Moment of inertia of an irregular body

OBJECT: To determine the moment of inertia of an irregular body about an axis passing through its centre of gravity and perpendicular to its plane by dynamical method (Inertia Table)

Apparatus used: Inertia Table, irregular body, regular body, stop watch, sprit level, physical balance, weight box and Vernier calipers.

Formula used: The moment of inertia of the irregular body can be determined by following formula.

$$I_2 = I_1 \frac{(T_2^2 - T_0^2)}{(T_1^2 - T_0^2)}$$

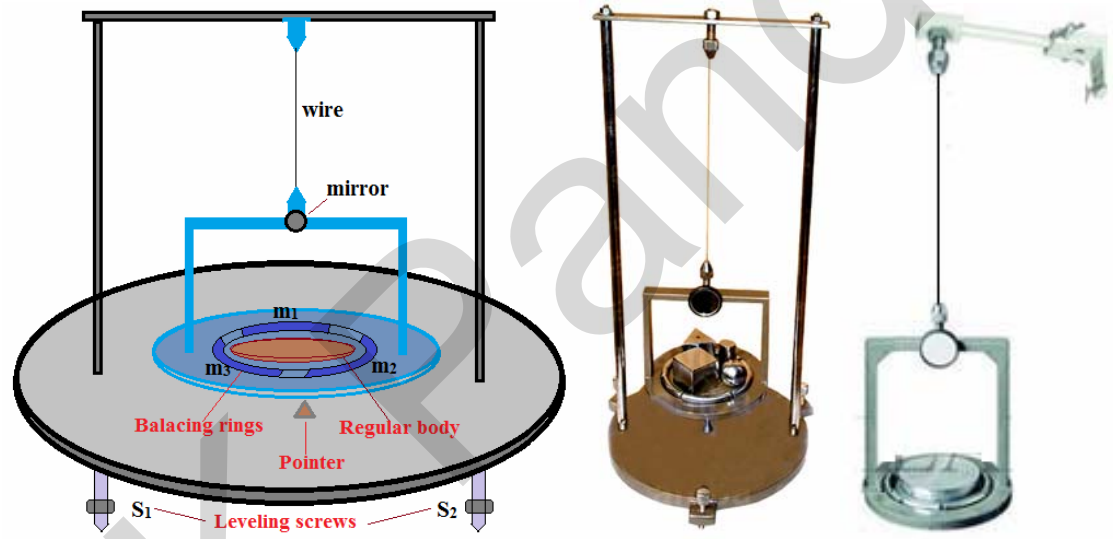
Where I_1: Moment f inertia of regular body, I_2: Moment f inertia of irregular body,

T_0: Time period of oscillation of inertia table, T_1: Time period of oscillation of regular body,

T_2: Time period of oscillation of irregular body,

If regular body is in shape of disc having radius R and mass M then, $I_1 = \frac{1}{2} M R^2$

Figure:



Procedure:

(1) Using sprit level, balance the plane of inertia table by rotating screws S_1 and S_2 so that its base becomes horizontal.

(2) Balance the inertia table by placing the balancing rings in grooves such that pointer in base of inertia disc just lies above the pointer on the base of base of inertia table.

(3) Give the slight twist to the table so that it begins to execute torsional in horizontal plane. Now note the time for 20 oscillations with lamp, scale, telescope arrangement or by eye. Repeat it three times. This will give you value of $T_0=t_0/20$.

(4) Now place the regular body on the table and do again the step 3. This will give you value of $T_1=t_1/20$.

(5) After it, place the irregular body on the table and do again the step 3. This will give you value of $T_2=t_2/20$.

(6) If given regular body is in shape of disc, then find its mass with help of physical balance and also find its diameter with help of Vernier calipers.

Observations:

(1) Least count of stop watch=…….sec

(2) ***Table for T_0, T_1 and T_2***

Sr. no.	Body	Time for 20 oscillations				Time Period (sec)
		Ist	2nd	3rd	Mean	
1.	Inertia Table alone	*A*	*B*	*C*	$t_0=(A+B+C)/3$	$T_0=t_0/20$
2.	Regular body	*P*	*Q*	*R*	$t_1=(P+Q+R)/3$	$T_1=t_1/20$
3.	Irregular body	*X*	*Y*	*Z*	$t_2=(X+Y+Z)/3$	$T_2=t_2/20$

(3) Mass of regular body=……..gm

(4) Least count of Vernier calipers = $\frac{value\ \text{of one division on main scale}}{Number\ of\ \text{divisions on vernier scale}}$ =……..cm

(5) Zero error in Vernier calipers =……..cm

(6) ***Table for diameter of regular body***

Sr. no.	M.S. (cm)	V.S. (div)	Un-corrected diameter (d= MS + CS x LC) (cm)	Mean un-corrected diameter (d: cm)	corrected diameter (D=d± zero error) (cm)
1.					
2.					
3.					
4.					
5.					
6.					

(7) *Radius of regular body (R)=D/2=…..cm*

Calculation: $I_1 = \frac{1}{2} M R^2$

$$I_2 = I_1 \frac{(T_2^2 - T_0^2)}{(T_1^2 - T_0^2)}$$

(Put all the values in the above formula and solve it with log method)

Results: The moment of inertia of irregular body= …….kg-m^2

Precautions:

1. The base and inertia table should always be horizontal.
2. The table should execute torsional vibrations only.
3. The amplitude of twist should be small so that the wire is not twisted beyond the elastic limit.
4. There should be no kink in wire.
5. Periodic time should be noted carefully.

Note: If irregular body is approximately in shape of thick hollow cylinder then you can check your result with an approximate calculation of I_2 with following formula.

$$I_2 = \frac{1}{2} m\left(R_1^2 + R_2^2\right),$$

Here m=mass of irregular body, R_1&R_2 : external and internal radius of thick hollow cylinder