**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: Balancing of multiple mass in single plane

### Experiment Number: 6

### FOCUS AREA: Experimental Analysis Methods

**About the Experiment**:

The balancing of rotating mass in single plane experiment is carried out to calculate the additional mass required for balancing the unbalance moment and also to find out the angular position of the additional masses used for balancing. The purpose of the experiment is to take an unbalanced system with rotating masses and adjust the radii and angles of the two outer masses in order to achieve a balanced system. It was initially observed that the system was unbalanced because of excessive vibration but calculating the correct radii and angles for the outer masses and adjusting them accordingly resulted in a balanced system and very little vibration was present.

1. **Learning Objectives and Cognitive Level:**

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| **Sr. No** | **Learning Objectives** | **Cognitive level** | **Action verb** |
| 1. Students will be able to: | List the reasons for balancing of rotating mass | Recall | List |
| 2. Students will be able to: | Identify instruments used in the experiment | Recall | Identify |
| 3. Students will be able to: | Describe conditions to be satisfied to achieve balance in rotating bodies | Understand | Describe |
| 4. Students will be able to: | Solve the mathematical equations acting on the rotating body | Apply | Solve |
| 5. Students will be able to: | Examine the analytical results with the simulation results | Analyse | Examine |
| 6. Students will be able to: | Evaluate how change in mass and position can improve the balance of the rotating body | Evaluate | Evaluate |

**2. Instructional Strategy:**

### 2.1 Method: Expository

### 2.2 Assessment Method: Formative Assessment

### 2.3 Description: The simulation shows the animation of the two masses rotating, for better understanding one can vary the masses and radii and this will cause the changes in the animation. The space is given to submit the calculated balancing mass and angle and comparing with the simulation. The animation will change after adding the calculated values which gives better visual understanding.

### 3. Task & Assessment Questions:

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| **Sr. No.** | **Instructions given by the Teacher** | **Tasks to be done by the Students** | **Assessment question aligned with the task** |
| 1. | Explain the significance of this experiment in real world applications. | Understand the significance of the experiment and recall its applications. | Q3, |
| 2. | Display/show the different Instruments used in the experiment. Explain the significance of each Instrument and its use in the experiment. | Recall the various Instruments used in the experiment and understand its significance. | Q8 |
| 3. | Explain the step by step procedure to be carried out in the experiment. | Understand the procedure to be followed to conduct the experiment. | Q1, Q2, Q5 |
| 4. | Explain how to use the various equipment’s used in the experiment. | Follow the instructions carefully in order to get the required outcome such as acceleration | Q6, Q7 |
| 5. | To carryout necessary calculations required for the experiment | To do the necessary calculations required | Q4, Q12, Q11 |
| 6. | To notice the outcome of the experiment | Observe the outcome of the experiment | Q10, |
| 7. | Observations to be noted down. | Note down the mass and position of the balancing mass. | Q9, |

### Additional Assessment Questions:

### If a wheel of radius R rolls without slipping through an angle θ, what is the relationship between the distance the wheel rolls, x, and the product Rθ?

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### Need to be drawn

### a) x > Rθ.

### b) x = Rθ.

### c) x < Rθ.

### Answer: b

### Explanation: None

### The single plane balancing is applicable only to thin disks or rotors where unbalance is only

### Two planes

### One plane

### Three planes

### Four planes

### Answer: b

### Balancing of rotating and reciprocating parts of an engine is necessary when it runs at

### slow speed

### high speed

### moderate speed

### All the above

### Answer: b

### A rigid body is in equilibrium if

### τnet = 0

### Fnet = 0

### Both a and b

### Answer: c

1. Balancing of multiple mass in single plane the net force and moment should be-
2. Net force > net moment
3. Net moment > net force
4. Net force = 0, net moment ≠ 0
5. Net force = 0, net moment = 0

**Answer:** Net force = 0, net moment = 0

1. Balancing is a method of correcting or eliminating unwanted inertia forces and couples in rotating and reciprocating parts of the machine
2. True
3. False

**Answer:** True

1. A system of rotating masses is said to be in dynamic balance if any resultant centrifugal force or couple does not exist.

A) False

B) True

**Answer:** True

8) Which of the following factors are not responsible for unbalancing in rotating systems?

A) Errors

B) Tolerance

C) Shape of the rotor

D) None of the above

**Answer:** None of the above

9) For dynamic balancing of a shaft,

A) the net dynamic force acting on the shaft is equal to zero

B) the net couple due to dynamic forces acting on the shaft is equal to zero

C) both (A) and (B)

D) none of the above **Answer:** both (A) and (B)

10) A disturbing mass m1attached to a rotating shaft may be balanced by a single mass m2 attached in same plane of rotation as that of m1 such that

A) m1.r2 =m2.r1

B) m1.r­2 = m2.r2

C) m 2.m1 = r1.r2

D) none of the above

**Answer:** B

11) For a balanced system force polygon should exist.

A) false

B) true

**Answer:** True

12) Example 21.1. Four masses m1, m2, m3and m4are 200 kg, 300 kg, 240 kg and 260kgrespectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and0.3m respectively and the angles between successive masses are 45°, 75° and135°.Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m.

A) 116 kg and 201.48°

B)111 kg and 201.48°

C)100 kg and 210.48°

D)116 kg and 210.48°

**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 | Display the apparatus with default values of masses and radii rotating about a plane | Recall the experiment |
| 2. | Change the mass and radii as per required | Display table to change radii and mass and also angle theta | To change the mass and radii as required |
| 3. | Observe the vibration in the apparatus | Display the bodies rotating as per the entered values | To display the required masses with required radii rotating |
| 4. | Enter the radii for the balancing mass | Display place to add the value of radii of the balancing mass | To specify the radii of the balancing mass |
| 5. | Enter the calculated mass and angle | Display provision to add the calculated mass and angle of the balancing body | To specify the mass and angle of the balancing body |
| 6. | Click on the start button | Display start button | To start the simulation with the balancing body |

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