of Inertia=
$$I = \sum mr^2$$
  
 $\therefore \quad I = m_1r_1^2 + m_2r_2^2 + \dots + m_nr_n^2$ 

Where  $m_1, m_2, ..., m_n$  are the masses of 1<sup>st</sup>, 2<sup>nd</sup>, ..., nth particle of the body at a distances  $r_1, r_2, ..., r_n$  from the axis.

Units: kgm<sup>2</sup>



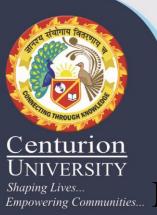
In case of continuous and homogeneous distribution of mass, the summation can be replaced with integration.

 $\therefore \quad I = \int r^2 dm$ 

Where dm is the mass of infinitesimal small element of the body at a distance r from the axis.

Moment of Inertia depends on:

- 1. Mass of the body
- 2. Distribution of mass of the body around the axis



# Radius of Gyration

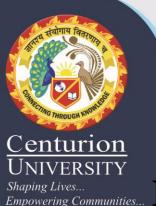
Shaping Lives... Empowering Communities... Moment of Inertia I can be written as:

 $I = MK^2$ 

Where K is the radius of gyration about the axis.

So, radius of gyration may be defined as the distance from the axis at which if its entire mass M be supposed to be concentrated, its moment of inertia about the given axis would be the same as with its actual distribution of mass.

$$K = \sqrt{\frac{\sum mr^2}{\sum m}}$$



## Reference

#### Shaping Lives... Empowering Communities... Mechanics by D. S. Mathur, S. Chand, chp-11.4 to 11.7

