**Round 1- Dynamics of Machine Lab**

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### Department: Mechanical Engineering

### Lab Submission Number: 143

### Discipline: Mechanical Engineering

### Name of the Lab: Dynamics of Machine Lab

### Name of experiment: Rim type flywheel

### Experiment Number: 9

### FOCUS AREA: Experimental Analysis Methods

**About the Experiment:**

In Rim type of flywheel, the mass of the flywheel is concentrated at the rim only i.e. not throughout the radius but only at the radius which is just opposite to disc type, thus imparting higher moment of inertia than disc type. Rim type flywheel is mounted on an axle, on the axle a small mass (bob) is tied with a thread and then the bob is released from rest. To calculate the time required for the mass to descend height **H**.

Use equation (1) and equation (2)

equating the torque and momentum of inertia

I×α=m×g×r    --------------------(1)

Hence, angular acceleration α is calculated,

Angular acceleration α is substituted in equation of motion thus, time taken for mass to descend height ‘H’ is obtained,

θ=ω0×t+0.5×α×t2   ---------------(2)

**1. Learning Objectives and Cognitive Level**

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| --- | --- | --- | --- |
| **S.No** | **Learning Objectives** | **Cognitive level** | **Action verb** |
| 1.Student will be able to: | Define the basic structure of Rim type flywheel and how to differentiate with other type of flywheel | Recall | Define |
| 2.Student will be able to: | Describe the behavior of Rim type flywheel when its rotating | Understand | Describe |
| 3. Student will be able to: | Identify the stress due to rotation | recall | identify |
| 4.Student will be able to: | Examine the time taken to reach the ground for metal bob while varying the radius and mass. Apply the angular acceleration equation and equation of motion to calculate the time in which mass will descend | Analyze | Examine |
| 5.Student will be able to: | Combine and compare the time taken to touch the ground by metal bob for both rim type and disc type flywheel | Create | Combine |

**2. Instructional Strategy**

### 2.1 Method: Expository

### 2.2 Assessment Method: Formative Assessment

2.3 Description: The animation of rim type flywheel is shown with front and top view for better visualization. The radius of flywheel and mass of metal bob can be varied to visualize the change in time taken for bob to touch the ground in the form of animation.

**3. Task & Assessment Questions**

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| --- | --- | --- | --- | --- |
| **S.No.** | **Instructions given by the Teacher** | **Tasks to be done by the Students** | **Assessment aligned with the task** | **LO associate with task** |
| 1. | Explain the complete working of flywheel and how it is useful for physical application | Understand the complete working of the available type of flywheel | Q1, Q5, Q12 | 2 |
| 2. | Explain how Rim type flywheel is different from other types of flywheel | Understand the concept of rim type of flywheel and how it is different from other type of flywheel | Q6, Q8 | 1 |
| 3. | Explain how principal stresses are generated in the rim wheel. | Understand the theory behind generation of stresses | Q4, Q10 | 3 |
| 4. | Explain how to measure angular acceleration and time of descent | Understand and apply the equation to calculate angular acceleration and time of descend | Q2, Q3, Q11, Q12 | 4 |
| 5. | Explain how to measure time of descend of mass at certain height by using equation of motion disc and rim type flywheel | Apply the concept to calculate the time of descend of mass at certain height for rim and disc type flywheel and compare the result | Q8, Q13 | 5 |

**Additional Assessment Question:**

### Which of the following statement is correct?

1. Flywheel does not reduce speed fluctuations during a cycle for a constant load, but flywheel does control the mean speed of the engine if the load changes.
2. Governor controls speed fluctuations during a cycle for a constant load, and governor also controls the mean speed of the engine if the load changes.
3. Governor controls speed fluctuations during a cycle for a constant load, but governor does not control the mean speed of the engine if the load changes.
4. Flywheel reduces speed fluctuations during a cycle for a constant load, but flywheel does not control the mean speed of the engine if the load changes

Answer: d

### A flywheel connected to a punching machine has to supply energy of 160 Nm while running at a mean angular speed of 12 rad/s. If the total fluctuation of speed is not exceeded to + 1.75%, the mass moment of inertia of the flywheel in kgm2 is

1. 56.25
2. 135.39
3. 31.75
4. 23.95

Answer: c

1. The coefficient of fluctuation of speed of Flywheel is given by
2. (N1+N2)/N
3. (N1-N2) x N
4. (N1-N2)/N
5. (N1+N2) + N

Answer: c

1. What types of stresses are set up in the rim of the flywheel?

1. Tensile stress due to the centrifugal force
2. Shrinkage stresses due to the unequal rate of cooling of casting
3. Tensile bending stress due to restraint of the arms
4. All the above

Answer: a

1. Why flywheels are used in punching machines? Which of the following statement is correct?

Statement A: It decreases the fluctuation of speed due to difference in output and input

Statement B: It decreases the variation of speed during each cycle of punching machine.

1. Statement A is correct, and Statement B is wrong
2. Statement B is correct, and Statement A is wrong
3. Both Statements are correct
4. None of the above statements are correct

Answer: c

# Why is the rim type of flywheel is used over the disc type of flywheel?

1. Rim type has less weight compared to disc type of flywheel.
2. Rim type has more weight compared to disc type of flywheel.
3. Disc type of flywheel has more weight than rim type
4. None of the above

Answer: a

1. The radius of Gyration (k) for Rim Type Flywheel having radius ‘r’ is given by
2. k = 2r
3. k=r/2
4. k=r
5. k=r/3

**Answer:** k=r

1. What is the value of the radius of gyration of the disc type flywheel as compared to rim type flywheel for the same diameter?

a) 21/2times

b) 1/ (21/2) times

c) 2 times

d) 1/2 times

**Answer:** 1/ (21/2) times

1. The energy is stored in Flywheel in form of
2. Potential energy
3. Kinetic energy
4. Heat energy
5. Electrical energy

**Answer:** Kinetic energy

1. The radial stress in a hollow circular rotation disc is at
2. The inner radius
3. The outer radius
4. The mean radius
5. The geometric mean radius

Answer (d)

11. For a certain engine having an average speed of 1200 rpm, a flywheel approximated as a solid disc, is requires for keeping the fluctuation of speed within 2% about the average speed. The fluctuation of kinetic energy per cycle is found to be 2 kJ. What is the least possible mass of the flywheel if its diameter is not to exceed 1 m?

(A) 40 kg

(B) 51 kg

(C) 62 kg

(D) 73 kg

Answer b

12. The ratio of the maximum fluctuation of speed to the mean speed is called

(a) fluctuation of speed

(b) maximum fluctuation of speed

(c) coefficient of fluctuation of speed

(d) none of these

Answer c

13. A rim type flywheel is mounted on an axle, on the axle a small mass (bob) is tied with a thread and then the bob is released from rest. Calculate the time required for the mass to descend height 120cm. If the radius of the axel is 5 cm and radius of flywheel is 50 cm and the mass of the bob is 15 kg

a) 4.7 s

b) 5.7 s

c) 6.7 s

d) 5.5 s

answer a

**4. Simulator Interactions**

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| --- | --- | --- | --- |
| **Sr. No.** | **What students will do?** | **What Simulator will do?** | **Purpose of the task** |
| 1. | See the displayed objectives and apparatus used then click on next button | Display objective and apparatus used | Recall the experiment |
| 2 | Change the values of radius and mass of the bob by scrolling the values available in variable section | Display the value of mass(bob) like radius of the bob and mass | To provide basic environment to start the experiment |
| 3 | Click on the play button | Start the simulation | To start the simulation |
| 4 | Note the value of time | Display time taken to reach the ground | To make student calculate the data |
| 5 | Calculate the time taken by mass(bob) manually | Display observation | To check for the calculated data whether it is correct or not |