(Prescribed as per new syllabus of SBTE, Bihar for the students of Part-II, Diploma in various branches of Engineering)
As a Sessional / Practical Paper
Under the Subject of:

"Engineering Mechanics Lab".

EXPERIMENT NO:-1

NAME OF EXPERIMENT: - **MOMENT OF INERTIA**

OBJECT:-To determine the moment of inertia of a fly wheel revolving about a fixed axis.

APPARATUS REQUIRED:-

(a) Wall Mounted Moment of Inertia Apparatus consisting of a fly wheel having its fixed axis shaft projected to wind rope over it,
(b) Stop watch-2 Nos
(C) Weight-1 Set
(d) Steel Tape of 3 meter Size -

THEORY:-If a weight W is attached to the cord wound round the shaft of a fly wheel is allowed to descend slowly through a measured height H cm the nos. of revolutions made by the wheel during this operation is N_1. If N_2 is the total nos. of revolutions made by the wheel from the start to stop then the Moment of Inertia I is given by

$$I = [WH / g] [(gt^2-2H) \{1-(N_1/ N_2)\}] / 8 p^2N_1^2 \quad kg\ cm\ ^2$$

Where: t = time of fall in seconds

DEDUCTION: - The total work done by gravity will be WH and up to the instant the weight is on the point of detaching the axle this work has been spent as follows:

(a) in giving K.E. to the falling weight "W"
(b) in overcoming the frictional resistance
(c) In giving K.E. to the wheel.

Let W kgf	=	Weight attached to the cord
H cm	=	height of its fall
t sec	=	time of its fall
v cm/sec	=	Velocity of weight as the cord is released from the axle
I kg cm^2	=	moment of inertia of the fly wheel
N_1	=	Nos. of rotations turned through by the wheel under the pull of W till the cord gets detached
w rad /sec	=	angular velocity of the wheel when the cord is released
N_2	=	total nos of rotations made by the wheel from start to stop

If v is the velocity of "W"

Therefore, when the weight just detach the axle the average velocity will be v/2

Hence, ½ v t = H

Or v = 2 H / t

And, Energy Acquired by the weight W = ½ (W / g) v^2

= (W / 2g) (4 H^2 / t^2

= (2 W H^2) / g t^2

So, the difference between WH & the K. E. acquired by the falling weight W represents the energy reaching the drum is spent in overcoming friction in giving K.E. to the wheel.

Energy reaching the fly wheel = WH – (2WH^2) / (gt^2)

= WH(1 + 2H / gt^2)

Ultimately, the whole of the energy is dissipated in overcoming frictional resistance out of the entire motion of the wheel, i.e. in N_2 revolutions and assuming that the frictional loss per revolution is constant.

Therefore loss per revolution = WH {(1- (2H) / (gt^2)} 1 / N_2

Energy loss when "W" is falling = WH {(1 – (2H) / (gt^2)} N_1 / N_2

Energy imparted to the wheel when the weight detaches the axle.

= [WH {(1- (2H) / (gt^2)}] -
[WH {(1 – (2H) / (gt^2)} N_1 / N_2]

Or, E =WH {1 – (2H) / (gt^2)} {1 – (N_1 / N_2)}

= ½ I w^2

Where w is the maximum angular velocity.

Now average revolutions / second = N_1 / t

And Maximum revolutions / sec = 2N_1 / t

w = Angular velocity at the instant "W" detaches from the axle of the fly wheel

= 4 p N_1 / t

Therefore E = ½ I w^2

Or, I = 2E / w^2

Therefore, I = 2WH {1-(2H) / (gt^2)} {1 – (N_1 / N_2)} / (16 p^2 N_1^2)} t^2

So, I = {WH/g} (gt^2- 2H) (1- N_1/N_2) / 8 p^2 N_1^2

PROCEDURE :- (I) A cord is wound on the axle of the wheel. At one end of the string a weight hangs and the other end is so attached that when the weight is allowed to fall freely the wheel rotates and when the weight is detached other end of the string gets detached from the axle.

(ii) Start with a weight of 1 kg and measure the height of the weight from the ground. Let the weight to fall slowly and measure the height of the weight at the time of detachment of cord from the axle. The difference between these two heights is the height of fall "H".(iii) Count the numbers of revolutions N_1 and time t(iv) Count the total numbers of revolutions N_2.

Repeat the above mentioned procedure at least for five times and find out the mean value of Moment of Inertia I.

EXPERIMENTAL RESULTS:-

Obser-vation No.	Weight in kg. W	Height of Fall in cm "H"	Time of Fall in sec "t "	N_1	N_2	Moment of inertia of the Wheel in kg.cm^2	Mean Value of "I"	Remarks if any
1								
2								
3								
4								
5								

PRECAUTIONS:-

(a) The load should not rest on the ground , it should hang freely
(b) All the joints should be carefully oiled to reduce its friction
(c) The movement of the load or effort during the experiment should be uniform through out the motion

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