P.S.R. ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)
(An ISO 9001 : 2008 Certified Institution)
Sevalpatti (P.O), Sivakasi - 626140.
TamilNadu

DEPARTMENT OF MECHANICAL ENGINEERING

161ME58
DYNAMICS LABORATORY MANUAL

B.E. Mechanical Engineering
III Year / V Semester
(2019-2020)

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Rev : 02
June : 2019

Prepared By
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12/6/2019
HOD/Mech
Head Of the Department
Department of Mechanical Engineering
P.S.R. Engineering College
Sevalpatti, Sivakasi - 626 140

P.S.R. Engineering College

Vision & Mission Statement

Vision

- To contribute to the society through excellence in technical education with societal values and thus a valuable resource for industry and the humanity

Mission

- To create an ambience for quality learning experience by providing sustained care and facilities
- To offer higher level training encompassing both theory and practices with human and social values
- To provide knowledge based services and professional skills to adapt tomorrow's technology and embedded global changes

Department of Mechanical Engineering

Vision & Mission Statement

Vision

- To provide broad-based education and training in mechanical engineering and its applications to enable the graduates to meet the demands in a rapidly changing needs in industry, academia and society

Mission

- To impart high quality technical education and training that encompasses both theory and practices with human and social values
- To equip the students to face tomorrows technology embedded global changes
- To create, explore, and develop innovations in mechanical engineering research

Department of Mechanical Engineering

Programme Specific Outcomes

PSO 1 - Apply the concepts of mathematics and science in mechanical systems

PSO 2 - Design and analyze components and systems for mechanical engineering applications

PSO 3 - Synthesis data and technical concepts for application to mechanical engineering software

PSO 4 - Apply manufacturing and management practices in industries

Programme Outcomes of Mechanical Engineering

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Lifelong learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

161ME58	DYNAMICS LABORATORY	L	T	P	C
		0	0	3	2

Programme: B.E. Mechanical Engineering **Sem:** 5 **Category:** PC
Aim: To educate the students to apply the kinetic solutions to various experiments
Course Outcomes:
The students will be able to
CO1. Know the functions of kinematic links and its mechanisms
CO2. Interpret the fundamentals of the natural frequency of free vibration of fixed beam
CO3. Find the gyroscopic effect
CO4. Determine the basic concepts of governor apparatus
CO5. Identify the different cam profile mechanisms
CO6. Enumerate the critical speed of shaft

LIST OF EXPERIMENTS

1. Study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2. Study of kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
3. Determination of Mass moment of inertia of Fly wheel and Axle system.
4. Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
5. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
6. Determination of gyroscopic effect and couple.
7. Determination of range sensitivity, effort etc., for Watts, Porter and Proell Governors.
8. Cam profile and Motion curve drawings
9. Determination of natural Frequency and verification of Laws of springs in Single degree of freedom Spring Mass System.
10. Determination of torsional natural frequency of single and Double Rotor systems.
11. Vibration of Equivalent Spring mass system.
12. Determination of critical speeds of shafts.
13. Balancing of rotating masses
14. Transverse vibration of Free-Free beam – with and without concentrated masses.

Total Periods: 45

LIST OF EQUIPMENTS

S. NO	Description of Equipment	Quantity Required
1.	Cam Analyzer	1 No.
2.	Motorized Gyroscope	1 No.
3.	Governor Apparatus - Watt, Porter, Proell and Hartnell governors.	1 No.
4.	Whirling of Shaft Apparatus	1 No.
5.	Static and Dynamic Balancing Machine	1 No.
6.	Vibrating Table	1 No.
7.	Vibration Test Facilities Apparatus	1 No.
8.	Gear Model	1 No.
9.	Kinematic Models to Study Various Mechanisms	1 No.

<table>
<tr><td rowspan="3">Evaluation Criteria & Marks</td><td colspan="3">Continuous Assessment (25)</td><td rowspan="2">End Semester Examination</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Model Exam</td><td>Observation & Record Work</td><td>Attendance (10%)</td></tr>
<tr><td>7.5</td><td>15</td><td>2.5</td><td>75
[Min Pass: 37]</td><td>100
[Min Pass: 50]</td></tr>
<tr><td>Attendance Mark</td><td colspan="5">91% and above – 10, 86-90% - 8, 81-85% - 6, 76-80% - 4, 75% - 2</td></tr>
<tr><td>Grade Criteria</td><td colspan="5">O (90-100), A+ (80-89), A (70-79),B+ (60-69), B (50-59), (<50)-RA</td></tr>
</table>

Course Outcomes	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2					3			2		3	1	3
CO2	3	2		3					3			2		3	2	3
CO3	2	3		2					3			2		2		3
CO4	3	3		2					3			2		2		2
CO5	3	3		2					3			2		3		3
CO6	3	2		3					3			2		2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

MODES OF DELIVERY

Course Name with Code	Course Content						
	Lab Manual	Viva Questions	PPT	Videos	Group Activity (Quiz, Case Studies and others)	Industrial Training/ Industrial visit	Mini Project
161ME58- Dynamics Laboratory	✓	✓	✓	✓	✓		

CONTENTS BEYOND THE SYLLABUS

Course Name with Code	Content
161ME58 Dynamics Laboratory	• Natural frequency of free vibration • Vibration measurement

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE PLAN

Subject Code: 161ME58 | Year/ Sem/Sec: III / V / **I &** II

Subject Name: DYNAMICS LABORATORY | Branch : MECHANICAL

Aim: To educate the students to apply the kinetic solutions to various experiments

Course Objectives:
a) To apply natural frequency of vibration
b) To study the various gear parameters
c) To understand the concepts of vibration analysis

Course Outcomes: At the end of the course, the students will be able to
1. Know the functions of kinematic links and its mechanisms
2. Interpret the fundamentals of the natural frequency of free vibration of fixed beam
3. Find the gyroscopic effect
4. Determine the basic concepts of governor apparatus
5. Identify the different cam profile mechanisms
6. Enumerate the critical speed of shaft

S. No	**Topics to be Covered**	**No of Periods**	**Cumulative Periods**
1.	Fixed Beam Vibration With Central Point Load	2	2
2.	Fixed Beam Vibration With Eccentric Point Load	2	4
3.	Natural Frequency Of Free Transverse Vibration Of Cantilever Beam	3	7
4.	Turn Table Apparatus	2	9
5	Determination Of Spring Force By Using Watt's Governor	2	11
6.	Determination Of Sensitivity Effort For The Proell Governor	2	13
7.	Dynamic Analysis Of Cam Mechanism	3	16
8.	Bifilar Suspension	3	19
9.	Motorized Gyroscope	2	21
10.	Simply Supported Beam Vibration With Point Load	3	24
11.	Whirling Of Shaft	3	27
12.	Compound Pendulum	3	30
13.	Free Torsional Vibration Of Single And Two Rotor System	3	33
14.	Wheel And Axle System	3	33
15.	Static And Dynamic Balance Of Rotor	3	36
16.	Study Of Gear Parameters And Gear Trains	3	42
17.	Study Of Kinematics Of Various Mechanisms And Universal Joint	3	45
	TOTAL PERIODS		**45**

CONTENTS

S. No	Name of the Experiments	MARKS	SIGNATURE
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			

TABULATION:

Sl. No.	Load in Kg	Deflection in m			Frequency in Hz
		Loading	Unloading	Average	

OBSERVATIONS:

Width of the beam b =------------------ in mm

Depth of the beam d =

Length of the beam l =

Ex. No. : 1 **FIXED BEAM VIBRATION WITH CENTRAL POINT LOAD**

Date :

AIM:

To determine the natural frequency of free transverse vibration of fixed beam with central point load.

APPARATUS REQUIRED:

- Main frame – made from channel about 1.2 m length.
- Trunnion - Two brackets of trunnion bearing with slots to insert beam fitted at 1 m apart.
- Weights.

FORMULA TO BE USED:

Natural frequency ( ) =

Where δ = deflection = m

Take E = 2 x 10^5 N/mm^2, I = ….

PROCEDURE:

- Proper lubrication is ensured for bearings.
- Beam is fitted into both slots of trunnion bearings and is tightened.
- Weights are added on the load hanger, deflection and frequency are calculated and are tabulated.

GRAPH:

The graph is drawn by taking load in x-axis and deflection in y-axis.

RESULT:

Thus the natural frequency of free transverse vibration of fixed beam with central point load is determined and the graph is plotted.

1) Natural frequency by analytical method =
2) From graph =

TABULATION:

Sl. No.	Load in Kg	Deflection in m			Frequency in Hz
		Loading	Unloading	Average	

OBSERVATIONS:

Width of the beam b =

Depth of the beam d =

Length of the beam l =

Distance from load to left support a = Distance from load to right support b =

Ex. No. : 2 **FIXED BEAM VIBRATION WITH ECCENTRIC POINT LOAD**

Date :

AIM:

To determine the natural frequency of free transverse vibration of fixed beam with Eccentric point load.

APPARATUS REQUIRED:

- Main frame – made from channel about 1.2 m length.
- Trunnion - Two brackets of trunnion bearing with slots to insert beam fitted at 1 m apart.
- Weights.

FORMULA TO BE USED:

Natural frequency ( ) = …… Hz

Where δ = deflection = m

Take E = 2 x 10^5 N/mm^2, I = …. m^4

PROCEDURE:

- Proper lubrication is ensured for bearings.
- Beam is fitted into both slots of trunnion bearings and is tightened.
- Weights are added on the load hanger, deflection and frequency are calculated and are tabulated.

GRAPH:

The graph is drawn by taking load in x-axis and deflection in y-axis.

RESULT:

Thus the natural frequency of free transverse vibration of fixed beam with eccentric point load is determined and the graph is plotted.

1) Natural frequency by analytical method =
2) From graph =

TABULATION:

Sl. No.	Applied Weights (Kg)	Deflection (mm)			Frequency (HZ)
		Loading	Unloading	Average	

Ex. No. : 3

Date :

NATURAL FREQUENCY OF FREE TRANSVERSE VIBRATION OF CANTILEVER BEAM

AIM:

To determine the natural frequency of free transverse vibration of Cantilever beam.

APPARATUS REQUIRED:

- Cantilever beam with displacement measuring system.
- Set of weights.

FORMULA TO BE USED:

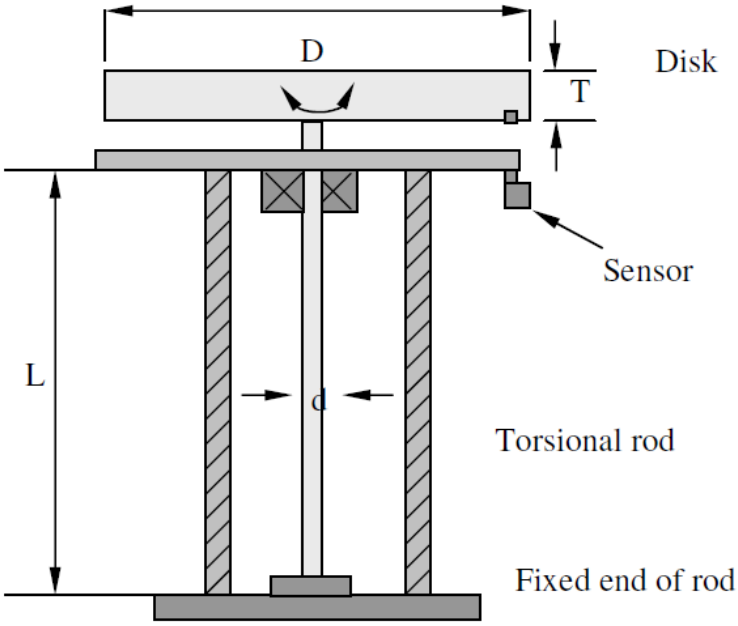
Natural Frequency = Where δ = deflection in m.

PROCEDURE:

- Power supply is switched on.
- Read mode is calibrated to zero by switching to read mode.
- Calibration mode is set to 10.00 by changing the switch to calibration mode.
- Ensure zero in the read mode by again switch to read mode.
- Load is placed on the hanger in the steps of 0.5 kg and deflections are noted during loading and unloading positions and are tabulated.
- The frequency is calculated by using the above formula

RESULT:

The Natural Frequency of free transverse vibrations of helical spring is-------------- Hz



OBSERVATIONS:

1. Weights added on each side W = kg
2. Initial distance of total weight from axis r_1 = cm
3. Final distance of weight from axis r_2 = cm
4. Speed of disc motor (N) = rpm
5. Time for change in position of weights from r_1 to r_2 = sec

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Ex. No. : 4 **TURN TABLE APPARATUS**

Date :

AIM:

To determine i) Angular velocity ii) Angular acceleration iii) Mass moment of inertia and iv) Centrifugal force using turn table apparatus. APPARATUS REQUIRED:

- Turn table apparatus experimental setup.
- Set of weights
- Stop watch

THEORY

Mass moment of inertia of machine member such as connecting rod, flywheel plays an important role for the evaluation of inertia force and consequent stress in various members of the machine. Moment of inertia of flywheel or other rotating member, contributes for kinetic energy stored and consequent fluctuation of speed due to variable input or loading condition. Certain machine members have complicated shape and theoretical determination of mass moment of inertia is tedious and time consuming. With the use of Turn Table apparatus we can find the moment of inertia of any object easily.

FORMULAS USED:

- Initial velocity V_1=................................m/s
- Final Velocity V_2 =................................m/s
- Angular acceleration a =................................ m/
- Centrifugal force f = ... N
- Mass moment of inertia I = m. ……………..kg-m^2 Where $D_1 = 2\ r_1$ …… m. , $D_2 = 2\ r_2$ …….m , N = speed inrpm

PROCEDURE:

- Initial setup is made by adjusting the weights to the original position and the distance is noted.
- Power supply is switched on.
- Then the speed is gradually increased by adjusting the knob.
- After sometime any one of the weights is moved to the extreme end of the rod.
- Stop watch is started to note the time taken.
- The other weight is also reached the extreme position of the rod.
- Stop watch is stopped and the readings ie., time, speed and the distance are noted.
- Speed is decreased to zero and power supply is switched off.

RESULT:

Thus the experiment on turn table apparatus was done.

i) Initial velocity = ------ m/s
ii) Final Velocity = ------ m/s
iii) Angular acceleration (a) = ------- m/s^2
iv) Mass moment of inertia (I) = ------- kgm^2
v) Centrifugal force (F) = ------- N
vi) TABULATION:

TABULATION:

Sl. No.	Motor Speed(rpm)	Angular velocity (w) rad/s	Sleeve displacement (X) mm	Height (h) mm	$\alpha = \cos^{-1}$ (h/L) (α) degrees	Radius of rotation (r) m	Force (F) kgf

OBSERVATIONS:

Length of each link (L) =

Initial height of governor (h_o) =

Initial radius of rotation (r_o) =

Weight of each ball assembly (w) =

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Ex. No. : 5 **DETERMINATION OF SPRING FORCE BY USING WATT'S GOVERNOR**

Date :

AIM:

To determine the spring force by using watt's governor and to draw its characteristic curves.

APPARATUSREQUIRED**:**

- Watt's governor apparatus.
- Digital tachometer
- Steel rule.

FORMULASUSED**:**

1. Angular velocity ( ) = ……rad/s.
2. Height of the governor (h) = – ….. mm
3. $\alpha = \cos^{-1}$………………degrees
4. Radius of rotation (γ) = 50 + L sin α ….m
5. Spring force (F) = r..................kgf

Where X = sleeve displacement in mm.

= Initial height of governor in mm L = Length of each link in mm

= Initial radius of rotation in mm W = weight of each ball in kgf.

PROCEDURE:

When the control unit is switched on and the speed control valve is slowly rotated it increases the governor speed until the center sleeve rises off the lower stop and aligns with first division on the graduated scale. The sleeve positions and speed are then recorded. Speed may be determined using Digital tachometer. The governor speed is increased in steps to give suitable sleeve movement and readings are repeated at each stage throughout the range of sleeve movement possible.

The result may be plotted as curves of speed against sleeve position. Further test are carried out changing the value of one variable at a time to produce a family of curves.

GRAPHS:

The following graphs are plotted.

- Radius of rotation vs force
- Displacement vs speed.
-

RESULT:

Thus the spring force using watt's governor is determined and its characteristics curves are plotted.

TABULATION

Sl. No.	Sleeve displacement X (mm)	Speed N (RPM)	Radius of Rotation r (cm)

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Ex. No. : 6

DETERMINATION OF SENSITIVITY EFFORT FOR THE PROELL GOVERNOR

Date :

AIM

To determine the sensitiveness, effort and various characteristics of the Watt, Porter, Proell and Hartnell Governors

DESCRIPTION

In the Proell Governor, with the use of fly weights (Forming full ball) the governor becomes highly sensitive. Under these conditions large sleeve displacement is observed for very small change in speed.

In order to make it stable, it is necessary to carry out the experiments by using half ball fly weight on each side.

DIMENSIONS

(1) Length of each link 'L'	=	mm
(2) Initial height of governor h_0	=	mm
(3) Initial radius of rotation r_0	=	mm
(4) Weight on sleeve.	=	kg
(5) Weight of each ball.	=	gm
(6) Extension of length BG.	=	mm

Go on increasing the speed gradually and take the readings of speed of rotation 'N' and corresponding sleeve displace- X complete the following table

Draw the following Graphs

1. Speed Vs Sleeve displacement 'X'
2. Keeping static position draw the graph of sleeve displacement vs radius of rotation of balls by actual measurement.
3. Plot the graph of sleeve displacement vs speed when the governor is rotating.

RESULT

Thus the sensitivity and effort of governors of various types are found and the related graphs are drawn.

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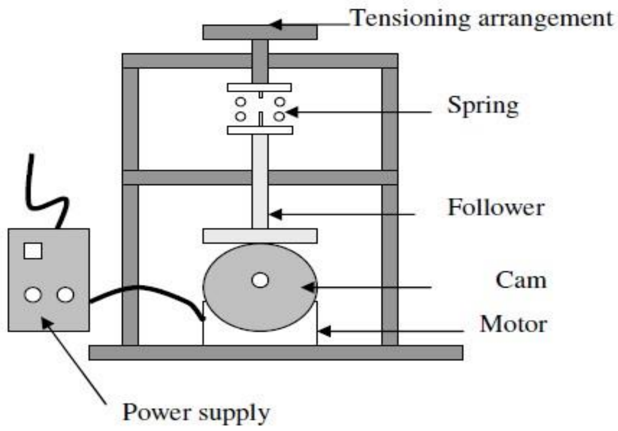

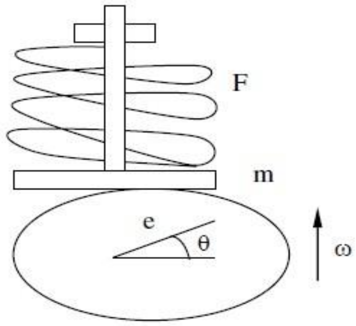

TABULATION:

Sl. No.	Angle (degree)	Distance (mm)	Displacement from Dial Gauge (mm)

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Ex. No. : 7 **DYNAMIC ANALYSIS OF CAM MECHANISM**

Date :

AIM:

To draw the follower displacement diagram for given cam profile.

APPARATUSREQUIRED**:**

- Cam analysis machines with cam.
- Follower.
- Set of weights
- Controller bar
- Dial gauge

THEORY

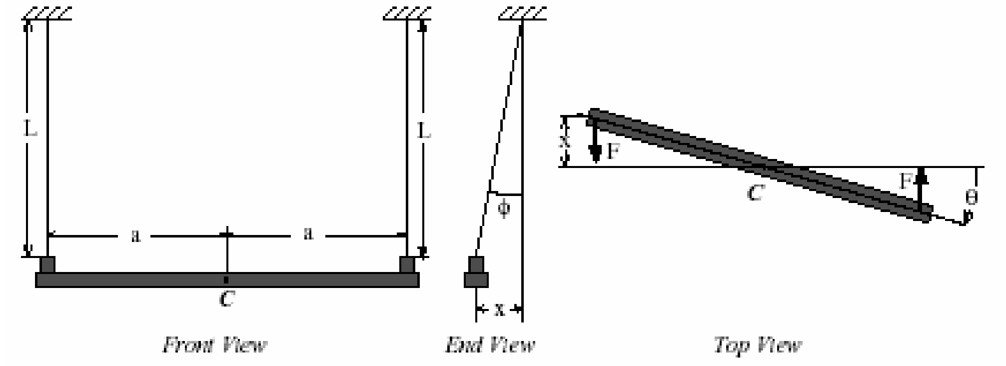
A reciprocating or oscillating cam is subjected to acceleration or angular acceleration and retardation. During retardation, the contact between cam and follower is maintained by spring force. The force required for retardation, F = m × f where, m is the mass of the follower and f is the retardation. If F is less than m × f, then the follower will not follow the cam profile and gap will be created. This phenomenon is called cam jump. The retardation f depends on square of angular of cam. In other words, as angular speed is increased, at one particular speed cam jump will occur, corresponding to a spring setting. The minimum speed at which cam jump occurs can be determined.

PROCEDURE:

- Dial gauge is set to zero by rotating the hand wheel attached to the cam.
- Reading of the displacement scale is noted as zero.
- The hand wheel is rotated in steps of 20^{O} for one complete revolution.
- Readings are tabulated ie., displacement from dial gauge, distance from linear scale are noted.
- The graph is plotted by taking crank angle in x-axis and distance in y-axis and the follower displacement diagram is drawn.

RESULT:

Thus the dynamic analysis of cam is observed and the follower displacement diagram is drawn.



TABULATION:

S.No.	H (cm)	Time taken for 10 oscillations (Seconds)	Frequency of oscillation (f_n)	Radius of Gyration(K)

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Ex. No. : 8 **BIFILAR SUSPENSION**

Date :

AIM:

To determine the radius of gyration using bifilar suspension.

APPARATUS REQUIRED:

Bifilar suspension arrangement.

THEORY

A uniform rectangular bar is suspended by strong cord from the pin vices of the sub frame. It is drilled at regular intervals along its length to accept two pegged masses. By measuring the periodic time of torsional vibration for various lengths of suspension, values for the radius of gyration of the bar assembly can be found and compared with the theoretical value.

PROCEDURE:

- The bifilar suspension strings are attached in the chucks mounted on the top of the beam present in the frame.
- The strings are adjusted to equal lengths.
- Required weights are fixed over the beam of bifilar.
- System is oscillated about the vertical axis passing through the center of beam.
- Time required for 'n' oscillations is noted. Say n = 10.
- The procedure is repeated by changing the length of the suspension.

FORMULA TO BE USED:

For Bifilar suspension

=

Where = frequency of oscillations, CPS

b = Distance of string from center of gravity = 28

cm. L = Length of strings in m = h

K = Radius of

gyration K =

=

= sec

RESULT:

Thus the radius of gyration of a body using bifilar suspension is determined.

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$$F_n \quad \frac{1}{2\pi} \times \frac{b}{k} \sqrt{\frac{g}{l}}$$

f_n

$$\frac{1}{2\pi} \times b \times f_n \times \sqrt{\frac{g}{l}}$$

$$f_n \quad \frac{1}{t_{expt}}$$

$$t_{expt} \quad \frac{\text{time taken for 10 oscillaitons}}{10}$$

TABULATION:

Sl. No.	Rotor speed in RPM	Weight Added		Time for 45^{O} Precession in seconds	Applied torque in N-m	Gyroscopic couple in N-m
		KG	N			

OBSERVATION:

Radius of the disc (r) =
Mass of the disc (m)
Thickness =
Distance of weight from center of disc (x) =

Ex. No. : 9 **MOTORISED GYROSCOPE**

Date :

AIM:

To determine the gyroscopic couple applied to the spinning motor with gyroscope.

APPARATUS REQUIRED:

- Stop watch.
- Dead weight.
- Measuring tape.
- Digital Tachometer.

THEORY

Gyroscope is a body, which, while spinning about an axis, is free to rotate in either directions under the action of external forces. Schematic arrangement of Gyroscope is as shown in the Figure. The motor is coupled to the disc rotor, which is balanced. The disc shaft rotates about 'X-X' axis in two-ball bearing housed in the frame No.1. This frame can swing about 'Y-Y axis in bearings provided in the yoke type frame No.2. While in a steady position, Frame No.1 is balanced. The yoke frame is free to rotate about vertical axis 'Z-Z'. Thus freedom of rotation about three perpendicular axis is given to the rotor

A) AXIS OF SPIN

If a body is revolving about an axis is known as axis of spin. (XX is the axis of spin).

B) PRECESSION

Precession means the rotation about the third axis OZ which is perpendicular to both the axis of spin 'XX' and that of couple 'YY'.

C) AXIS OF PRECESSION

The third axis OZ is perpendicular to both the axis of spin 'XX' and that of couple 'YY' is known as axis of precession.

D) GYROSCOPIC EFFECT

To a body, revolving (or spinning) about an axis say 'OX'. If a couple represented by a vector OY perpendicular to 'OX' is applied, the body tries to precess about an axis 'OZ' which is perpendicular both to 'OX' and 'OY'. Thus the plane of spin, plane of precession and plane of gyroscopic couple are mutually perpendicular. The above combined effect is known as precession or gyroscopic effect

FORMULA TO BE USED:

1. Moment of inertia I = m ……. Kg – m^2
2. Angular velocity of spin ω = ….. rad/s.
3. Angular velocity of precession = …..rad/s
4. Gyroscopic couple c = I ω …..N-m.
5. Torque applied T = W

   …..N-m Where x = distance of weight from

   center of disc.

PROCEDURE:

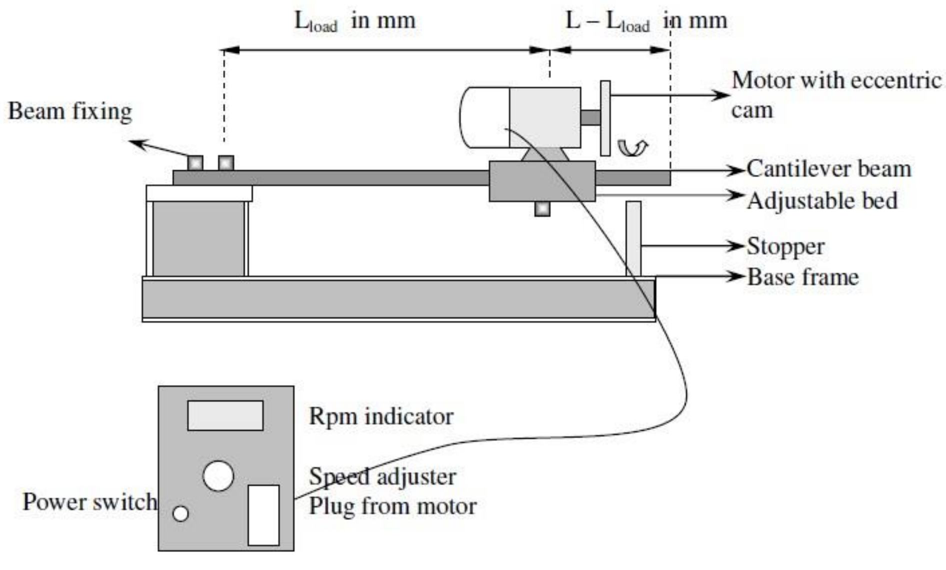
- The rotor is checked for vertical position and the balance weight is adjusted if required.
- The time is to be kept at zero position and the supply is switched on.
- The rotor is started by applying the voltage of ground no volts and then reduced. The speed of the rotor is to be adjusted as required.
- The rotor speed is to be noted using digital tachometer. The speed is to be noted when it becomes steady.
- At the same instant the required weight is to be added on weight pan.
- The time for 10 precession is noted down by using stop watch.

PRECAUTIONS:

- Check out the fastening to the tight before start.
- Check the balance of the rotor before start.
- Lubricate the bearings periodically.
- Keep the base over a level position.

RESULT:

Thus the motorized gyroscopic couple applied to the spinning motor with gyroscope has been determined.



TABULATION:

Sl. No.	Load in		Theoretical Calculation (δ)	Experimental Deflection			Frequency in Hz	
	Kg	N		Loading (mm)	Un Loading (mm)	Average (m)	Experimental	Experimental

OBSERVATIONS:

Width of the beam b =

Depth of the beam d =

Length of the beam l =

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Ex. No. : 10 **SIMPLY SUPPORTED BEAM VIBRATION WITH POINT LOAD**

Date :

AIM:

To determine the natural frequency of free transverse vibration of Simply Supported beam with point load.

APPARATUS REQUIRED:

- Main frame – made from channel about 1.2 m length.
- Trunnion - A bracket of trunnion bearing with slots to insert beam.
- Weights.

FORMULA TO BE USED:

Natural frequency ( ) = ……

Hz Where δ = deflection = m

Take E = 2 x 10^5 N/mm^2, I = …. m^4

PROCEDURE:

- Proper lubrication is ensured for bearings.
- Beam is fitted into both slots of trunnion bearings and is tightened.
- Weights are added on the load hanger, deflection and frequency are calculated and are tabulated.

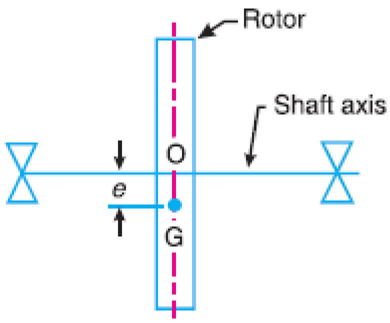
GRAPH:

The graph is drawn by taking load in x-axis and deflection in y-axis.

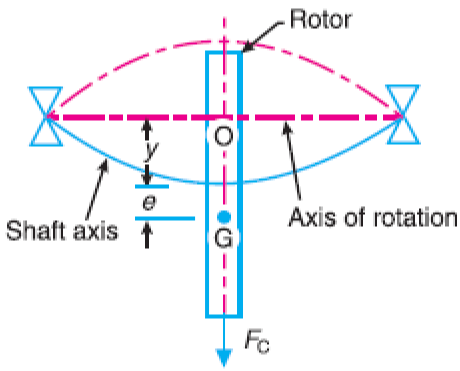
RESULT:

Thus the natural frequency of free transverse vibration of Simply Supported beam with point load determined and the graph is plotted.

1) Natural frequency by analytical method =
2) From graph =



(*a*) When shaft is stationary.



(*b*) When shaft is rotating.

TABULATION:

Sl. No.	Length of shaft between Centre L mm	Diameter of shaft d mm	Calculated speed (Critical) rpm N_C	Observed speed (Critical) rpm N_O

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Ex. No. : 11 **WHIRLING OF SHAFT**

Date :

AIM

To determine the Critical speed of the shaft

Description

The apparatus consists of a frame to support its driving motor and fixing and sliding blocks, etc. A special design to provided to clear out the effects of bearings of motor spindle from those of testing shafts. The special design features of this equipment are as follows.

APPARATUS

1. Tachometer
2. Kinematic coupling: This coupling is specifically designed to eliminate the effect of motor spindle bearings on those of the rotating shafts.
3. Ball bearing fixing ends: (m and n). These ends fix the shaft while it rotates. The shaft can be replaced within a short time with the help of this unit. The fixing ends provide change of the fixing condition of the rotating shaft as per the requirement.
4. End fixing arrangement. At motor end as well as at tail end different end conditions can be developed by making use of different fixing blocks.
5. Supported end condition - Make of end block with single self-aligning bearing.

Fixed end condition - Make use of end block with double bearing:

The guards D1 and D2 can be fixed at any position on the supporting bar frame which fits on side supports F. Rotating shafts are to be fitted in blocks in A and B stands.

Speed control of drying motor

The driving motor is 250V, AC/DC, 1/6 HP, 6000 rpm 50 c/s motor and speed control unit is dimmer stat of 240 V, 2A, 50 c/s.

Measurement of speed

To measure the speed of the rotating shaft a simple tachometer may be used by removing the bearing cover on the opposite side of the shaft extension of the motor.

Whirling of elastic shafts

If, L = Length of shaft in meter

E = Young's modulus 290×10^9

N/m^2 I = Moment of inertia of the shaft

m4

σ = Density of the material shaft (kg/m^3)

Then the frequency of vibration for the various modes is given by the equation

$$f = k \frac{E\ I}{\sigma\ L^4}$$

The various values for k are given below

End condition	Value of K for 1st mode
Supported, supported	1.57
Fixed, supported	3.95, 3.8
Fixed, fixed	3.56

Shaft Dia 'm'	I m4	σ = Kg/m^3
0.47×10^{-2}	25.39×10^{-12}	0.15
0.64×10^{-2}	79.91×10^{-12}	0.28
0.79×10^{-2}	194.78×10^{-12}	0.424

PRECAUTION

If the revolutions of an unloaded shaft are gradually increased it will be found that a certain speed will be reached at which violent instability will occur. The shaft deflecting will become so large, the shaft will be fractured, but if this speed is quickly run through the shaft will become straight again and run true until at another higher speed the same phenomenon will occur, the deflection now however, being in a double bow and so on. Such are called critical speeds of whirling.

It is advisable to increase the speed of shaft rapidly and pass through the critical speeds first rather than observing the 1^{st} critical speed which increases the speed of rotation slowly. In this process there is a possibility that the amplitude of vibration will increase suddenly bringing the failure of the shaft. If however, the shaft is taken to maximum first and then slowly reduced. (Thus not allowing time to build-up the amplitude of vibration at resonance) higher ends will be observed first and the corresponding speed noted and then by reducing the speed further the next mode of tower frequency can be observed without any danger of rise in amplitude as the speed is being decreased and the internal forces are smaller in comparison with the bending spring forces hence possibility of build-up of dangerous amplitudes at response or near response is avoided.

Thus it can be seen that it is destructive test of shafts and it is observed that the elastic behavior of the shaft material changes a little after testing it for a few times and it is advisable therefore, to user fresh shaft samples after wards. Fix the apparatus firmly on the suitable foundation.

RESULT: The whirling speed of the shaft for various conditions are thus noted.

TABULATION:

Sl. No.	Distance of C.G h (mm)	Time for 10 Oscillations in (sec)	Natural Frequency of Oscillation in Hz	Time Period	
				Theoretical (sec)	Experimental (sec)

Mass of the Rod (m) = kg Length of the Rod (L) =mm

Ex. No. : 12 COMPOUND PENDULUM

Date :

AIM:

Determination of mass moment of inertia of a given compound pendulum.

PROCEDURE:

Fix the brass bush in any of the holes of pendulum, and mount the pendulum over the suspension shaft, fitted at top beam of frame. Oscillate the pendulum and measure the time required for 10 oscillations. Repeat the procedure by putting the bush in different holes.

CALCULATIONS:

m = Mass of compound pendulum

h = Distance of c.g. from axis of suspension.

K = Radius of gyration about an axis through c.g. Perpendicular to plane of oscillation.

Natural frequency of oscillation:

$$f_n = \frac{1}{2\pi}\sqrt{\frac{g\times h}{k^2+h^2}} = \frac{1}{t}$$

$$t = 2\pi\sqrt{\frac{k^2+h^2}{g\times h}}$$

Practically, $t = \dfrac{\text{time for 10 oscillations}}{10}$

Therefore $K = \sqrt{\left(\left(\frac{t}{2\pi}\right)^2 \times g \times h\right) + h^2}$

And equivalent length of pendulum $l = \dfrac{k^2+h^2}{h}$

The equivalent length can be verified by setting the simple pendulum to 1.

Result

Thus the mass moment of inertia of a given compound pendulum has been determined

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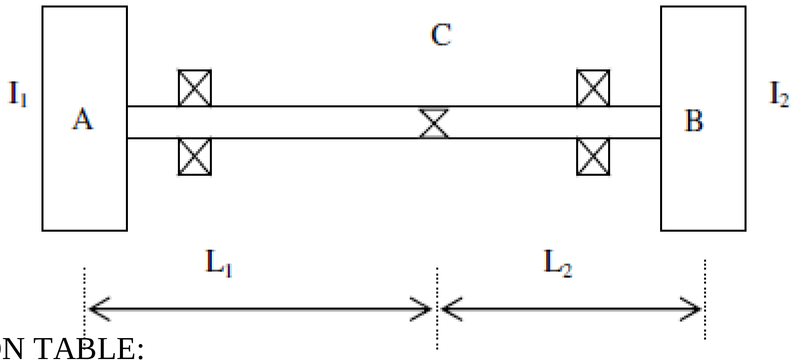

OBSERVATION TABLE:

S.No.	Rotor Locked	No. of Oscillations	Time	ω_n (Hz)	I_A (Kgm^2)

Mass	I_A	I_B	No. Oscillations	Time Required for n OSC	(EXPT) ω_n	(THEO) ω_n

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Ex. No. : 13 FREE TORSIONAL VIBRATION OF SINGLE AND TWO ROTOR SYSTEM

Date :

AIM:

To study the free vibrations of single rotor system and determine the natural frequency of vibration theoretically and experimentally.

DISCRIPTION OF SET UP:

Two discs having different mass moment of inertia are clamped one at each end of shaft by means of collect and chucks. Mass moment of inertia of any disc can be changed by attaching the cross lever weights. Both discs are free too oscillate in the ball bearings. This provides negligible damping during experiment.

PROCEDURE:

1. Initially determine experimentally the mass moment of inertia of the single rotors by conducting a free vibration test after fixing one the rotors.
2. Fix two discs to the shaft and fit the shaft in the bearings.
3. Deflect the discs in opposite direction by hand and release.
4. Note down time required for particular number of oscillations.
5. Fit the cross arm to one of the discs say B and again note down time.
6. Repeat the procedure with different equal masses attached to the ends of cross arm and note down the time.

SPECIMEN CALCULATIONS:

1) Find of shaft as follows =

Where G = modulus of rigidity of shaft = 0.8×10^6 kg/sq.cm

	=	$\pi/32$ d4
	=	M.I. of disc, A
	=	M.I. of disc, B (With weights on cross arm)
d	=	shaft diameter
L	=	Length of the shaft
	=	$w/g * D^2/8$
	=	$w/g*D^2/8 + 2$

$D^2/8$ (Neglecting

effect of cross arm)

Where W1 = Wt. attached to the cross arm R = Radius of Fixation of wt. of the arm

=theoretical = Number of oscillations / time for n oscillations = c/sec.

RESULT:

Thus the study of free vibrations of single rotor system has been determined and the natural frequency of vibration was compared with theoretical and experimental results.

TABULATION:

Sl. No.	W	h	n	t	N	I	
						Experimental	Theoretical

OBSERVATIONS:

Diameter of shaft, d= Diameter of flywheel D=

Ex. No. : 14 WHEEL AND AXLE SYSTEM

Date :

AIM:

To determine the moment of inertia of a flywheel.

APPARATUS REQUIRED:

Flywheels, cord, weights, stop watch, meter rod.

THEORY:

The flywheel as shown in figure is a solid disc made of steel. It is mounted on a horizontal shaft supported on two bearings. The shaft also serves as an axis about which the wheel rotates. A cord is attached to the shaft, at the other end of which weights can be hung. The whole structure is supported by the wall bracket. The polar moment of inertia of the flywheel method. The cord is wound over the shaft. Then the flywheel is released so that it starts rotating under the action of the weights attached to the cord. After the weights have moved a distance h, during time t, the cord detaches itself from the shaft. Let n be the number of revolutions made by the flywheel in time t. Let N be the total number of revolutions made by the flywheel to come to rest form the start.

PROCEDURE:

1. Given some turns of the cord on the shaft and hold the flywheel.
2. Hang some weight on the other end of the cord.
3. Release the flywheel so that the weight starts moving down. Simultaneously press knob of the stop watch.
4. Note the time's' taken by the weight 'W' to travel the height 'h' when the cord detaches from the shaft.
5. Also count the number of revolutions 'n' made by the flywheel in time't'.
6. Further count the number of revolutions till the flywheel comes to rest. Let the total revolutions made by the flywheel from start to stop be 'N'.
7. Increase the weight W and repeat the experiment.
8. Measure the diameter of shaft and flywheel.

PRECAUTIONS:

1. The bearings should be lubricated before performing the experiment.
2. Stop watch should be started simultaneously with the release of the weight.
3. Distance traveled by weight should be measured accurately.

SOURCES OF ERROR:

1. Error in measuring time by stop watch.
2. Error in counting exact number of revolution up to the detachment of the cord

RESULT:

Thus the moment of inertia of a flywheel was determined.

TABULATION:

Sl. No.	Plane	Block	Distance from Reference plane L (cm)	Centrifugal force in terms of balls	Couple with respect to L

Ex. No. : 15 STATIC AND DYNAMIC BALANCE OF ROTOR

Date :

AIM:

To study the counter balance weight in rotating mass system and to perform static and dynamic balancing on the given rotor mass system.

APPARTUS REQUIRED:

Steel ball, steel rule, Weighing scale, Allen key.

DESCRIPTION:

The apparatus basically consists of a shaft mounted frame and cylinder with the circular protector scale allows the exact longitudinal angular position of each adjustable to back to be determined.

For dynamic balance of the rotating main frame suspended from support frame by two short lines such that the main frame and supporting frame are in the same plane.

PROCEDURE:

STATIC BALANCING:

- The belt was removed
- Combined hook gored to screwed pulley
- The chord ends of the paired screw were attached to that shaft material in a downward direction.
- The steel balls were put in pairs until the block becomes horizontal.
- The number of balls gives the value of centrifugal force in terms of number of balls for the block. Repeat same procedure with another block.

DYNAMIC BALANCING:

- The machine was left and the couple blocks were kept ready for the experiment.
- The angular position of the rotating blocks were determined.

ASSUMPTIONS:

- The block is assumed to be horizontal
- The four blocks are uniformly spaced at 5cm along the length of the shaft.

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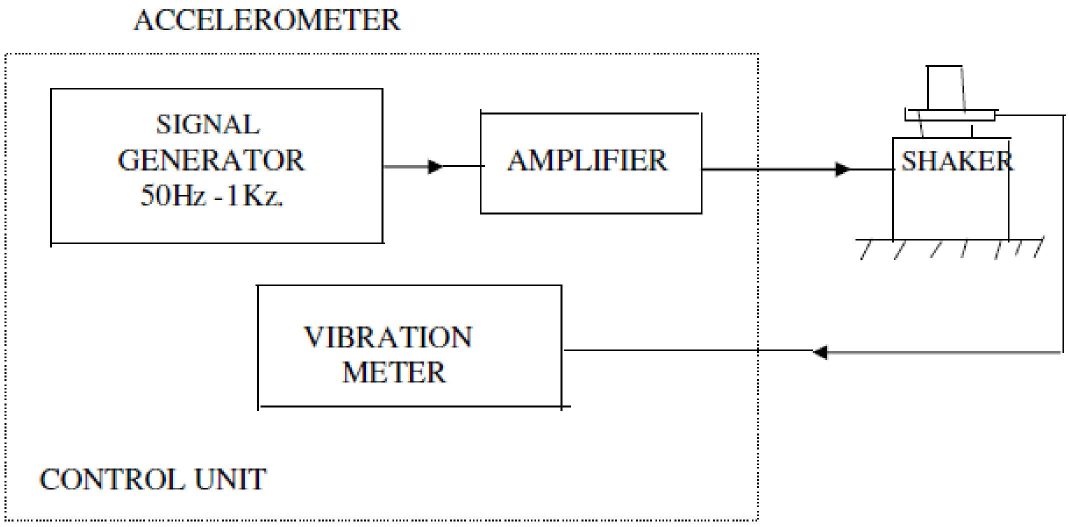
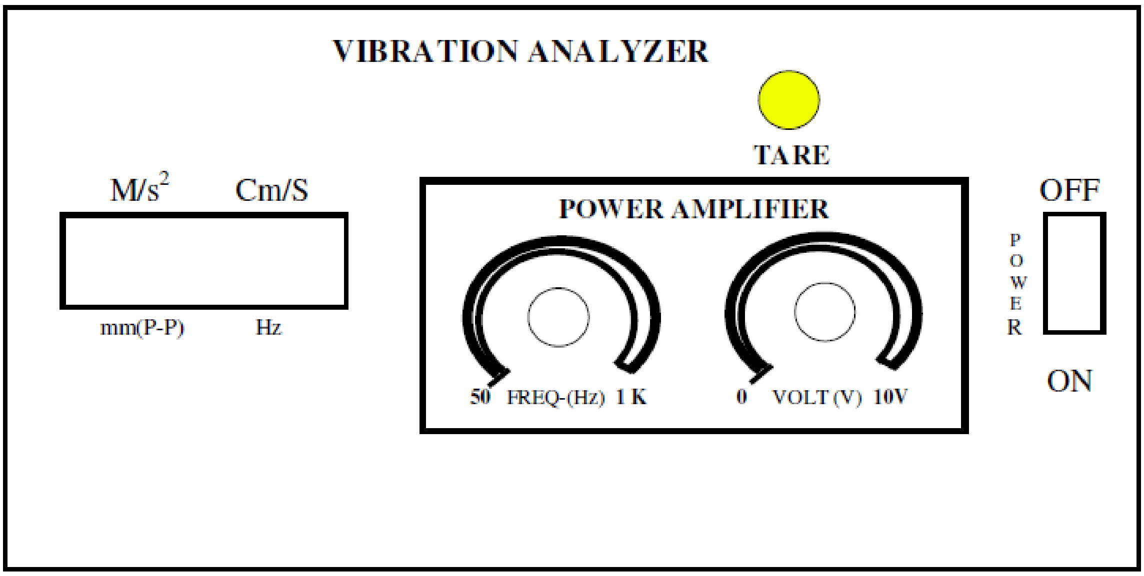
RESULT

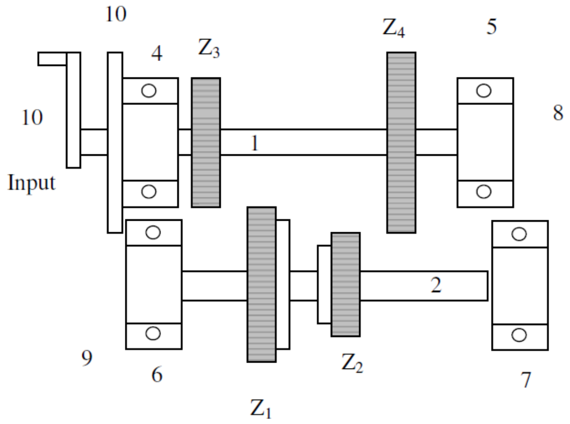
Thus the counter balance weight in rotating mass system and the performance of static and dynamic balancing on the given rotor mass system was studied.



BLOCK DIAGRAM FIG-1



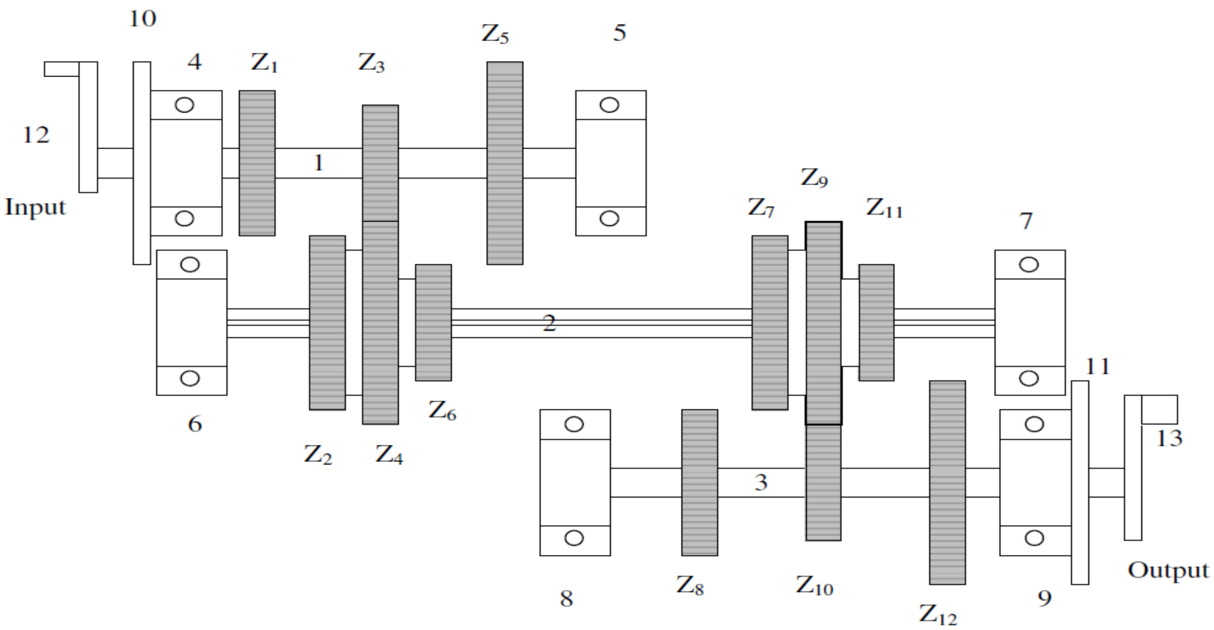
SIMPLE GEAR TRAIN



1 - Input shaft.
2 - Output shaft.
4 - 7 - Plumber block.
8, 9 - protractor .
10 - handle.

Z_1, Z_2 - Input shaft gears
Z_3, Z_4 - Output shaft gears

COMPOUND GEAR TRAIN



1 - Input shaft.
2 - Intermediate shaft.
3 - Output shaft.
4 - 9 - Plumber block.
10, 11 - Angle protector.
12,13 - hand wheels.

Z_1, Z_3, Z_5 - Input shaft gears
Z_2, Z_4, Z_6 - Intermediate shaft gears
Z_8, Z_{10}, Z_{12} - Output shaft gears

Ex. No. : 16 **STUDY OF GEAR PARAMETERS AND GEAR TRAINS**

Date :

AIM

To study the gear parameters and velocity ratios for various gear trains

APPARATUS REQUIRED

1. Various gear models

THEORY

Spur, Helical, Bevel and worm and worm gear models

Each and every gear models are mounted in separate wooden boards.The provisionsare made for measurement of angle turned by pinion and gear.

Experiments

1. Rotate the pinion shaft find angle of rotation of output shaft for one revolution of input shaft.
2. Measure number of teeth and find speed ratio
3. Compare with practical value.

Simple gear train

In simple speed gear box, only three different output speeds can be obtained by change gears.. These types of gear boxes are widely used in machine tools, automobiles and number of machines, where speed change is required. This speed will be in geometric progressive inversely proportional to speed ratio for constant power transmission. This also can be verified by this setup.

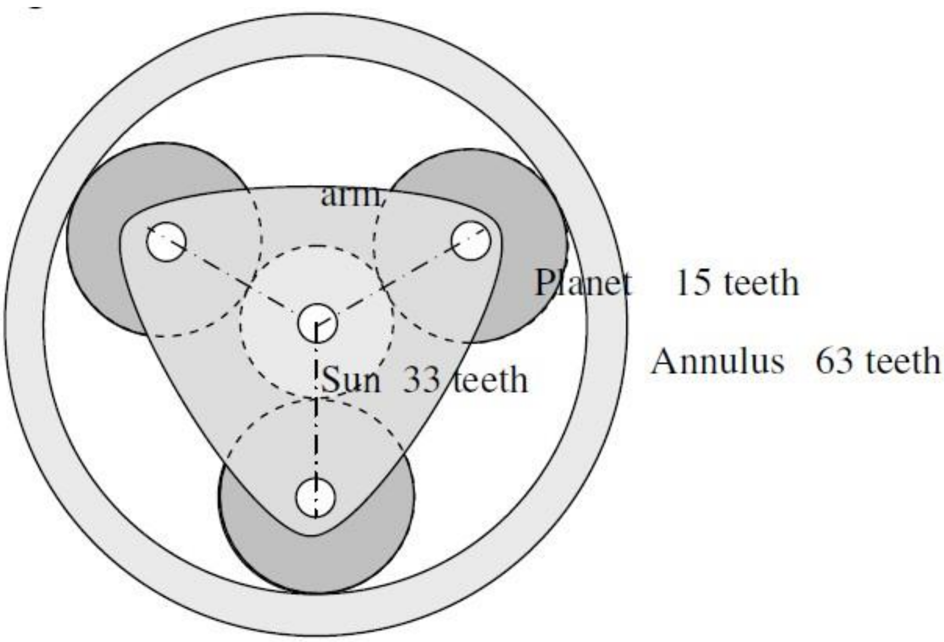
Experimental setup:

The gear train arrangement consists of Two shafts. In shaft 1 (input), three fixed gears are provided. In output shaft (No 2) sliding gear are provided for selectively engaging with gears in 1 & 2. All shafts are mounted on ball bearings.All items are mounted on a single base. The speed change can be achieved by manual shifting of sliding gears.

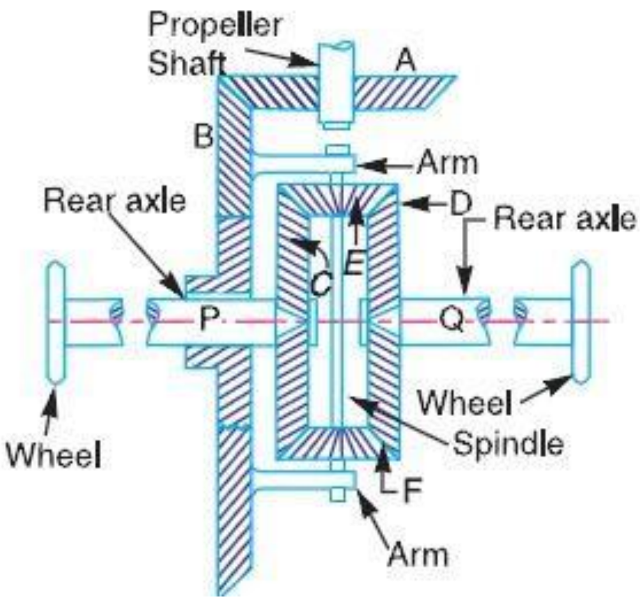
Experimental procedure

1. Count the number of teeth in each gear.
2. Calculate module of gears, Verify that it is same for all the gears. Module = outer diameter of any gear teeth/(number of teeth + 2)
3. Measure center distance between the shafts. Eg.,Center distance of shaft1- 2 = $((40 \times m) + (20 \times m))/2$.
4. Estimate gear ratio (output rev/ input rev) in each combination 1-3, 2-4, etc.,
5. Set different position of 1|3 and 2|4, give and revolution to output shaft andmeasure output revolutions. Estimate gear ratio and verify with calculated values.

EPICYCLIC GEAR TRAIN



DIFFERENTIAL GEAR



Compound Gear Train

In multi speed gear box, different output speeds can be obtained by change gears. With two numbers of 3 positions sliding gear in intermediate shaft 3 × 3 = 9 different speeds can be obtained in the output shaft for a constant input shaft speed. These types of gear boxes are widely used in machine tools, automobiles and number of machines, where speed change is required. This speed will be in geometric progressive inversely proportional to speed ratio for constant power transmission. This also can be verified by this setup

Experimental setup

The gear train arrangement consists of three shafts. In shaft 1 & 3 (input and output), three fixed gears are provided. In intermediate shaft (No 2) two sliding gears are provided for selectively engaging

with gears in 1 & 3. All shafts are mounted on ball bearings. Input and output shafts are provided with rope pulleys to measure torque. All items are mounted on a single base. The speed change can be achieved by

manual shifting of sliding gears. If 1, 2 & 3 are positions of slide gear 1 and 4, 5& 6are positions of slide gear 2, then the following combination are possible 1-4, 1-5, 1-6,2-4, 2-5, 2-6, 3-4, 3-5 &

3-6.

Epicyclic Gear Train

The Epicyclic gear consists of a sun, arm and annulus are mounted on a shaft. The sun is keyed to the shaft. The shaft is driven by a motor through a gearbox and a chain sprocket. The ratio of speeds can be evaluated by fixing any one of the member andgiving motor rotation to one member and counting the rotation of the third member. This also can be done for motorized movement of sun wheel.

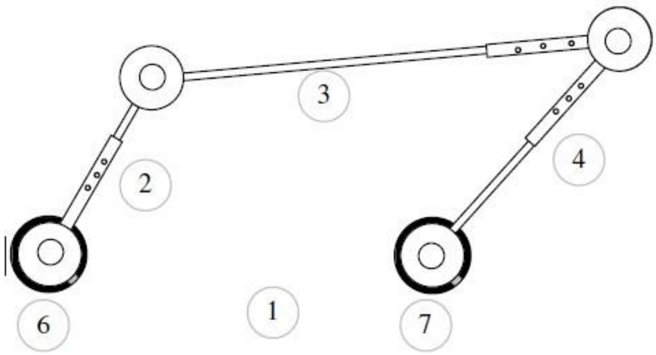
Differential gear

The bevel gear A (known as pinion) is keyed to the propeller shaft driven from the engine shaft through universal coupling. This gear A drives the gear B(known as crown gear)which rotates freely on the axle P. Two equal gears C and D are mounted on two separate parts P and Q of the rear axles respectively. These gears, in turn mesh with equal pinions E and F which can rotate freely on the spindle provided on the arm attached to gear B. When the automobile runs on a straight path, the gears C and D must rotate together. These gears are rotated through the spindle on the gear B. The gears E and F do not rotate on the spindle. But when the automobile is taking a turn, the inner rear wheel should have lesser speed than the outer rear wheel and due to relative speed of the inner and outer gears D and C the hears E and F start rotating about the spindle axis and at the same time revolve about the axle axis. Due to this epicyclic effect the speed of the inner rear wheel decreases by a certain amount and the speed of the outer rear wheel increases, by the same amount.

RESULT

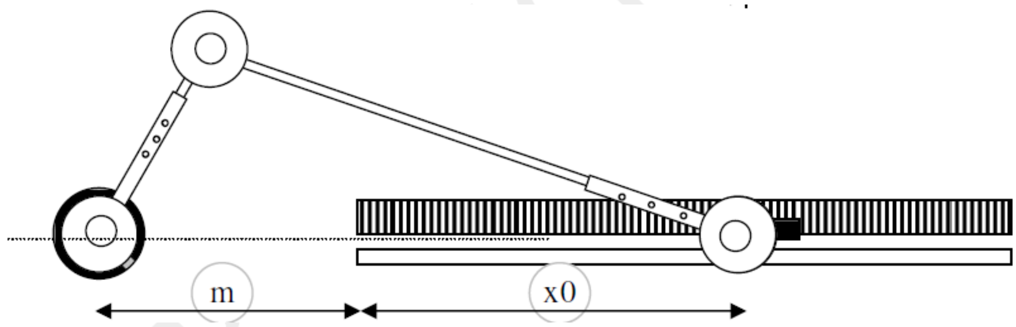
Thus the gear parameters and velocity ratios of various gear trains were studied

FOUR BAR CHAIN



1, 2, 3, 4	- Links.
6,7	- Angle protractors

Slider crank mechanism



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Ex. No. : 17 **STUDY OF KINEMATICS OF VARIOUS MECHANISMS AND UNIVERSAL JOINT**

Date :

AIM

To study the kinematics of slider crank, four bar mechanisms and universal joints

APPARATUS REQUIRED

1. Experimental setup for four bar chain
2. Experimental setup for Universal joint

Four bar mechanism

Four bar linkage forms core mechanism for most of the machines. Even complicated mechanism can be split into number of four bar mechanisms. The problems of four bar mechanism namely analysis and synthesis can be solved by graphical, analytical and experimental means. Graphical methods include finding out velocity and acceleration of a point or link by drawing velocity and acceleration diagram. Using relative velocity method or instantaneous center method. Analytical methods include vector approach, trigonometrical method or complex algebra method. Experimental method is by constructing a model and analyzing the motion by measurements.

The experimental set consists of a four bar mechanism model having the following features.

(1) Two links are fixed on to a board. The distance between the pivot is considered as length of fixed link 1.

(2) Each moving link is telescopic type and its length can be varied by grub screw provided.

(3) Hinges are provided with ball bearings to reduce error due to clearance.

(4) Angular position of links 2 (crank) and 4 (rocker) can be measured to are solution of 0.1_o by venire protractors.

(5) The links are in two planes so that complete rotation of crank is possible.

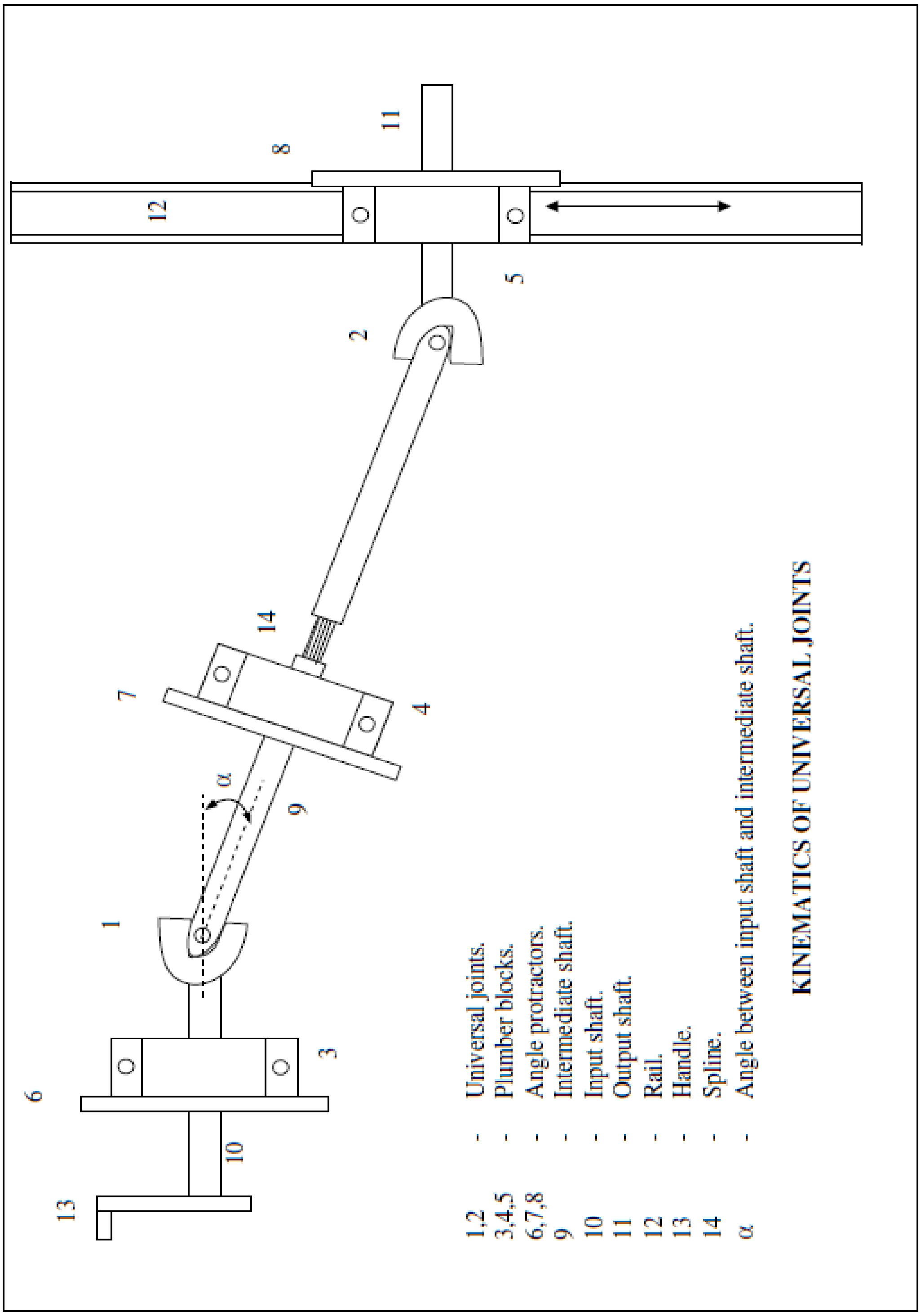
Slider crank mechanism

Slider crank chain is a form of four bar mechanism in which length of one of the link is infinity. In this case reciprocating motion is converted into rotary motion and vice versa.

Examples of such applications are in I.C engines. Reciprocating pumps, power presses etc. The relation between motions of links is required to establish kinematics motion and also for analysis of inertia forces. The relation between position and velocity of links can be evaluated by analytical method and experimental method Experimental method is by making model of mechanism and analyzing its moments by physical measurements and analysis.

Oscillating Cylinder Mechanism

Oscillating cylinder mechanism is a form of four bar mechanism in which length of one of the link is infinity. In this case reciprocating motion is converted into rotary motion and vice versa. Examples of such



applications are in I.C engines. Reciprocating pumps, power presses etc. The relation between motions of links is required to establish kinematics motion and also for analysis of inertia forces. The relation between position and velocity of links can be evaluated by analytical method and experimental method. Experimental method is by making model of mechanism and analyzing its moments by physical measurements and analysis.

Kinematics of Universal Joints

Universal joint (or Hooke's joint) can transmit power between inclined axes. If _ is the inclination between the input and output shaft then, angular velocity of output shaft,

$$\omega_2 = \omega_1 \frac{\cos\alpha}{1-\left(\cos^2\theta \sin^2\alpha\right)}$$

Where, ω is the angular velocity of input shaft.
And θ is the angle turned by input shaft.

It can be seen from the above equation, (ω_2/ω_1) is not constant and varies as a function of θ. This will introduce angular acceleration and hence inertia torque and stresses due to that uniform velocity ratio (or no angular acceleration) can be achieved by introduction of one more universal coupling in the same sense to give angular velocity of output shaft.

$\omega_2 = \omega$ for all values of θ.

An experimental set up is made to verify the above.

RESULT

Thus the kinematics of slider crank, four bar mechanisms and universal joints were studied.

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SEVALPATTI - 626 140
SIVAKASI
Virudhunagar District.

BONAFIDE CERTIFICATE

Certified that this is a Bonafide Record of work done

by R.SEENIVASAN

Roll No 17ME089 *in the* DYNAMICS (161ME58)

Laboratory of this College during the academic year 2019 - 2020.

Staff - in - Charge

Head of the Department

Department of Mechanical Engineering
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Register No. 1706085

Submitted for the Practical Examination held on 22-10-2019

Internal Examiner

External Examiner

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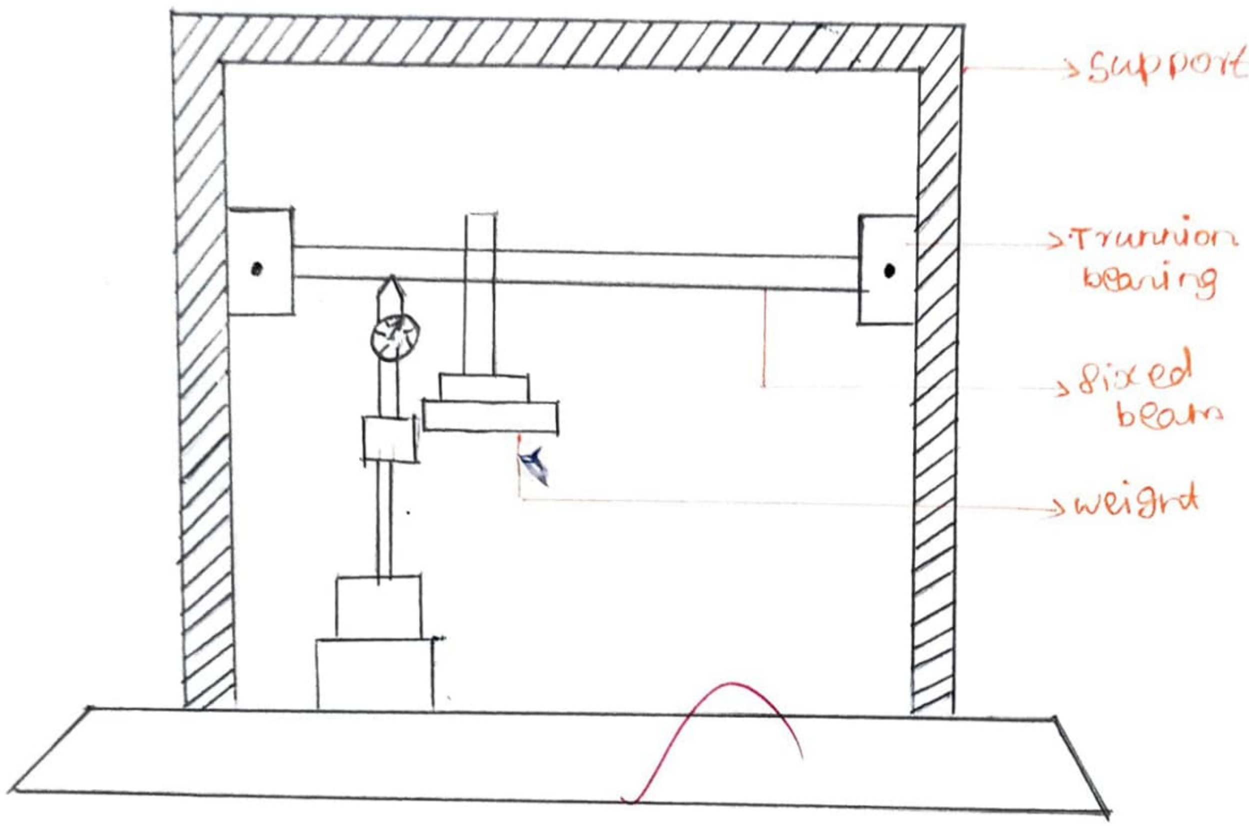
Completed
[signature] 3/10/19

DIAGRAM:



NATURAL FREQUENCY OF FREE TRANSVERSE VIBRATIONS OF FIXED BEAM WITH ECCENTRIC POINT LOAD

NATURAL FREQUENCY OF FREE TRANSVERSE VIBRATIONS OF FIXED BEAM WITH ECCENTRIC POINT LOAD

AIM:

To determine the natural frequency of force free transverse vibrations of fixed beam with eccentric point load.

Apparatus Required:

Main frame - Made from channel about 1.2m length.

Trunnion - Two brackets of trunnion bearing. with slots inserts beam fitted at 1m apart.

Formula to Be USED:

Natural frequency $(f_n) = \frac{0.4985}{\sqrt{\delta}}$ Hz

δ = deflection $= \frac{Wa^3b^3}{3EIL^3}$ in m

$E = 2\times10^5$ N/mm² & $I = \frac{bd^3}{12}$ m⁴

PROCEDURE:

The proper lubrication for bearing was ensured.

The beam was fitted into both slots of trunnion bearings and it was tightened.

OBSERVATION:

Width of the beam, b = 20mm

Depth of the beam, d = 7mm

Length of the beam, l = 1070mm

Distance of Load from Left Support, a = 340mm

Distance of Load from Right Support, b = 730mm

Young's modulus, $E = 2 \times 10^5 \ N/mm^2$

$$I = \frac{bd^3}{12} = 571.67 \ mm^4$$

TABULATION:

S. NO	LOAD		DEFLECTION IN mm			FREQUENCY IN HZ	
	kg	N	LOADING mm	UNLOADING mm	AVERAGE mm	THEORETICAL	EXPERIMENTAL
1.	1	9.81	0.90	0.99	0.95	26.42	16.21
2.	2	19.61	1.78	1.85	1.82	18.68	11.70
3.	3	29.43	2.50	2.56	2.53	15.23	9.9
4.	4	39.24	3.21	3.21	3.21	13.21	8.79

The weight was added in the load hanger and calculated deflection and frequency was calculated.

The dial gauge was fixed such that the plunger make contact with the beam. where there is no load condition.

CALCULATION:

deflection $(\delta) = \frac{Wa^3b^3}{3EIL^3}$ mm

W - weight in N

a - Distance from Load to left support

b - Distance from Load to Right support

E - Young's modulus in N/mm^2

I - Moment of inertia in mm^4

L - Length of the shaft

THEORITICAL CALCULATION:

$$\delta = \frac{19.62 \times (1.53 \times 10^{16})}{4.20 \times 10^{17}} = \frac{2.99 \times 10^{17}}{4.20 \times 10^{17}}$$

$$\delta = 0.712 \text{ mm}$$

THEORITICAL FREQUENCY:

$$f = \frac{0.4985}{\sqrt{\delta}} = \frac{0.4985}{\sqrt{0.3547 \times 10^{-3}}}$$

$$f = 26.42 \text{ HZ}$$

EXPERIMENTAL FREQUENCY:

$$f = \frac{0.4985}{\sqrt{0.95 \times 10^{-3}}} = 16.21 \text{ HZ}$$

$$f = 16.21 \text{ HZ}$$

RESULT:

Thus the natural frequency of the transverse vibration of fixed beam with eccentric point load was determined. Graphs were plotted.

FROM ANALYTICAL METHOD:

Natural frequency in theoritical method } = 18.39 HZ

natural frequency in experimental method } = 11.65 HZ

FROM GRAPH :

Natural frequency in theoritical method } = 18.70 HZ

Natural frequency in experimental method } = 12.66 HZ

PRACTICAL EVALUATION	
Observation (10)	8
Calculation / Result (10)	8
Viva (10)	8
Total Marks (30)	24
Signature of	

11/6/19

CALCULATION:

i) Experimental frequency $= \frac{0.4985}{\sqrt{1.55 \times 10^{-3}}}$

$= 12.66 Hz$

ii) Theoretical frequency $= \frac{0.4985}{\sqrt{0.71 \times 10^{-3}}}$

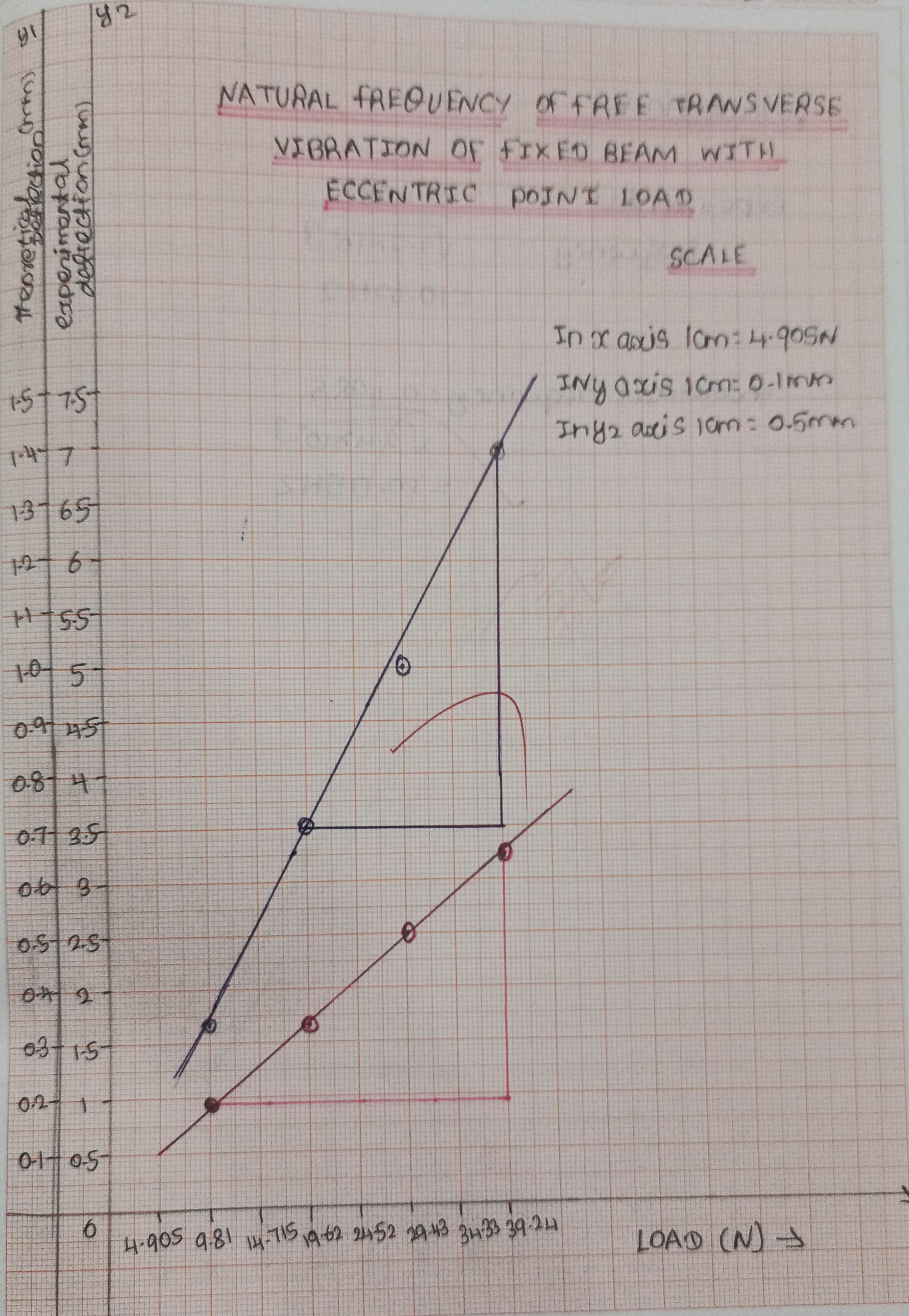
$= 18.70 Hz$

DATE 04 08 2019

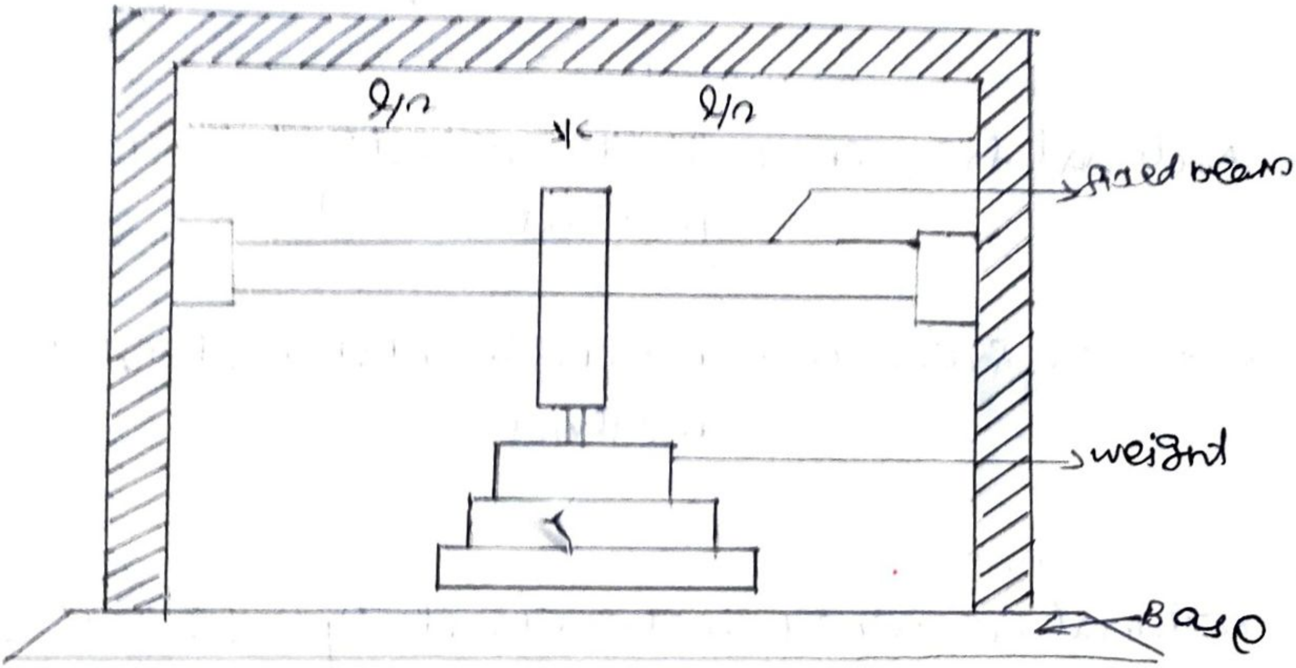
NATURAL FREQUENCY OF FREE TRANSVERSE VIBRATION OF FIXED BEAM WITH ECCENTRIC POINT LOAD

SCALE

In x axis 1cm = 4.905N
In y axis 1cm = 0.1mm
In y_2 axis 1cm = 0.5mm



DIAGRAM



NATURAL FREQUENCY OF FREE TRANSVERSE FIXED BEAM VIBRATION WITH CENTRAL POINT LOAD

NATURAL FREQUENCY OF FREE TRANSVERSE VIBRATION OF FIXED BEAM WITH CENTRAL POINT LOAD

AIM:

To determine the natural frequency of the free transverse vibration of fixed beam with central point load.

APPARATUS REQUIRED:

Main frame - Made from channel about 1.07m length.

Trunnion - Two bracket of Trunnion balancing with slots to insert fitted of 1m apart weights.

FORMULA:

Natural frequency $(f_n) = \frac{0.4985}{\sqrt{\delta}}$ Hz

$$\delta = \frac{Wl^3}{192EI}$$

$$E = 2\times10^5 \ N/mm^2$$

$$I = \frac{bd^3}{12} \ mm^4$$

where,

δ = deflection in mm

W - load applied in N

l - length of the beam in m

E - Young's modulus of beam

Observation:

Width of the beam (b) : 20mm

Depth of the beam (d) : 7mm

Length of the beam (l) : 1070mm

Tabulation:

S.No	Load kg	Load N	Deflection in M Loading	Deflection in M Unloading	Deflection in M Average	Frequency (Hz) Theory Exp	Theoretical value (M) x 10^{-3}	Theoretical deflection (mm)
1.	1	9.81	0.547	1.33	1.41	1.375	21.34	13.44
2.	2	19.62	1.094	2.61	2.68	2.645	15.68	10.04
3.	3	29.43	1.642	3.69	3.68	3.67	12.30	8.23
4	4	39.24	2.189	4.65	4.65	4.65	10.65	7.08

PROCEDURE :

Proper Lubrication was ensured for bearing.

The beam was fitted into the both slots of trunnion bearing and tightened.

Then the load hanger was fixed over the beam.

Then the dial gauge was fixed such that the plunger that make contact with the beam while in the no load condition.

Then the weight were added on the load hanger.

Deflection was measured and tabulated.

finally the natural frequency was calculated by using formula.

GRAPH :

The graph is drawn by taking load in x axis and deflection in y axis.

MODEL CALCULATION:

$$I = \frac{bd^3}{12} = \frac{20 \times 7^3}{12}$$

$$I = 571.6 mm$$

THEORETICAL CALCULATION:

$$\delta = \frac{WL^3}{192EI} = \frac{9.81 \times (1070)^3}{192\,EI}$$

$$\delta = 0.547 \text{ mm}$$

THEORITICAL FREQUENCY:

$$f_n = \frac{0.4985}{\sqrt{0.547 \times 10^{-3}}}$$

$$f_n = 21.31 \text{ HZ}$$

EXPERIMENTAL FREQUENCY:

$$f_n = \frac{0.4985}{\sqrt{1.375 \times 10^{-3}}}$$

$$f_n = 13.44 \text{ HZ}$$

PRACTICAL EVALUATION	
Observation (10)	8
Calculation / Result (10)	10
Viva (10)	9
Total Marks (30)	27
Signature of /	

Result:

Thus the natural frequency as the trasverse vibration of fixed beam with central point load was determined and the graph was plotted.

Theoretical:

i) Natural frequency of analytical : 14.84 Hz
ii) Natural frequency of graphical (fn) : 9.665 Hz

Graphical:

i) Natural frequency of analytical : 10.175 Hz
ii) Natural frequency of graphical : 10.62 Hz

2/7/19

calculations:

Experimental frequency $= \frac{0.4985}{\sqrt{2.2\times10^{-3}}}$

$= 10.62 Hz$

theoretical frequency: $\frac{0.4985}{\sqrt{2.4\times10^{-3}}}$

$= 10.175 Hz$

EX: NO: 2

DATE 11 06 2019

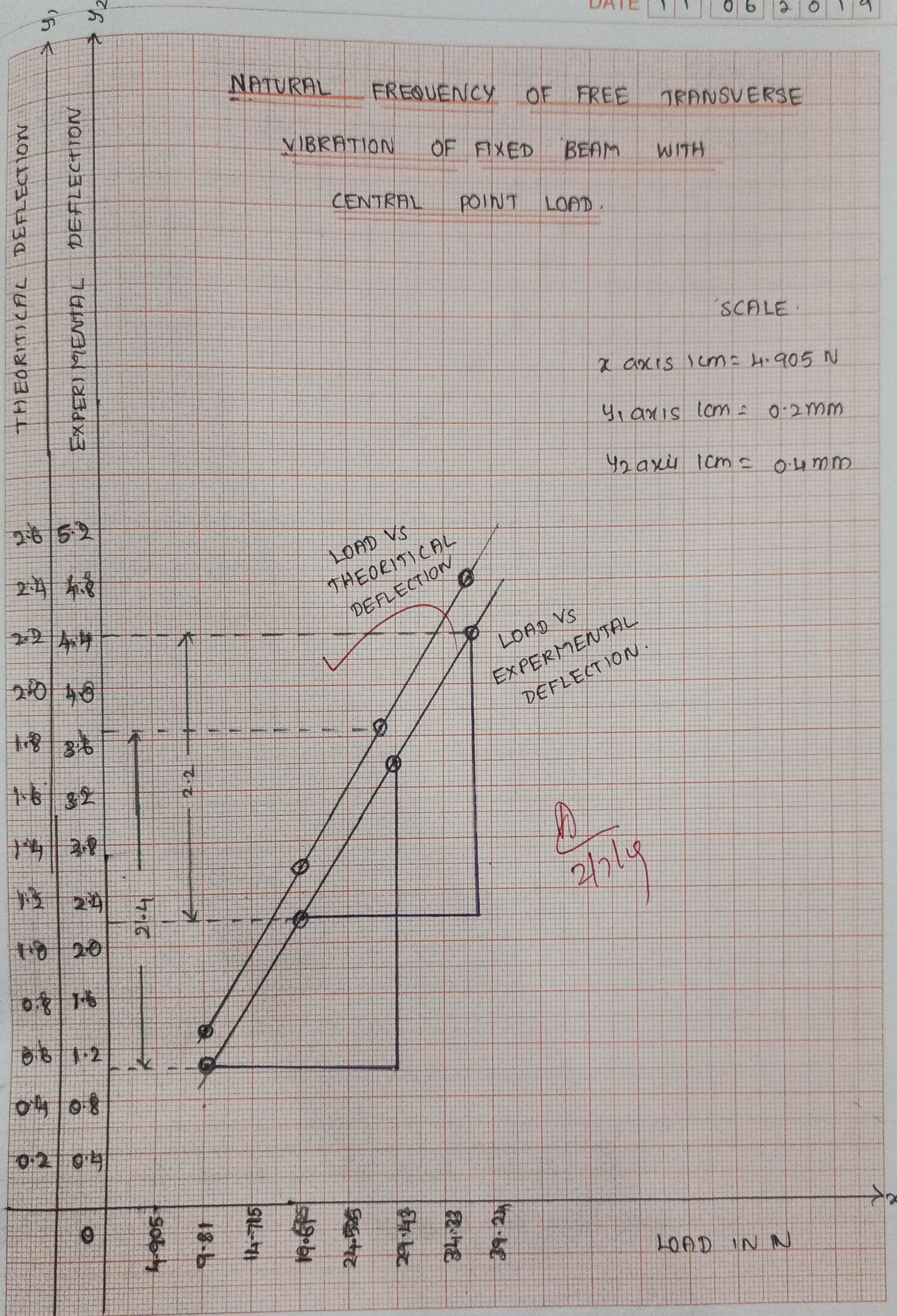
NATURAL FREQUENCY OF FREE TRANSVERSE VIBRATION OF FIXED BEAM WITH CENTRAL POINT LOAD.

SCALE.

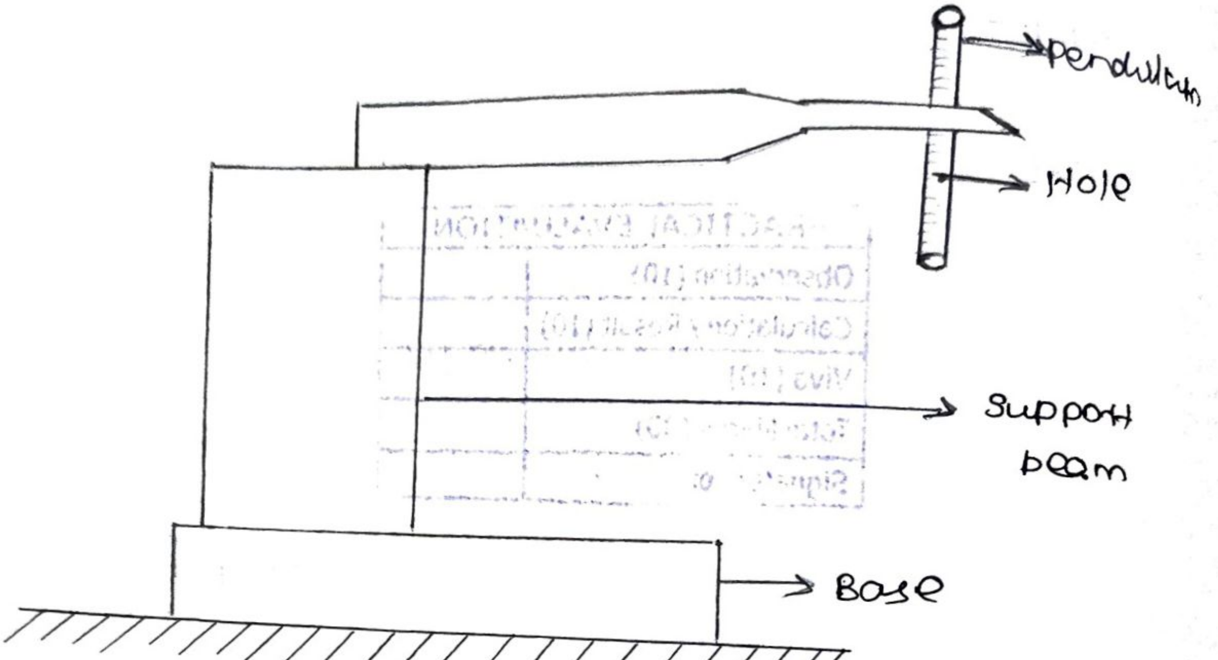
x axis 1cm = 4.905 N

y_1 axis 1cm = 0.2mm

y_2 axis 1cm = 0.4mm



DIAGRAM



OBSERVATION:

COMPOUND PENDULUM

mass of the square rod = 0.9kg

Length of the square rod : 500 mm

mass of the circular rod : 2.09 kg

length of circular rod : 550 mm

COMPOUND PENDULUM

AIM :

Determination of mass moment of inertia of a given compound pendulum.

FORMULA TO BE USED :

m - mass of the compound pendulum.
h - distance of cg from axis of suspension.
k - Radius of gyration about an axis throad c.g perpendicular to plan of oscillation.

Natural frequency of oscillation.

$$f_x = \frac{1}{2\pi}\sqrt{(g \times h)/(k^2+h^2)} = 1/t$$

$$t = 2\pi\sqrt{\frac{k^2+h^2}{g \times h}}$$

$$t = \frac{\text{time for 10 oscillation}}{10}$$

$$k = \sqrt{((t/2\pi)^2 \times g \times h) + h^2}$$

An equivalent length of pendulum,

$$J = \frac{k^2+h^2}{h}$$

The equivalent length can be varified by setting the simple pendulum.

TABULATION:

S. NO	MATERIALS	DISTANCE OF CG H(mm)	TIME TAKEN FOR 10 OSCILLATION (t) sec	NATURAL FREQUENCY OF OSCILLATION (Hz)	TIME PERIOD		MASS MOUNT OF INERITIA
					THEORITICAL (sec)	EXPERIMENTAL (sec)	
1.	SQUARE	225	12.68	0.843	1.186	1.256	0.353
		175	11.57	0.848	1.116	1.116	0.354
		80	12.09	0.749	1.833	1.25	0.44
2.	CIRCULAR	210	12.06	1.116	1.203	1.203	0.309
		140	10.63	1.678	1.063	1.063	0.288
		70	10.68	1.216	1.068	1.068	0.367

MODEL CALCULATION:

$$k^2 = \frac{L^2}{I^2} = \frac{(0.59)^2}{12}$$

$$= 0.028 m^2$$

NATURAL FREQUENCY:

$$f = \frac{1}{FN} = \frac{1}{0.896} = 1.16 sec$$

PROCEDURE :

The brass brush was fixed in the hole of pendulum.

The pendulum was mounted over the suspension shaft fitted at top beam of frame.

The pendulum was oscillated and the time was measured required for 10 oscillation.

The procedure was repeated by changing the brush in different hole.

$$f_n = \frac{1}{2\pi}\sqrt{\frac{gh}{k^2+h^2}}$$

$$= \frac{1}{2\pi}\sqrt{\frac{9.81 \times 0.210}{0.0208 \times (0.40)^2}}$$

$$f_n = 0.896 Hz$$

MOMENT OF INERTIA :

$$I = \frac{k^2 + h^2}{h}$$

$$= \frac{(0.0208)^2 + (0.210)^2}{0.210}$$

$$I = 0.28815 mm^4$$

RESULT :

Thus the mass moment of Inertia of given compound pendulum has been determined.

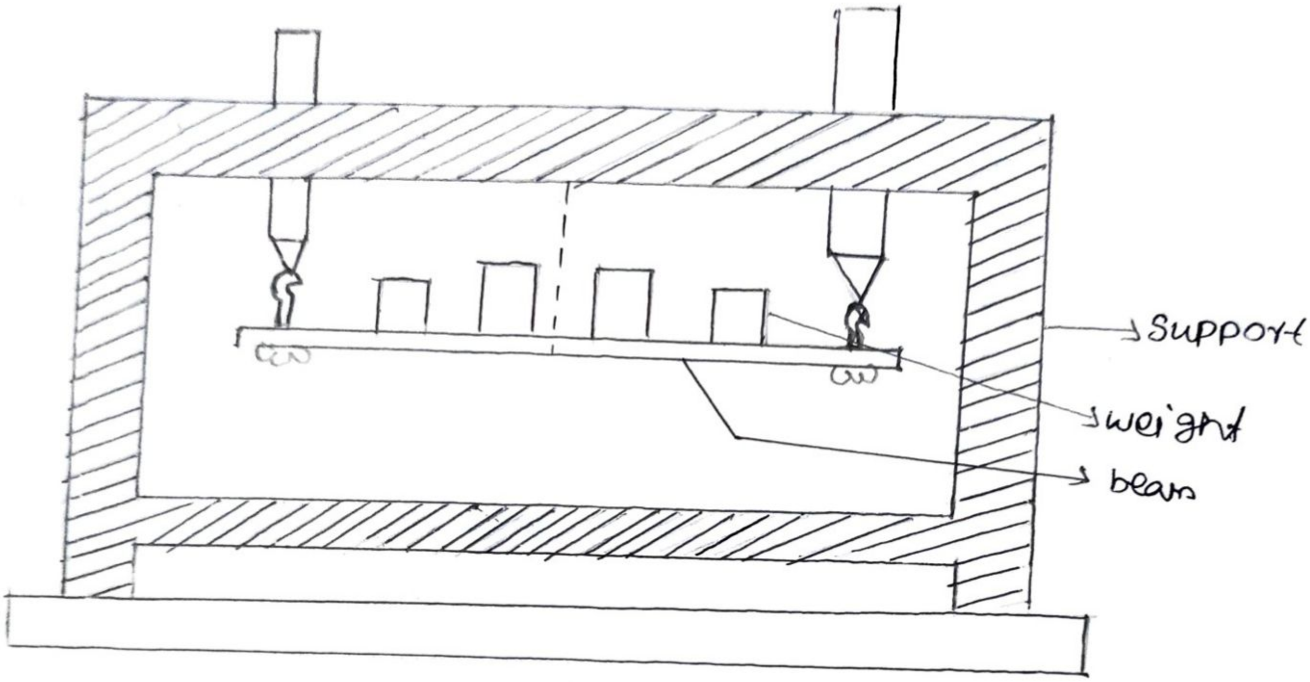
Square moment of Inertia = 0.321 m

Circular moment of Inertia = 0.372 m

PRACTICAL EVALUATION	
Observation (10)	8
Calculation / Result (10)	10
	8
...s (30)	26

9/2/19

DIAGRAM:



BIFILLER SUSPENSION

OBSERVATION:

Radius of the string (B) = 28cm = 0.28m

Length of the string (L) = 56cm = 0.56m

weight (W) = 1.5kg

BIFILAR SUSPENSION

AIM:

To determine the radius of gyration using bifilar suspension.

APPARATUS REQUIRED:

Bifilar suspension arrangement.

FORMULA TO BE USED:

for bifilar suspension.

$$f_n = \frac{1}{2\pi} \times \frac{b}{k}\sqrt{\frac{g}{l}}$$

$$f_n = \frac{1}{2\pi} \times \frac{b}{f_n} \times \sqrt{\frac{g}{l}}$$

$$f_n = \frac{1}{t_{emp}}$$

$$= \frac{\text{Time taken for 10 oscillations sec}}{10}$$

where,

f_n = frequency of oscillations.
b = distance of spring from centre of gravity = 28 cm
L = Length of string (m)
K = Radius of gyration

TABULATION:

S. NO	H cm	TIME TAKEN FOR 10 OSCILLATION (SEC)	FREQUENCY OF OSCILLATION (fn)	RADIUS OF GYRATION (K) m
1.	40	13.60	0.735	0.300
2.	35	12.59	0.794	0.296
3.	30	12.19	0.833	0.308
4	25	10.88	0.925	0.300
				0.301

MODEL CALCULATION:

$$K = \frac{1}{2\pi} \times b \times fn \times \sqrt{g/h}$$

$$fn = 1/t$$

t = Time taken for 10 oscillation

$$t = \frac{13.60}{10} = 1.356 \text{ sec}$$

$$fn = 1/t = \frac{1}{1.356} = 0.735 \text{ sec}$$

$$K = \frac{1}{2\pi} \times b \times fn \times \sqrt{g/h}$$

$$= \frac{1}{2\pi} \times 0.28 \times 0.735 \times \sqrt{\frac{9.81}{0.45}}$$

$$K = 0.300 m$$

PROCEDURE :

The bifillar suspension strings are attached in the chucks mounted on the top of the beam present in the frame.

The strings are adjusted to equal length required weight are fixed over the beam of bifilar.

System is oscillated about the vertical axis passing through the under of beam.

Time required for 'n' oscillation is noted say n=10

the procedure is repeated by changing the length of the suspension.

RESULT :

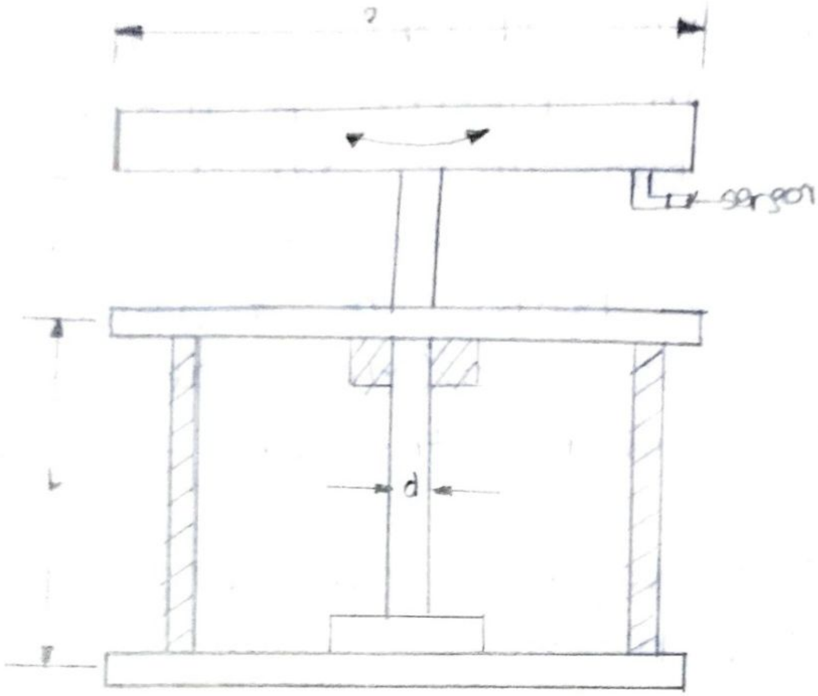
Thus the radius of gyration of body using bifiler suspension was determined.

Radius of gyration k = 0.301m

6/8/19

PRACTICAL EVALUATION	
Observation (10)	8
Calculation / Result (10)	10
V...	7
	25

TURN TABLE APPARATUS



OBSERVATION:

1. mass added on each side (m) = 0.2kg

2. Initial distance of total weight from axis } $r_1 = 0.2m$

3. final distance of weight from axis } $r_2 = 0.29m$

4. speed of disc motor N = 61 rpm

5. Time for change in position of weight from r_1 to r_2 } = 4.53sec

$D_1 = 2 \times r_1 = 2 \times 0.2 = 0.4m$

$D_2 = 2 \times r_2 = 2 \times 0.29 = 0.58m$

TURN TABLE APPARATUS

AIM:

To determine i) Angular velocity ii) Angular acceleration iii) mass moment of inertia iv) centrifugal force using turn table apparatus.

APPARATUS REQUIRED:

Turn table apparatus experimental setup
set of weights
stop watch.

FORMULA TO BE USED:

Initial velocity $V_1 = \frac{\pi D_1 N}{60}$ m/s

Final velocity $V_2 = \frac{\pi D_2 N}{60}$ m/s

Angular acceleration $a = \frac{V_2 - V_1}{t}$ m/s²

Centrifugal force $F = \frac{m V_2^2}{r_2}$ N

mass moment of inertia $I = m r_2^2$ kg-m²

where

$D_1 = 2 \times r_1$ m

$D_2 = 2 \times r_2$ m

N = speed in rpm

MODEL CALCULATION :

initial velocity , $V_1 = \frac{\pi D_1 N}{60}$ m/s

$= \frac{\pi \times 0.4 \times 61}{60} = 1.27$ m/s

$V_1 = 1.27$ m/s

final velocity , $V_2 = \frac{\pi D_2 N}{60}$ (m/s)

$= \frac{\pi \times 0.58 \times 61}{60} = 1.85$ m/s

$V_2 = 1.85$ m/s

Radius , $r = \frac{r_1 + r_2}{2} = \frac{0.2 + 0.29}{2}$

$r = 0.245$ m²

acceleration , $a = \frac{V_2 - V_1}{t}$ (m/s²)

$= \frac{1.85 - 1.27}{4.53}$

$a = 0.128$ m/s²

Centrifugal force $F = \frac{m V_2^2}{r}$ N

$= \frac{0.2 \times (1.85)^2}{0.245}$

$F = 2.79$ N

Mass moment of inertia , $I = m r_2^2$

$I = 0.2 \times (0.29)^2$

$= 0.016$ kg/m²

Angular velocity $\omega = \frac{2\pi N}{60}$ rad/s

$= \frac{2\pi \times 61}{60} = 6.38$ rad/se

$\omega = 6.38$ rad/sec

PROCEDURE:

Initial setup was spring by adjusting the weights to the original position and the distance r_1 was noted.

The power supply was switched on.

The speed was gradually increased by adjusting the knob.

After sometime one of weight was moved to extreme end of the rod.

The stop watch started and the time taken was noted.

The stop watch was stoped and the following reading was noted ie. time, speed and the distance r_2.

The speed was decreased to zero and switch off the power supply.

RESULT:

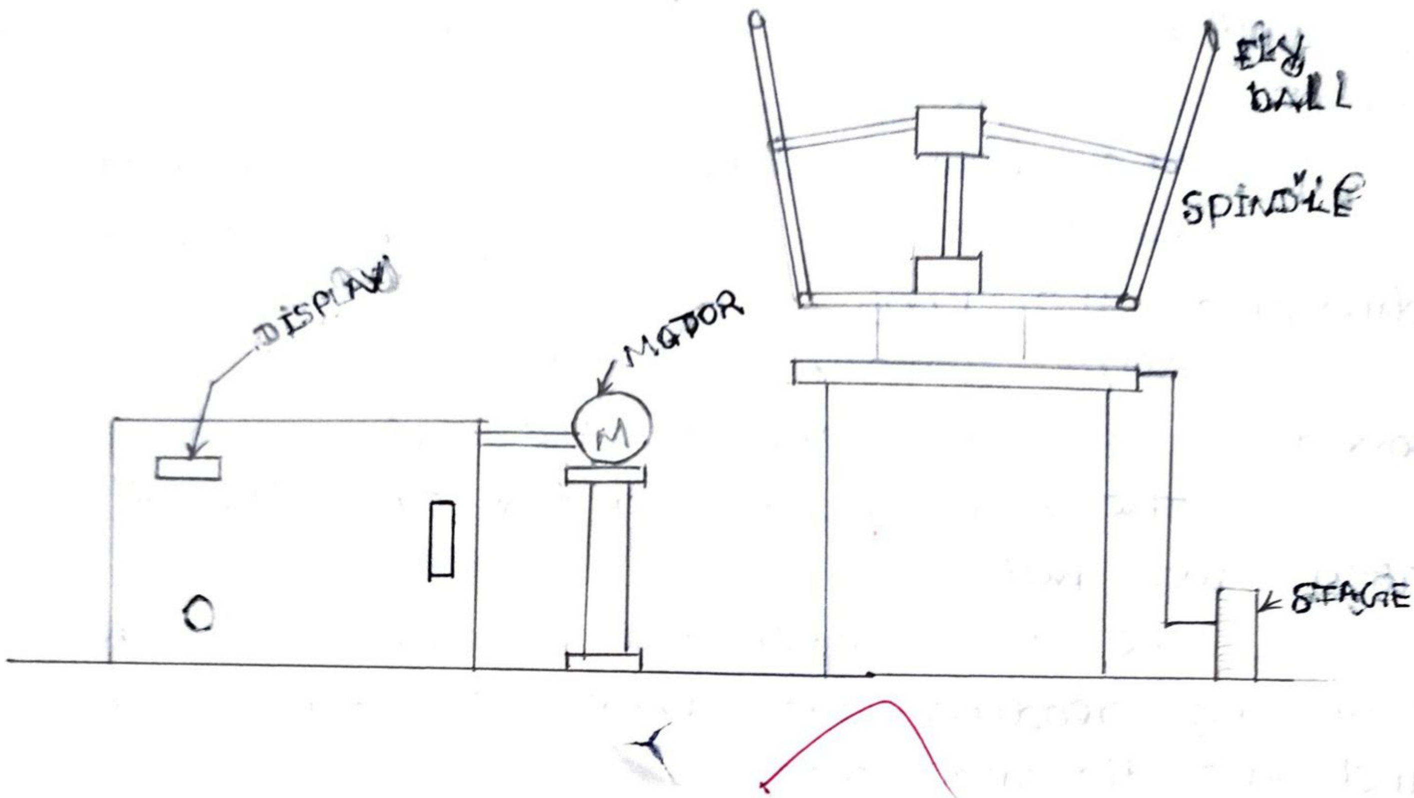
Thus the experiment on turn table was done.

i) initial velocity v_1 = 1.27 m/s
ii) final velocity v_2 = 1.85 m/s
iii) Angular acceleration (a) = 0.128 m/s²
iv) mass moment of inertia (I) = 0.016 kg m²
v) centrifugal force (F) = 2.79 N
vii) Angular velocity (ω) = 6.38 rad/sec
vi) Angular acceleration (α) = 1.408 rad/s²

PRACTICAL EVALUATION	
Observation (10)	10
Calculation / Result (10)	10
Viva (10)	8
Total Marks (30)	28
Signature of Faculty	

20/6/19

DIAGRAM



DETERMINATION OF SENSITIVITY EFFORT FOR THE PROELL GOVERNOR

AIM:

To determine the sensitivity effort and various charactestic of the proell governor:

DESCRIPTION:

In the proell governor with the use of fly weights the governor becomes highly sensitive. under these conditions large sleeves displacement is observed for very small change in speed. In order to make it stable. It is necessary to carry out the experiment by using belt ball fly weight on each side.

DIMENSIONS:

Length of each link 'L' :
Initial height of governer (ho) :
Initial radius of rotation (ro) :
weight on sleeve :
weight of each ball :

TABULATION

S. NO	Speed N (rpm)	Height h (mm)	Force F N	Angular velocity (ω)	Sleeve displacement (x) mm	Radius of rotation (r) m	$\alpha = \cos^{-1}(h/L)$
1.	240	32.5	14.09	25.13	35	181.02	76.06
2.	260	28.2	16.54	27.22	43	181.95	77.81
3.	280	26.5	19.29	29.32	47	182.36	78.67
4.	300	25	22.14	31.41	50	182.66	79.32
5	320	24	25.20	33.51	52	182.64	79.75

MODEL CALCULATION :-

1. Angular velocity (ω) $= \frac{2\pi N}{60}$

$= \frac{2 \times \pi \times 240}{60}$

$= 25.13$ rad/sec

2. Height of the governor (h) $= h_0 - (x/2)$ mm

$= 50 - (35/2)$

$= 32.5$ mm

3) $\alpha = \cos^{-1}(h/l)$

$= \cos^{-1}\left(\frac{32.5}{2}\right)$

PROCEDURE:

The control unit was switched on.

The speed control value was rotated and the governor speed was in closed.

The control value was stopped when the centre sleeve rises off the lower stop and first division alitned on the graduated scale.

The sleeve position was recorded and the speed was also recorded.

The governor speed was increased in steps to suitable sleeve movement is given and the readings were noted down.

The range of the sleeve movement was continued this through out.

$= \cos^{-1}(0.2407)$

$\alpha = 76.06$

4. Radius of rotation $(r) = 50 + l$

$= 504 (135) \sin (76.06)$

$= 181.02$ mm

$= 0.181$ m

5. Spring force $(F) = \omega^2 r \left(\frac{w_1 + w_2}{g}\right)$

$= (25.13)^2 (0.181) \left(\frac{110.21}{9.81}\right)$

$= 14.09$ kg.F

GRAPH:

Speed vs sleeve displacement.

for static position sleeve displacement vs radius of rotation of balls by actual measurement.

sleeve displacement vs speed when governor is rotating.

RESULT:

Thus the sensitivity and effort of proell governor of various types were found and the related graph were drawn.

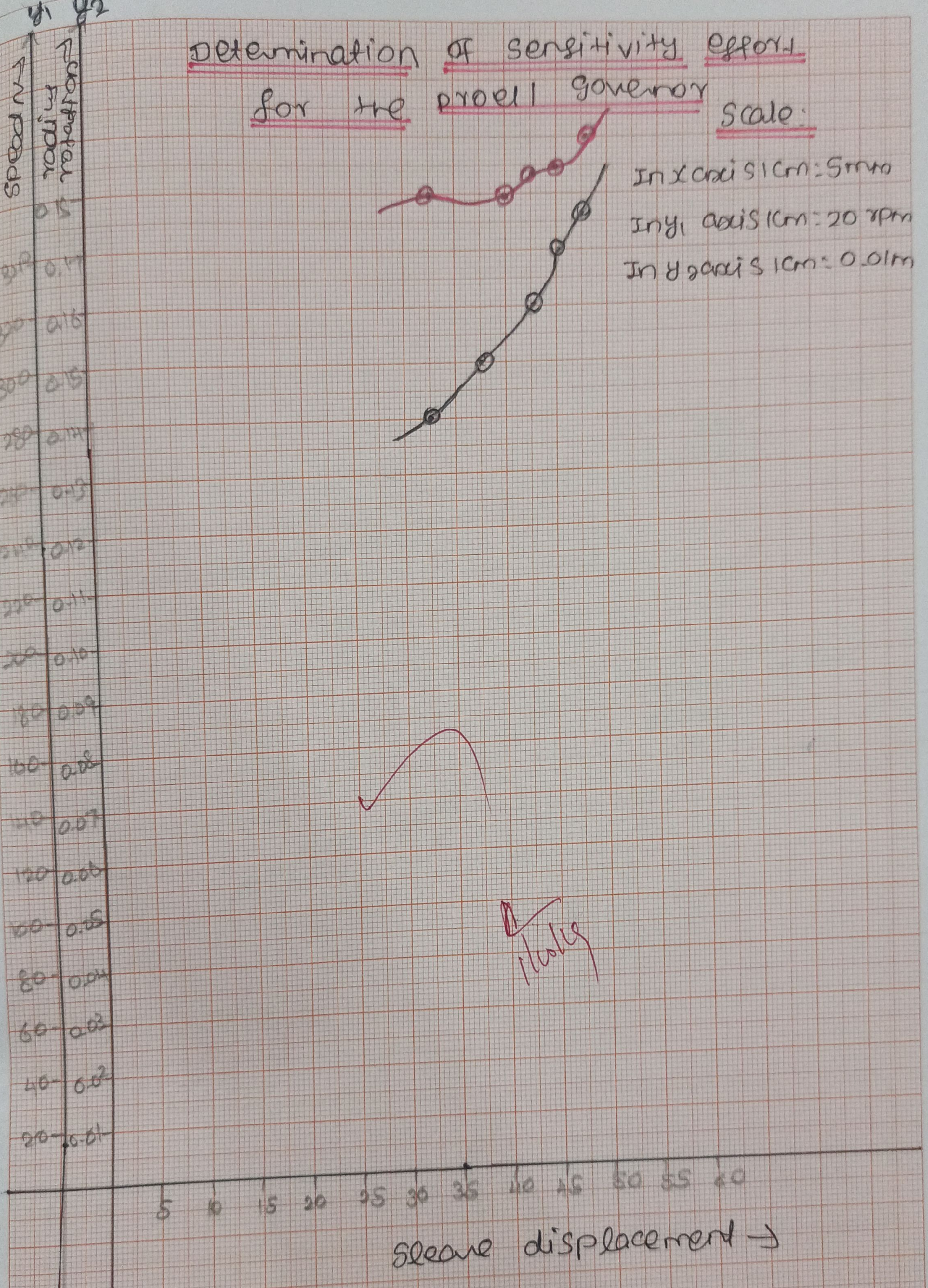
3/5/19

PRACTICAL EVALUATION	
Observation (10)	8
Calculation / Result (10)	10
Viva (10)	8
Total Marks (30)	26
Signature of Facult	

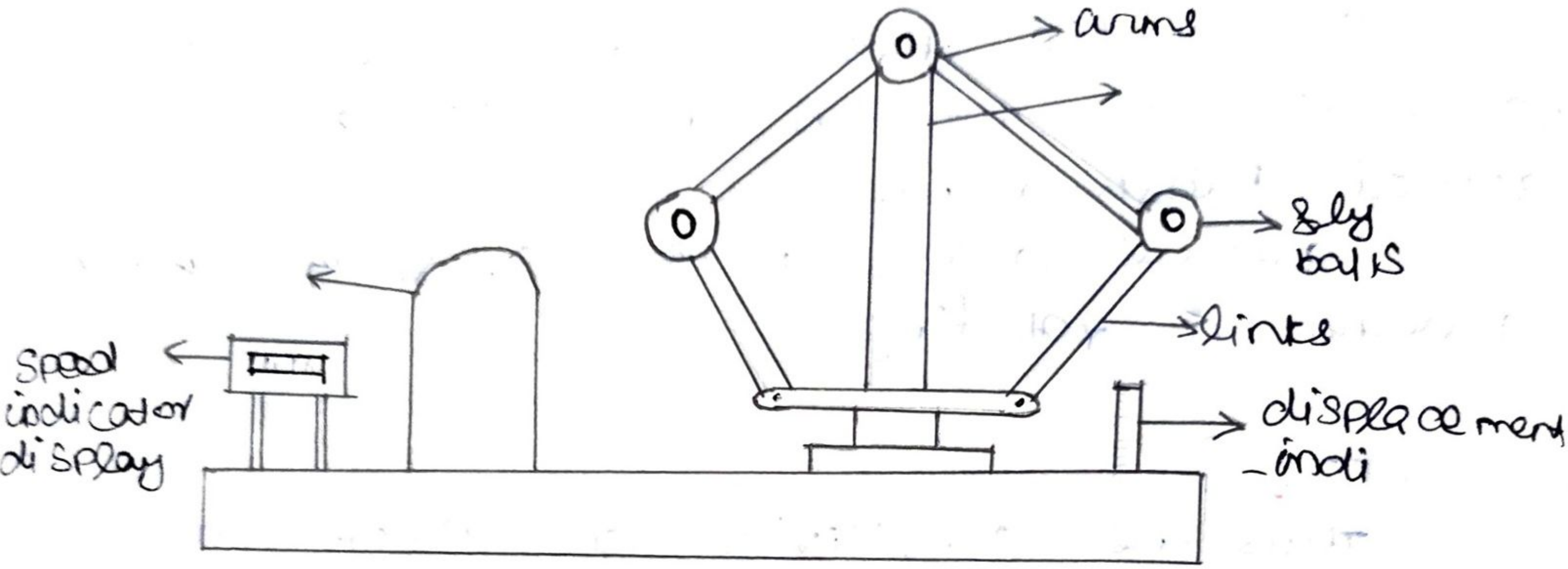
Ex-No: 6

DATE 27 08 2019

Determination of sensitivity effort for the proell governor



DIAGRAM



OBSERVATION:

Length of each link (l) = 135 mm

Initial height of governor (h_0) = 70 mm

Initial radiation of rotation (r_0) = 165 mm

weight of each ball assembly (W) = 0.21 kg.

DETERMINATION OF SPRING FORCE BY USING WATT'S GOVERNOR

AIM:

To determine the spring force by using watt's governor and to draw this characteristics curve.

APPARATUS REQUIRED:

watt's governor apparatus
Digital tachometer
steel rule.

FORMULA:

Angular velocity, $\omega = \frac{2\pi N}{60}$ (rad/sec)

Height of the governor, $h = h_0 - (x/2)$ (mm)

$\alpha = \cos^{-1}(h/l)$ degree

Radius of rotation, $r = 50 + l \sin \alpha$ m

spring force, $f = \omega^2 \times r \times (w/g)$ - kg f

where,

x - sleeve displacement in mm

h_0 - Initial height of governor in mm

L - Length of each link in mm

R_0 - Initial radius of rotation in mm

w - weight of each ball in kg-f.

S. NO	MOTOR SPEED (rpm)	ANGULAR VELOCITY	SLEEVE DISPLACEMENT	HEIGHT	$\alpha = \cos^{-1}(h/l)$	RADIUS OF ROTATION	FORCE
1.	220	23.03	14	63	62°18'	169.53	11.05
2.	240	25.03	30	55	65°51'	173.28	13.4
3.	260	27.22	45	47.5	69°23'	176.35	16
4.	280	29.32	58	41	72°19'	178.64	19
5.	300	31.42	61	39.5	72°59'	179	22

CALCULATION:

Angular velocity, $\omega = 2\pi N/60$

$= \frac{2\pi \times 22}{60}$

$\omega = 23.03$ rad/sec

$h = h_0 - (x/2) \Rightarrow 70 - (14/2) \Rightarrow h = 63$ mm

$\alpha = \cos^{-1}(h/l) \Rightarrow \cos^{-1}\left(\frac{63}{135}\right)$

$\alpha = 62°18'$

$r = 50 + L \sin\alpha$

$= 50 + (135)\sin(62°18')$

$r = 0.169$ m

$F = \omega^2 \times r \times (W/g)$

$= (23.03)^2 \times (0.169) \times \left(1 + \frac{0.21}{9.81}\right)$

$F = 11.05$ N.

PROCEDURE:

The control unit was switched on.

The speed control valve was rotated and increase the governor speed.

The control valve was stop when the centre sleeve raise off the lower stop and aligns with first division on the graduated scale.

The sleeve positions and the speed was recorded.

The governor speed was increased on steps to give suitable sleeve movement and the reading was noted down.

The continued throughout the range of sleeve movement possible.

RESULT:

Thus the spring force using watt's governor is determined and its characteristics curve were plotted.

7/9/24

PRACTICAL EVALUATION	
Observation (10)	9
Calculation / Result (10)	9
Viva (10)	9
Total Marks (30)	27
Signature of Faculty	

Ex.No: 7

DATE 03 09 2019

DETERMINATION OF SPRING FORCE BY USING WATTS GOVERNOR

Scale:

x axis 1cm : 5mm

y_1 axis 1cm : 20 rpm

y_2 axis 1cm : 2 kg-m

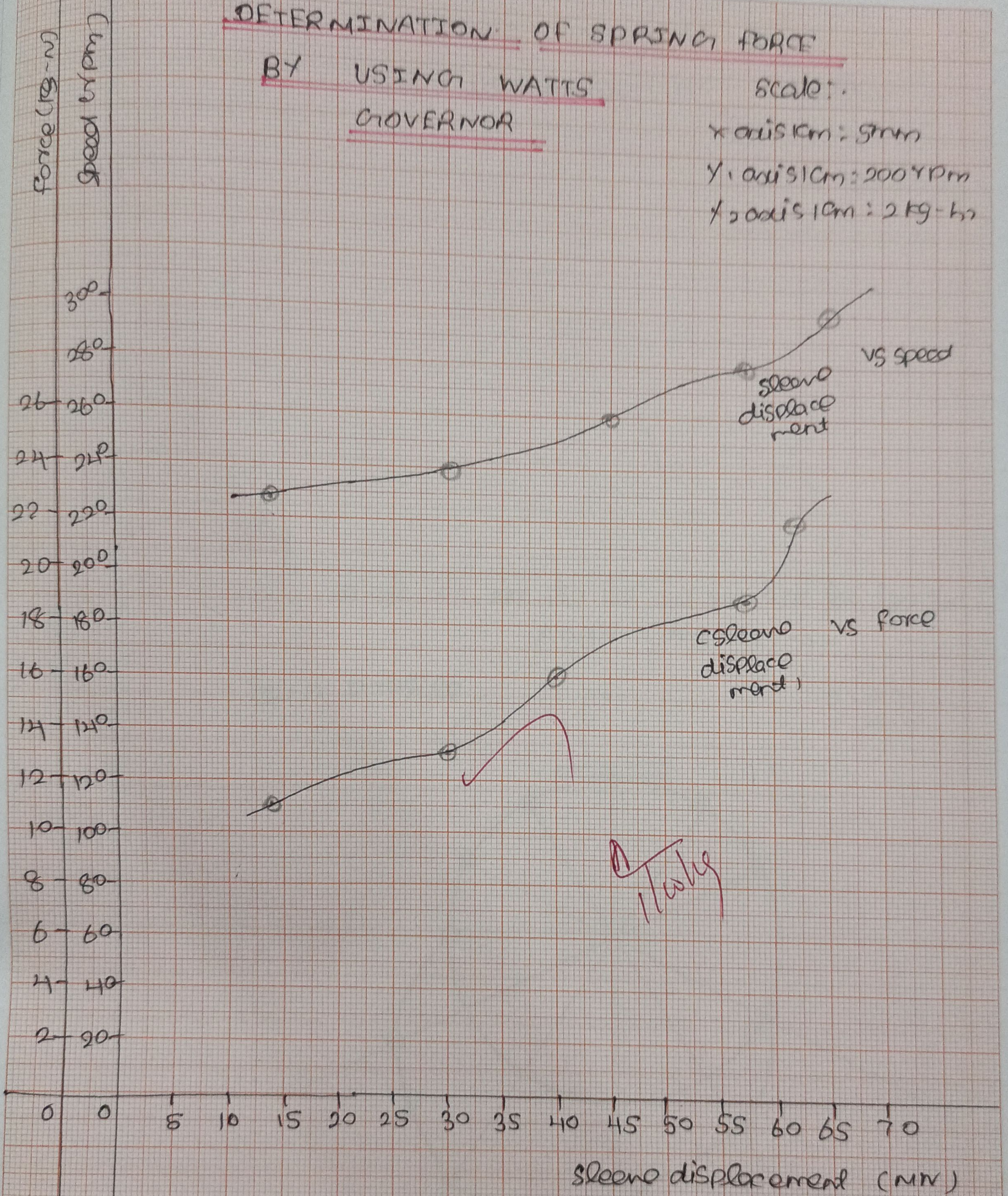
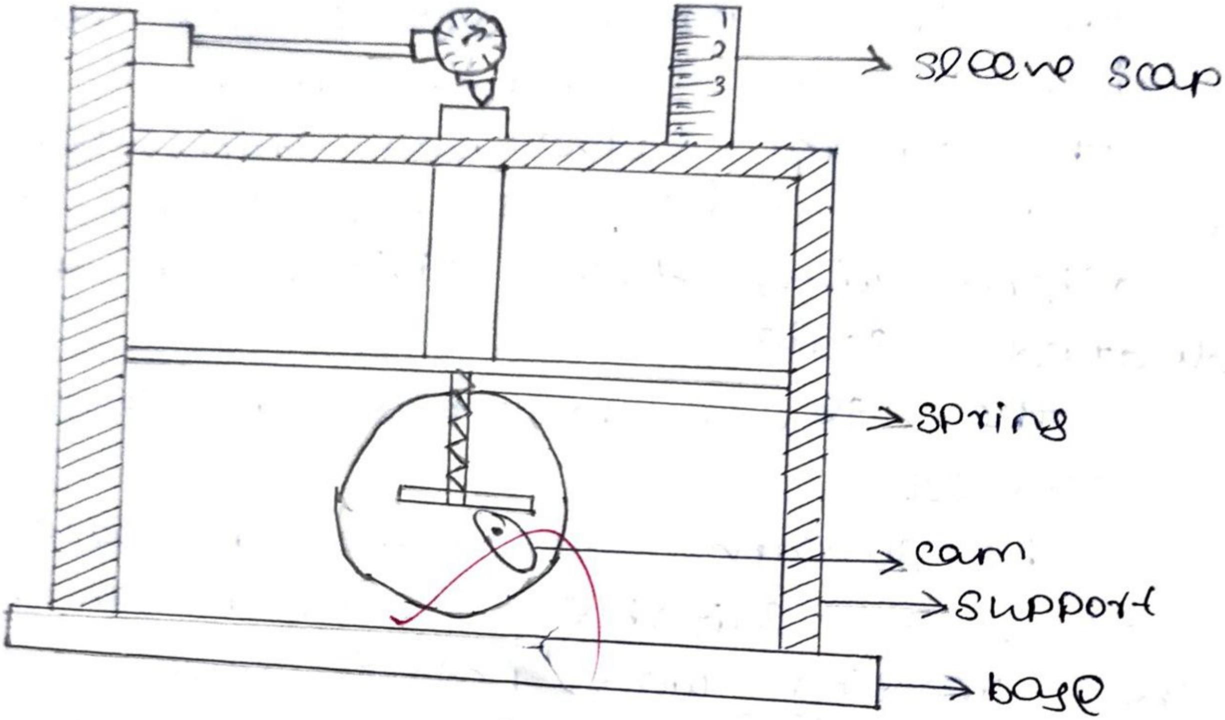


DIAGRAM:



DYNAMICS ANALYSIS OF CAM MECHANISM

AIM :

TO draw the follower displacement diagram for given cam project.

APPARATUS REQUIRED:

Cam analysis machine with cam follower
set of weight
Controller bar
Dial gauge.

PROCEDURE:

The dial gauge was setted to zero by rotating the hand wheel attached to the cam.

The reading was noted on the displacement the dial gauge and scale as zero

The following reading were noted down. displacement from the dial gauge and distance from the binear scale was tabulated.

TABULATION:

Sl No	Angle (degree)	Distance (mm)	Displacement from Dial Gauge (mm)
1.	30	0	0
2.	60	0	0.20
3.	90	0	0.32
4.	120	4	4.33
5.	150	7	8.36
6.	180	8	8.43
7.	210	4	4.65
8.	240	0	0.31
9.	270	0	0.53
10.	300	0	0.30
11.	330	0	0.10
12.	360	0	0
		0	

GRAPH:

The graph was plotted by taking crank angle to x-axis and distance y-axis and the following displacement diagram was drawn.

RESULT:

Thus the dynamic anaysis of cam was observed and the follower displacement diagram was drawn.

PRACTICAL EVALUATION	
Observation (10)	8
Calculation / Result (10)	8
Viva (10)	8
Total Marks (30)	24
Signature	

Ex.No:8

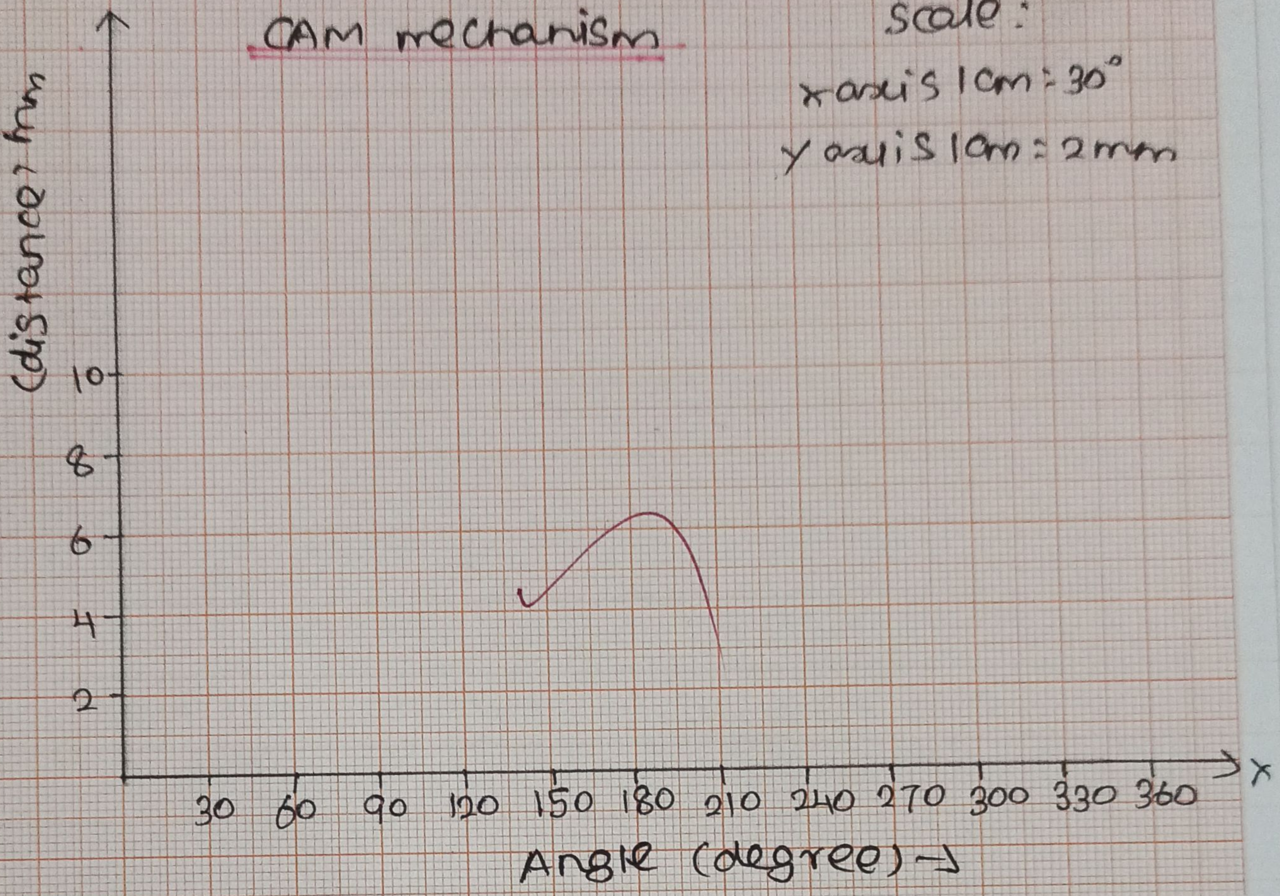
DATE 07 09 2019

Dynamic analysis of CAM mechanism

Scale:

x axis 1cm = 30°

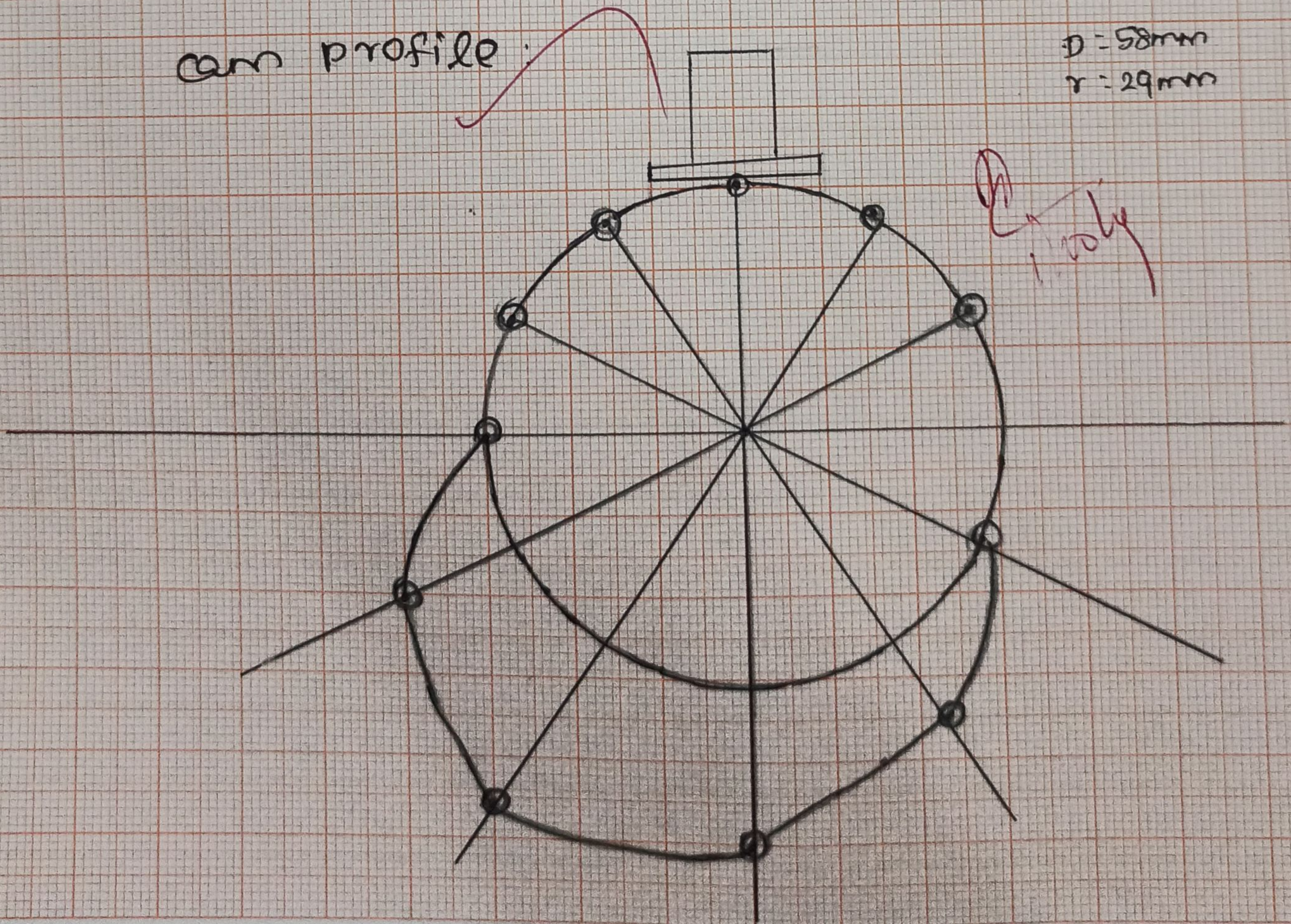
y axis 1cm = 2mm



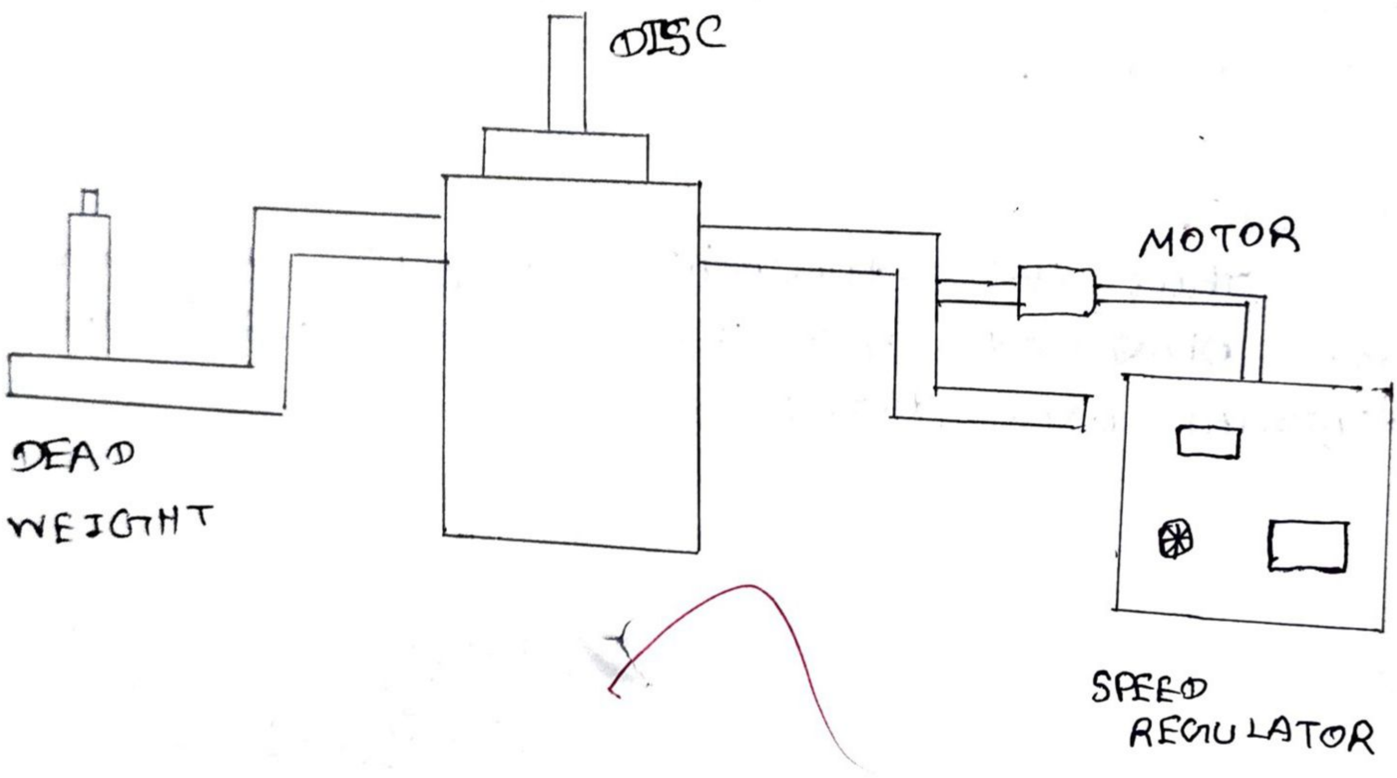
cam profile:

D = 58mm

r = 29mm



DIAGRAM



MOTORISED GYROSCOPE

AIM :

To determine the gyroscope couple applied to the motor with gyroscope.

APPARATUS REQUIRED:

- Stop watch
- blade weight
- measuring tape.
- Digital tachometer.

FORMULA:

moment of inertia $I = Mk^2$ kg m^2

Angular velocity of spin $w = \frac{2\pi N}{60}$ rad/sec

Angular velocity of precession (w_p) $= \left(\frac{\theta \times \pi/180}{t}\right)$ rad/sec

Gyroscope couple $C = I \times w \times w_p$ N-m

Torque applied $T = W \times x$ N-m

PROCEDURE:

The motor is checked for rectial position and the balance weight is adjusted is required.

The time is to be kept at zero position and the supply is switched on.

OBSERVATION:

Radius of disc (r) = 105 mm = 0.105 m

mass of the disc m = 6.9 kg

Thickness = 10 mm = 0.01 m

Distance of weight from centre of disc x = 175 mm = 0.175 m

TABULATION:

S. NO	ROTOR SPEED in RPM	WEIGHT ADDED kg	N	TIME FOR 45° PRECESSION in sec	APPLIED TORQUE in N-m	GYROSCOPIC COUPLE N-M
1.	1440	0.5	4.905	4.29	0.859	1.04
2.	1440	1	9.81	1.53	1.717	2.92

MODEL CALCULATION:

i) Movement of inertia $I = mr^2$

$= 6.9 \times 10.07432^2$

$I = 0.378 \ kg\text{-}m^2$

ii) $\omega = \frac{2\pi N}{60}$

$= \frac{2 \times 3.142 \times 1440}{60}$

$\omega = 150.79$ rad/sec

The motor is standed by applying the voltage of ground no volts and then reduced.

The speed of the motor is to be a adjusted as required.

The motor speed is to be noted using digital tachometer. The speed is to be noted down it become steady.

At the same instant the required weight is to be added on weight pan.

The time for 10 precession is noted down by using stop watch.

PRECAUTION:

Checkout the testening to the rotor before start.

Checkout the balance of rotor before start.

Lubricate the bearings predically.

Keep the ball over a position.

iii) $\omega_p = (\theta \times \pi/180)/t$

$= \frac{45 \times \pi/180}{4.2}$

$= 0.183$ rad/s

iv) Gyroscopic couple:

$C = I \times \omega \times \omega_p$

$= 0.0378 \times 150.79 \times 0.183$

$= 1.04$ N-m

v) Torque $= W \times u$

$= 4.905 \times 0.175$

$= 0.85$ N-m

Exp. No.:
Date :

RESULT:

Thus the motorised gyroscope couple applied to the spinning motor with gyroscope is determined.

PRACTICAL EVALUATION	
Observation (10)	8
Calculation / Result (10)	8
Viva (10)	8
Total Marks (30)	24
Signature of Fac	

SERVICE IS OUR MOTTO

P.S.R. ENGINEERING COLLEGE

(Autonomous Institution, Affiliated to Anna University, Chennai)

Sevalpatti, Sivakasi – 626140

Department of Mechanical Engineering

ATTAINMENT VALUE OF LABORATORY OUTCOMES

161ME58 - DYNAMICS LABORATORY

Course Outcomes:

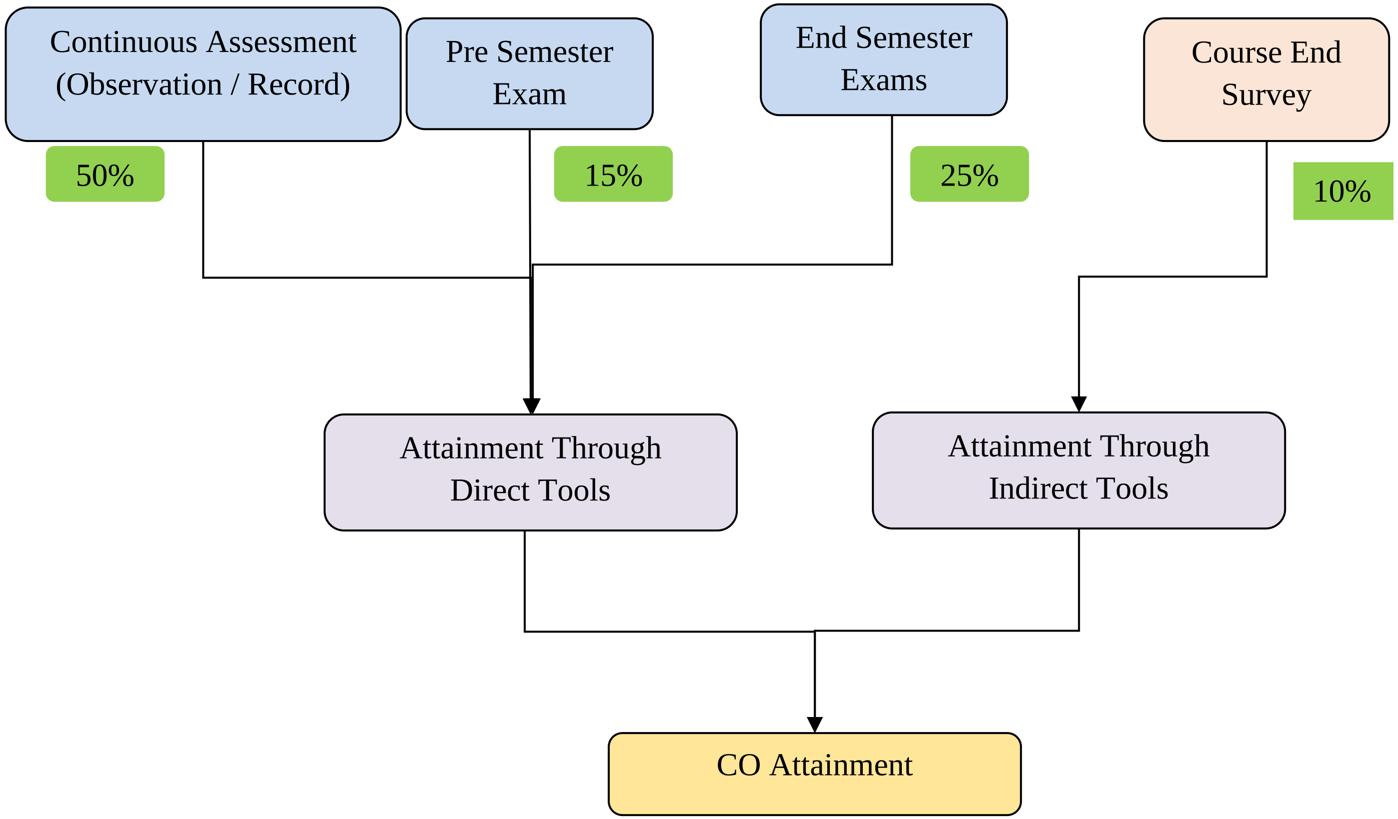
The students will be able to

- CO1. Know the functions of kinematic links and its mechanisms
- CO2. Interpret the fundamentals of the natural frequency of free vibration of fixed beam
- CO3. Find the gyroscopic effect
- CO4. Determine the basic concepts of governor apparatus
- CO5. Identify the different cam profile mechanisms
- CO6. Enumerate the critical speed of shaft

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		2					3			2		3	1	3
CO2	3	2		3					3			2		3	2	3
CO3	2	3		2					3			2		2		3
CO4	3	3		2					3			2		2		2
CO5	3	3		2					3			2		3		3
CO6	3	2		3					3			2		2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

COURSE OUTCOMES ATTAINMENT – PRACTICAL COURSES



[Reference from Evaluation Manual]

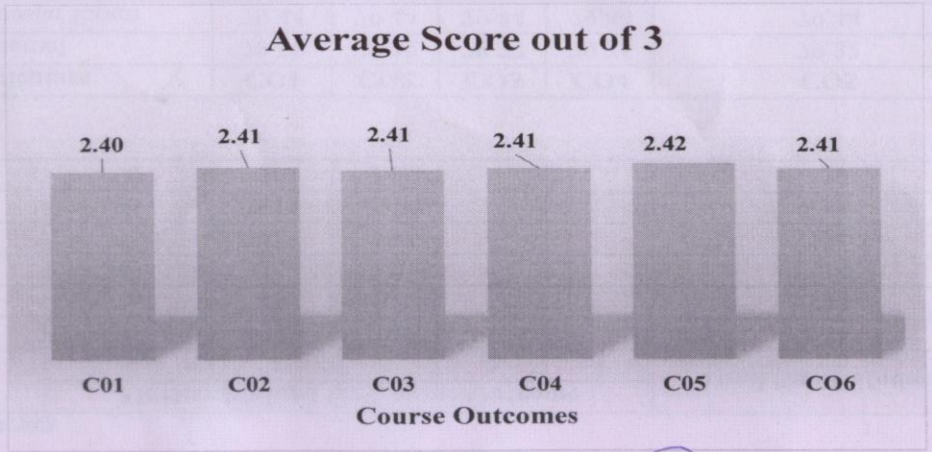
Evaluation of Course Outcomes				
Course Code & Name	: 161ME58 - DYNAMICS LABORATORY			
Course Teacher	: Dr.A.Muthiah & Mr.D.Sundarrajan			
Year / Semester	: III/V/ I & II			
Academic Year	:2019-20	Odd	Batch	2017-2021

Course End Survey

Course Outcomes	Marks obtained for Course Outcome					Total No of Students	Score	
	5	4	3	2	1		Net	100
CO1	91	33	10			134	617	92.09
CO2	76	45	13			134	599	89.40
CO3	85	36	13			134	608	90.75
CO4	75	46	13			134	598	89.25
CO5	95	31	8			134	623	92.99
CO6	90	30	14			134	612	91.34

Particulars	CO1	CO2	CO3	CO4	CO5	CO6
Internal	78.38	79.32	78.77	79.25	79.22	78.85
End Semester Exam	79.44	79.44	79.44	79.44	79.44	79.44
Course End Survey	92.09	89.40	90.75	89.25	92.99	91.34
Attainment (0.65 of Internal+0.25 of ESE + 0.1 of CES)	**80.07**	**80.36**	**80.17**	**80.31**	**80.66**	**80.28**

Course Outcomes	C01	C02	C03	C04	C05	CO6
Average Score Out of 5	4.00	4.02	4.01	4.02	4.03	4.01
Average Score Out of 3	**2.40**	**2.41**	**2.41**	**2.41**	**2.42**	**2.41**



Signature of the Course Tutor **Signature of the Course Co-ordinator/Moderator** **Head of the Department**

161ME58 - DYNAMICS LABORATORY
CO- PO Mapping

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		2					3			2		3	1	3
CO2	3	2		3					3			2		3	2	3
CO3	2	3		2					3			2		2		3
CO4	3	3		2					3			2		2		2
CO5	3	3		2					3			2		3		3
CO6	3	2		3					3			2		2		3

Internal CO- PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	78.38	78.38		78.38					78.38			78.38		78.38	78.38	78.38
CO2	79.32	79.32		79.32					79.32			79.32		79.32	79.32	79.32
CO3	78.77	78.77		78.77					78.77			78.77		78.77		78.77
CO4	79.25	79.25		79.25					79.25			79.25		79.25		79.25
CO5	79.22	79.22		79.22					79.22			79.22		79.22		79.22
CO6	78.85	78.85		78.85					78.85			78.85		78.85		78.85

External CO- PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	79.44	79.44		79.44					79.44			79.44		79.44	79.44	79.44
CO2	79.44	79.44		79.44					79.44			79.44		79.44	79.44	79.44
CO3	79.44	79.44		79.44					79.44			79.44		79.44		79.44
CO4	79.44	79.44		79.44					79.44			79.44		79.44		79.44
CO5	79.44	79.44		79.44					79.44			79.44		79.44		79.44
CO6	79.44	79.44		79.44					79.44			79.44		79.44		79.44

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Internal	79.0	79.0		79.0					79.0			79.0		79.0	79.0	78.9
External	79.4	79.4		79.4					79.4			79.4		79.4	79.4	79.4

10/2/20
Signature of the Course Tutor

10/2/2020
Signature of the Course Co-ordinator/Moderator

10/2/20
Programme Co-ordinator

10/2/2020
Head of the Department

Evaluation of PO & PSO

Course Code & Name : **161ME58 - DYNAMICS LABORATORY**

Year / Semester : **IV / VII**

Direct Tool : **Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

Table 3. Average attainment score of Course Outcomes based on Program Outcomes (POs) & Program Specific Outcomes (PSOs)

Attainment of POs & PSOs from a Course considering all the Direct tools

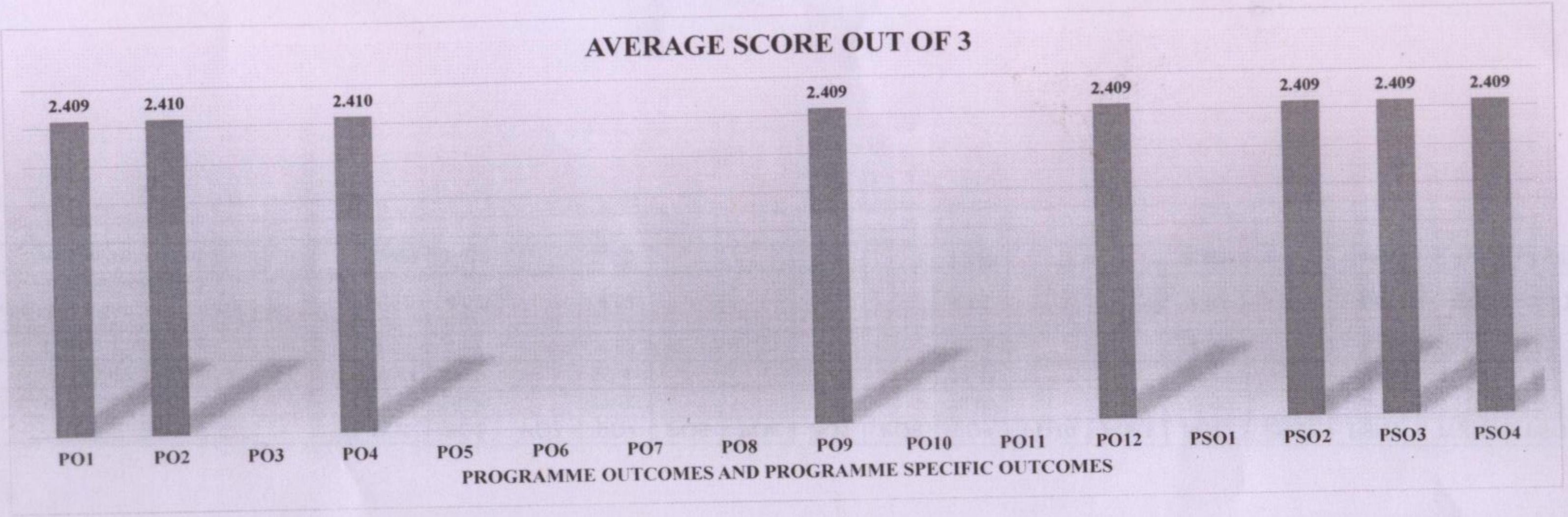
Course End Survey from CO Attainment

Course Outcomes	Survey Score
C01	92.09
C02	89.40
C03	90.75
C04	89.25
C05	92.99
CO6	91.34

CO- PO - PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C01	92.09	92.09		92.09					92.09			92.09		92.09	92.09	92.09
C02	89.40	89.40		89.40					89.40			89.40		89.40	89.40	89.40
C03	90.75	90.75		90.75					90.75			90.75		90.75		90.75
C04	89.25	89.25		89.25					89.25			89.25		89.25		89.25
C05	92.99	92.99		92.99					92.99			92.99		92.99		92.99
CO6	91.34	91.34		91.34					91.34			91.34		91.34		91.34
Score	**4.55**	**4.55**		**4.55**					**4.55**			**4.55**		**4.55**	**4.54**	**4.55**

Particulars	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Internal	78.98	78.99		78.98					78.97			78.97		78.97	79.01	78.95
Endsemester	79.44	79.44		79.44					79.44			79.44		79.44	79.44	79.44
Course End Survey	4.55	4.55		4.55					4.55			4.55		4.55	4.54	4.55
Attainment (0.65 of Internal+0.25 of ESE + 0.1 of CES) Out of 5	**4.02**	**4.02**		**4.02**					**4.02**			**4.02**		**4.02**	**4.02**	**4.01**
Attainment Out of 3	**2.409**	**2.410**		**2.410**					**2.409**			**2.409**		**2.409**	**2.409**	**2.409**



Signature of the Course Tutor	Signature of the Course Co-ordinator/Moderator	Programme Co-ordinator	Head of the Department
10/2/20	10/2/2020	10/2/20	10/2/2020