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**MECHANICS**  
**SUB. CODE-BSPH1102**  
*For B.Sc.(Physics & Chemistry)*  
**(Rotational Dynamics)**

Rotation about a fixed axis. Moment of Inertia

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# Moment of Inertia

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.

$$\text{Moment of Inertia} = I = \sum mr^2$$

$$\therefore I = m_1 r_1^2 + m_2 r_2^2 + \dots + m_n r_n^2$$

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

Units:  $\text{kgm}^2$



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

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

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



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# Radius of Gyration

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.

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



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# Reference

**Mechanics** by *D. S. Mathur*, S. Chand, chp-11.4 to 11.7

