**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:**

A flywheel is a mechanical device which is designed to efficiently store rotational energy. It is an inertial energy-storage device. It absorbs mechanical energy and serves as a reservoir, storing energy during the period when the supply of energy is more than the requirement and releases it during the period when the requirement of energy is more than the supply.

Flywheels have an inertia called the moment of inertia and thus resist changes in rotational speed. The amount of energy stored in a flywheel is proportional to the square of its rotational speed. A flywheel is a spinning wheel or disc with a fixed axle so that rotation is only about one axis.

The single cylinder engine is a prime candidate for the use of a flywheel. The intermittent nature of its power stroke makes one mandatory as it will store kinetic energy needed to carry the piston through the Otto cycle’s exhaust, intake, and compression stroke during which work must be done in the system.[1]

An imported application of a flywheel is in a mechanical press where for a fraction of time high energy is required for actual punching, shearing or forming. This energy is supplied by the flywheel. During the longer non active period, the speed of the flywheel is built up slowly by a low powered motor. Thus, the motor is not overloaded and also results in energy saving.[2]

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.

**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: | Assess the angular acceleration equation and equation of motion to calculate the time in which mass will descend | Evaluate | Evaluate |
| 4.Student will be able to: | Combine and compare the time taken by the flywheel to come to rest after the string is detached from the axle. | 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 side view for better visualization. The radius of flywheel and mass of metal bob can be varied to visualize the change in time taken by the flywheel to come into rest after the string is detached from the axle with the help of amination. For better understanding user can enter the experimental and theoretical moment of inertia and compare with the simulation results.

**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** |
| 1. | E**x**plain the significance of this experiment in real world applications. | Understand the significance of the experiment and recall its applications. | Q9, Q6 |
| 2. | 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 |
| 3. | Explain how Rim type flywheel is different from other types of flywheel | Understand the concept of disc type of flywheel and how it is different from other type of flywheel | Q6, Q8 |
| 4. | Explain the detail procedure of the experiment | Understand the concept and apply it properly to get the desired result | Q1 |
| 5. | Compare the angular velocity and number of turns after the bob touches the ground | Understand and apply the concept of moment of inertia to calculate moment of inertia and n2 | Q2, Q3 |
| 6. | Explain how to measure time of descend of mass at certain height by using equation of motion | Understand and apply the concept to calculate the time of descend of mass at certain height | Q8 |

**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

**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 | Calculate the moment of inertia theoretical and experimental, and then click on the “Submit” Button | Allow user to enter the calculated value | To provide basic environment to start the calculation |
| 5 | Compare the results with the simulation results | Display experimental and theoretical moment of inertia in comment box and percentage error | To make student calculate and compare the results |