SRM VALLIAMMAI ENGINEERINGCOLLEGE
(An Autonomous Institutions)

SRM Nagar, Kattankulathur– 603203

DEPARTMENT OF MECHANICAL ENGINEERING

NBA ACCREDITED

Lab Manual

V SEMESTER

ME 3568 - DYNAMICS LABORATORY

Regulation–2023

Academic Year 2026–27

Prepared by

Mr. G.RAJESH, M.Tech. (Ph.D), Assistant Professor/Mechanical

SRM VALLIAMMAIENGINEERING COLLEGE
(An Autonomous Institutions)

SRMNagar,Kattankulathur– 603203.

DEPARTMENT OF MECHANICAL ENGINEERING

OBJECTIVES:

1. Apply the principles of kinematics in the measurement of various kinematic parameters
2. Apply the principles of kinematics and dynamics in the measurement of vibration parameters in various experiments.
3. To Demonstrate the how speed is governed by using various governor
4. To Demonstrate how the concept of the gyroscope working
5. Apply the principles of kinematics and dynamics in the torsional natural frequency of single and Double Rotor systems

LIST OF EXPERIMENTS:

1. Study of gear parameter.
2. Kinematic models to study various mechanisms.
3. Determination of moment of inertia of flywheel and axle system.
4. Determination of Mass Moment of Inertia of axis symmetric bodies using Turn Table apparatus
5. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
6. Transverse vibration of Free beam – with and without concentrated masses.
7. Determination of torsional natural frequency of single and Double Rotor systems. Undamped and Damped Natural frequencies.
8. Dynamic analysis of cam mechanism.
9. Experiment of Watt Governor.
10. Experiment of Porter Governor.
11. Experiment of motorized gyroscope.
12. Determination of critical speed of shaft.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Determine the measurement of various kinematic parameters.
2. Found the vibration parameters in various experiments.
3. Demonstrated the how speed is governed by using various governor
4. Demonstrated the principle of the gyroscope working
5. Found the torsional natural frequency of single and Double Rotor systems

SRM VALLIAMMAIENGINEERING COLLEGE
(An Autonomous Institutions)

SRM Nagar, Kattankulathur– 603203.

DEPARTMENT OF MECHANICAL ENGINEERING

ME3568 - DYNAMICS LABORATORY

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

SL. NO.	NAME OF EQUIPMENTS	QUANTITY
1	Cam follower setup.	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	Two rotor vibration setup.	1 No.
6	Spring mass vibration system.	1 No.
7	Torsional Vibration of single rotor system setup	1 No.
8	Gear Models	1 No.
9	Turntable apparatus	1 No.

ME3568	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2										2	3	2		
CO2	3											2	3			
CO3	3											2	3			
CO4	3				2							2	3			
CO5	3				2							2	3			
Average	3				1							2	3			

(1-LOW, 2-MEDIUM, 3-HIGH)

]

SRM VALLIAMMAIENGINEERING COLLEGE
(An Autonomous Institutions)

SRM Nagar, Kattankulathur– 603203.

DEPARTMENT OF MECHANICAL ENGINEERING

ME3568 - DYNAMICS LABORATORY

Cycle – 1

- Study of gear parameter.
- Kinematic models to study various mechanisms.
- Determination of moment of inertia of flywheel and axle system.
- Determination of Mass Moment of Inertia of axis symmetric bodies using Turn Table apparatus
- Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
- Transverse vibration of Free beam – with and without concentrated masses.

Cycle – 2

- Determination of torsional natural frequency of single and Double Rotor systems. Undamped and Damped Natural frequencies.
- Dynamic analysis of cam mechanism.
- Experiment of Watt Governor.
- Experiment of Porter Governor.
- Experiment of motorized gyroscope.
- Determination of critical speed of shaft.

DEPARTMENT OF MECHANICAL ENGINEERING

REG NO	
SUBJECT	ME3568 - DYNAMICS LABORATORY
BRANCH	MECHANICAL ENGINEERING
YEAR \ SEM	III & V
REGULATION	2023
ACADEMIC YEAR	2026-2027

Ex.No.	Date	INDEX	Page No.	Marks	Sign
1.		Study of gear parameter.			
2.		Kinematic models to study various mechanisms.			
3.		Determination of moment of inertia of flywheel and axle system.			
4.		Determination of Mass Moment of Inertia of axis symmetric bodies using Turn Table apparatus			
5.		Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.			
6.		Transverse vibration of Free beam – with and without concentrated masses.			
7.		Determination of torsional natural frequency of single and Double Rotor systems. Undamped and Damped Natural frequencies.			
8.		Dynamic analysis of cam mechanism.			
9.		Experiment of Watt Governor.			
10.		Experiment of Porter Governor.			
11.		Experiment of motorized gyroscope.			
12.		Determination of critical speed of shaft.			

1. To study various types of Kinematic links, pairs, chains and Mechanisms

AIM: - To study various types of kinematics links, pairs, chains & Mechanisms.

APPARATUS USED: - Kinematics links, pairs, chains & Mechanisms.

THEORY: - 1. Definitions of kinematics links, pairs, chains & Mechanisms.

2. Classifications of kinematics links, pairs, chains & Mechanisms.

3. Diagrams of kinematics links, pairs, chains & Mechanisms

4 Advantages & Disadvantages of kinematics links, Pairs, chains & Mechanisms.

5. Applications of kinematics link, Pairs, chains & Mechanism

6. Examples of kinematics link, Pairs, chains & Mechanisms.

KINEMATIC LINK: - A mechanism is made of a number of resistant bodies out of which some may have motions relative to the others. A resistant body or a group of resistant bodies with rigid connections preventing their relative movement is known as a link. A link also known as kinematic link or element.

Examples :- A slider-crank mechanism consists of four links: frame and guides, crank connecting rod and slider, the crank link may have crankshaft and flywheel also, forming one link having no relative motion of these.

CLASSIFICATIONS OF LINKS:-

1. Binary link

2. Ternary link

3. Quarternary link

KINEMATIC PAIR: - A kinematic pair or simply a pair is a joint of two links having relative motion between them.

CLASSIFICATIONS OF PAIRS:

1- Kinematics pairs according to nature of contact:-

(i) Lower pair (links having surface or area contact)

Examples- Nut turning on a screw, shaft rotating in a bearing, universal joint etc.

(ii) Higher pair (Point or line contact between the links)

Examples:- when rolling on a surface, cam and follower pair, tooth gears, ball and roller bearings etc.

2- Kinematics pairs according to nature of Mechanical Constraint:-

(a) Closed pair (when the elements of a pair are held together mechanically)

Examples :- all the lower pairs and some of the higher pair

(b) Unclosed pair (when two links of a pair are in contact either due to force of gravity or some spring action),

Example :- cam and follower pair.

3- Kinematics pairs according to nature of relative motion:-

(i) Sliding pair

(ii) Turning pair

(iii) Rolling Pair

(iv) Screw pair (Helical pair)

(v) Spherical pair

KINEMATIC CHAIN :- A kinematic chain is an assembly of links in which the relative motions of the links is possible and the motion of each relative to the others is definite. If indefinite motions of other links , it is a non-kinematic chain.

Types of kinematics chains :-

(i) Four bar chain or quadric cycle chain

(ii) Single slider crank chain

(iii) Double slider crank chain

MECHANISM :- A linkage is obtained if one of the links of a kinematics chain is fixed to the ground. If motion of each link results in definite motions of the others, the linkage is known as a mechanism. If one of the links of a redundant chain is fixed, it is known as a structure. The degree of freedom of a structure is zero or less. A structure with negative degree of freedom is known as a superstructure.

OBSERVATION & CONCLUSION:-

1. Comparison between kinematics links,Pairs, chains & Mechanisms.

2. Type of Motion to be named.

VIVA-QUESTIONS:-

a) Define machine & structure.

b) Concept of kinematics links, pairs, chains & mechanism.

c) Classification & examples of all the kinematics links, pairs, chains & mechanism.

d) Grasshof's criterion.

e) Types & examples of constrained motion.

2.To study various types of gear trains- simple, compound, reverted, epicyclic and differential.

AIM: -To study various types of gear trains- simple, compound, reverted, epicyclic and differential.

APPARATUS USED: -. Arrangement of Gear train system.

THEORY: -

1. Definition of. Geart rain
2. Classification of Geartrain
3. Diagrams of different types of Gear train.
4. Working & Construction of different types of Gear train.
5. Advantages & Disadvantages of Gear train
6. Applications of Gear train .
7. Examples of Gear train

GEAR TRAIN :- A gear train is a combination of gears used to transmit motion from one shaft to another. It becomes necessary when it is required to obtain large speed reduction within a small space. The following are the main types of gear trains:

(i) Simple gear train

(ii) Compound gear train

(iii) Reverted gear train

(iv) Planetary gear train

SIMPLE GEAR TRAIN :- A series of gears, capable of receiving and transmitting motion from one gear to another is called a simple gear train. In it, all the gear axes remain fixed relative to the frame and each gear is on a separate shaft.

Train Value = Number of teeth on driving gear / Number of teeth on driven gear

COMPOUND GEAR TRAIN :- When a series of gears are connected in such a way that two or more gears rotate about an axis with the same angular velocity, it is known as compound gear train. In this type, some of the intermediate shafts.

Train Value = Product of Number of teeth on driving gear / Product of Number of teeth on driven gear

REVERTED GEAR TRAIN :- If the axes of the first and last wheels of a compound gear coincide; it is called a reverted gear train. Such an arrangement is used in clocks and in simple lathes where 'back gear' is used to give a slow speed to the chuck.

Train Value = Product of Number of teeth on driving gear / Product of Number of teeth on driven gear

PLANETARY OR EPICYCLIC GEAR TRAIN :- When there exists a relative motion of axis in gear train, it is called a planetary or an epicyclic gear train (or simply epicyclic gear or train). Thus in an epicyclic train, the axis of at least one of the gears also moves relative to the frame.

Consider two gear wheels S and P, the axis of which are connected by an arm a. if the arm 'a' is fixed, the wheels S and P constitute a simple train. However, if the wheel s is fixed so that the arm can rotate about the axis of S, the wheel P would also move around S. therefore, it is an epicyclic train.

DIFFERENTIAL GEAR :- When a vehicle takes a turn, the outer wheels must travel farther than the inner wheels. In automobiles, the front wheels can rotate freely on their axis and thus can adapt themselves to the conditions. Both rear wheels are driven by the engine through gearing. Therefore, some sirt of automatic device is necessary so that the two rear wheels are driven at slightly different speeds. This is accomplished by fitting a differential gear on the rear axle.

OBSERVATION & CONCLUSION: -

1. Comparison between simple, compound reverted, epicyclic and differential. Gear train.
2. To calculate the train value.
3. To calculate the speed of any gear.

APPLICATIONS :-

(i) Gear trains are used in automobiles.

(ii) Reverted gear train are used in clock and simple lathe

(iii) Epicyclic gear are used in transmission, computing devices.

(iv) Gears are used in different machinery.

VIVA-QUESTIONS :-

a. Define about gear trains with classification, advantages & disadvantages and applications.

b. Define train value.

c. Define differential gear train with applications.

3. DETERMINATION OF RADIUS OF GYRATION AND MOMENT OF INERTIA OF CONNECTING ROD BY OSCILLATION METHOD

Date:

Exp No:

AIM:

To determine the radius of gyration & moment of inertia of connecting rod using oscillation method.

APPARATUS REQUIRED:

1. Connecting rod
2. Verniercalliper
3. Stop watch

FORMULA:

Time period t_p= time taken / No of oscillation in (sec)

Moment of Inertia $I=mk^2$ (kgm^2)

K-radius of gyration(m) $K^2=h(l-h)$

Natural frequency $F_n=1/2\pi\sqrt{g/L}$ (Hz)

L_1=Equivalent length of the connecting rod when the system is from the small end.

$L_{1=}g(TP1/2\Pi/)^2$

h_1=Distance of small end from centre of gravity .

Natural frequency $F_{n2}=1/2\pi\sqrt{g/L_2}$ (Hz)

L_2= Equivalent length of the connecting rod when the system is from the big end.

$L_{2=}g(TP2/2\Pi/)^2$

L=L1+L2/2

h_2= Distance of big end from centre of gravity .

$h_1+h_2=l+d_1/2+d_2/2$

l- Length of connecting rod

PROCEDURE:

1. The experimental setup is taken and stand is fixed for oscillation of connecting rod.

2. The connecting with its small end is hanged on the stand.

3. Connecting rod is passed to a point and then it is released and allowed to oscillate.

4. Time is noted for 5 oscillation of rod.

5. Now some procedure is followed by hanging rod &readings are taken to find radius of gyration & MOI of connecting rod by using the formula.

$I=mk^2$ (kgm^2)

S.No	Type of End	Time for 5 oscillation (t)(s)	Mean time(s)	Time period $T_p(s)=t/n$	Natural Frequency (Hz)($1/t_p$)	Radius of Gyration (k)(m)	Moment of Inertia I(kgm^2)

RESULT:

Thus the radius of gyration & moment of inertia of given connecting rod is found out using oscillation method.

Radius of gyration =

Moment of Inertia =

Questions

1. Define crank effort and crank pin effort .
   Crank effort is the net effort applied at the crank pin perpendicular tothecrank , which gives the required turning moment on the crankshaft.
   The component of force acting along connecting rod perpendicular tothe crank is known as crank-pin effort.

2. Define Piston effort
   Net force acting on the piston is termed as piston effort.

3. What is meant by turning moment diagram or crank effort diagram?It is the graphical representation of the turning moment or crank effort for variosposition of the crank.It turning moment diagram, the turning moment is taken as the ordinate and crankangle as abscissa.

4. Explain the term maximum fluctuation of energy in flywheels. The difference between the maximum and the minimum energies is known as maximum fluctuation of energy. Maximum fluctuation=maximum energy-minimum energy .

5. Define coefficient of fluctuation of energy.It is the ratio of maximum fluctuation of energy to the work done per cycle .Ce=maximum fluctuation of energy/work done per cycle .

6. Define coefficient of fluctuation of speed. It is the ratio of maximum fluctuation of speed to the mean speed is called the coefficient of fluctuation of speed.
   Cs= (N1-N2)/NWhere,N1=maximum speedN2=minimum speed N=mean speed=(N1+N2)/2.

7. Define coefficient of steadiness.
   The reciprocal of the fluctuation of speed is known as coefficient of steadiness'=1/Cs =N/ (N1-N2).
8. Why flywheels are needed in forging and pressing operations
   In both the machines flywheels are required to control the variations in speed during each cycle of an engine.
9. Define static force analysis. If components of a accelerate, inertia is produced due to their masses. However, the magnitude of these forces is small compared to the externally applied loads. Hence inertia effects due to masses are neglected. Such an analysis is known as static force analysis.

10. Differentiate between static & dynamic equilibrium.
    Necessary and sufficient conditions for static and dynamic equilibrium are:1.vector sum of all the forces acting on a body is zero.2. The vector sum of all the moments of all the forces acting about any arbitrary pointer axis is zero. First conditions are sufficient conditions for static equilibrium together with second condition is necessary for dynamic equilibrium

4. DETERMINATION OF MASS MOMENT OF INTERIA OF COMPOUND PENDULUM

Ex**. No.;**
Date:

Aim

To find out the moment of inertia of the given body

Apparatus required:
1. Compound pendulum
2. Scale
3. Stop watch

Experimental Setup:
A compound pendulum represents a represents a rigid body supported at 'O'. So that it can swing in vertical plane about some axis passing through it.

Formula used:

1. Time period $Tp= 2\pi / \sqrt{Kexp^2+OH^2/g}$ xOG
   OG-distance between centre of gravity and suspension point
2. Experimental radius of gyration= $\sqrt{(4 \pi^2 /T}$ xgxOG)-Oh^2
   Time period observed =time taken/ no. oscillation
3. Experimental Frequency =1/T
4. Theoritical frequency =1/T $\sqrt{}$ GxOh/g^2 +oh^2

L-Length of compound pendulum
Moment of Inertia I= mk^2
m- mass of the compound pendulum

Procedure:

1. Measure the distance of suspension point O from the center of gravity G of given compound pendulum
2. Compound pendulum is suspended from the suspension point and is oscillated.
3. Time taken for 10 oscillations is found out using stop watch and three trials are made for the same suspension point.
4. By varying the distance of suspension point above procedure is repeated.
5. Average time taken for each suspension point is calculated.
6. Using formula Natural frequency, radius of gyration and Moment of inertia are calculated.

OBSERVATION:
Length of compound pendulum L= 1000mm
Mass of the compound pendulum=800mm
Distance of Centre of Gravity=L/2
Mass=760kg

Tabulation

Sl. No.	Heig ht	Time taken for 10 oscillation				Mean time' t' sec	Time period T=t/n sec	Natural frequency		Radius of gyration of k		Moment of inertia Kg-m^2
								Exp fn	Ther fn	Exp	Kthe	

Result :

Thus Radius of gyration of given compound pendulum and moment of inertia are found out Experimental radius of gyration Kexp=

Theoretical radius of gyration Kth=

Moment of inertia I=

Questions

1. What is free body diagram? A free body diagram is a sketch of the isolated or free body which shows all the pertinent weight force, the externally applied loads, and the reaction from its supports connections acting upon it by the removed elements.

2. Differentiate between static & dynamic equilibrium. Necessary and sufficient conditions for static and dynamic equilibrium are:1.vector sum of all the forces acting on a body is zero.2. The vector sum of all the moments of all the forces acting about any arbitrary pointer axis is zero. First conditions are sufficient conditions for static equilibrium together with second condition is necessary for dynamic equilibrium.

3. Define applied and constraint force. The external force acting on a system of body from outside the system is called applied force. The constraint forces are the forces existing internally within the body.

4. Differentiate between static force analysis and dynamic force analysis. If components of a machine accelerate, inertia forces are produced due to their masses. If the magnitude of these forces are small compared to the externally applied loads, they can be neglected while analysis the mechanism. Such analysis is known as static force analysis.

5. Define inertia force.
   The inertia force is an imaginary force, which when acts upon a rigid body, brings it in an equilibrium position. Inertia force = -Accelerating force = -m.a

7. StateD"Alembert"sprinciple.
   D'Alembert's principle states that the inertia forces and torques, and the and torques acting on a body together result in static equilibrium.

8. State principle of superposition.
   The principle of superposition states that for linear systems the individualresponses to several disturbances or driving functions can be superposed oneach other to obtain the total response of the system.

9. What is meant by turning moment diagram or crank effort diagram?
   It is the graphical representation of the turning moment or crank effort for variousposition of the crank.It turning moment diagram, the turning moment is taken as the ordinate and crankangle as abscissa.

10. Explain the term maximum fluctuation of energy in flywheels.
    The difference between the maximum and the minimum energies is known asmaximum fluctuation of energy.Maximum fluctuation=maximum energy-minimum energy .

5. TO STUDY THE DISPLACEMENT MOTION CURVE OF CAM

Exp No:
Date:

Aim :

To study the profile of given can using cam analysis system and to draw the displacement diagram for the follower and the cam profile .Also to study the Jump speed characteristics of the cam follower mechanism .

Apparatus required :

Cam analysis system and dial gauge .

Description :

A cam is a machine element such as cylinder or any other solid with a surface of contact so designed as to give the follower . A cam is a rotating body imparting oscillating motor to the follower . All the cam mechanisms are composed atleast of 3 links .

- Cam
- Follower
- Frame which guides the follower

Procedure :

1. Cam analysis system consists of cam roller follower . Pull the rod and guides of pull rod .
2. Set the cam through 10 degree and note the projected length of the pull rod above the guide .
3. Calculate the life by subtracting each reading with initial reading .

Jumpspeed :

1. The cam is run at gradually increasing speed at which the follower jumps off .
2. The jump speed is observed for the different loads of follower .

Tabulation

Angular Displacement of cams in degree	Linear displacement of the Follower in mm Linear displacement of the follower in mm **Circular Arc Cam**
0	
20	
40	
60	
80	
100	
120	
140	
160	
180	
200	
220	
240	
260	
280	
300	
320	
340	
360	

Graph: TodrawangulardisplacementsofthecamVsthelineardisplacementsofthe FollowerbygraphicalandPolarchart.

Result: Thus by measuring the follower lift cam profile was drawn and jumping speed was observed for the different loads of follower.

Questions

1. Define unbalance.:
A disc cam produces unbalance because its mass is not symmetricalwith the axis of rotation

2. Define windup.
Twisting effect produced in the camshaft during the raise of heavy loadfollower is called as windup.

3. What are the effect and causes of windup?
The effect of windup will produce follower jump or float or impact.
Causes of windup are:
When heavy loads are moved by the follower,
When the follower moves at a high speed, and
When the shaft is flexible.

4. Flywheels are needed in forging and pressing operation?
In both forging and pressing operation, flywheels are required to control the variations in speed during each cycle of an engine.

5. What is cam dynamics?
Cam dynamics is the study of cam follower system with considering the dynamicforces and torques developed in it

6. How jump of the follower is reduced in cam follower system
In cam follower system the jump is reduced by using retaining spring

7. What is the remedy for camshaft windup?
Camshaft windup can be prevented to a large extend by mounting theflywheel as close as possible to the cam.

8. What is Spring surge
Spring surge means vibration of the retaining spring.

9. What are the types followers used in cam mechanism
Flat, Mushroom, roller

6. EXPERIMENTAL VERIFICATION OF GYROSCOPIC COUPLE

Date:
Exp No:

Aim:

To determine the active and the reactive gyroscopic couples and compare them.

Apparatus required:

Gyroscopic, tachometer, variable voltage transformer, rotating disc with a light reflecting sticker to scraboscope speed measurement.

Procedure:

1.The disc is made to rotate at a constant speed at a specific time using variable voltage transformer.

2.the speed of the disc(N) is measured using a scraboscope or tachometer.

3. a weight/mass is added on the extending platform attached to the disc .

4.this causes an active gyroscopic couple and the whole assembly (rotating disc, rotor and weight platform with weight) is standing to move in a perpendicular plane to that of plane rotating disc. This is called gyroscopic motion.

5.the time taken(t) to the transverse a specific angular displacement(Ø) is noted.

Formula used:

1. Mass moment of inertia of the disc(I)

   $I= md^2/8$

   M-mass of disc

   d-diameter of disc

2. Angular velocity of disc(ω)

   $\omega = 2\prod N/60$ rad/sec

   N- speed of disc

3. Angular velocity of precession

   $\omega_p = (Ø/t)*(\prod/180)$ rad/sec

4. Reactive gyroscopic couple

   $C_r = I\omega\omega_p Nm$

5. Active gyroscopic couple

C_a=wL

w- weight added mg in N

L- Distance between centre of weight to the centre plane of disc.

Graph: between active and reactive and gyroscopic couples are obtained.

Active couple vs reactive couple

Weight added vs reactive couple

TABULATION:

S no	Speed	Weight added		Angular displacement (θ)	Time for angle turned (t)	Angular revolution of precession (r/s)	Angular velocity of disc (r/s)	Active couple (N/m)	Reactive couple (N/m)
		M Kg	W (N)						

Result :

Thus the above characteristics curves are drawn in graph and the comparison between active and reactive and gyroscopic couples are obtained.

Questions

1. What is the effect of gyroscopic couple on rolling of ship? Why?
   We know that, for the effect of gyroscopic couple to occur, the axis of precession should always be perpendicular to the axis of spin. In case of rolling of a ship, the axis of precession is always parallel to the axis of spin for all positions. Hence there is no effect of the gyroscopic couple acting on the body of the ship[during rolling.

2. What is the principle of inertia governors? In inertia governors, the balls are so arranged that the inertia forces caused by an angular acceleration or retardation of the shaft tend to alter their positions.

3. Define power of a governor? The power of a governor is the work done at the sleeve for a given percentage change of speed. It is the product of the mean value of the effort and the distance through which the sleeve moves. Power=Mean Effort Lift of sleeve

4. What is meant by isochronous condition in governors? A governor with zero range of speed is known as an isochronous governor. Actually the isochronisms is the stake of Infinite sensitivity.

5. Give the applications of gyroscopic principle. It is used:(i) In instrument or toy known as gyroscope.(ii) In ships in order to minimize the rolling and pitching effects of waves, and(iii) In aero planes, Monorail cars, gyrocompasses, etc.

6. What so you mean by governor effort? The mean force acting on the sleeve for a given percentage change of speed for lift of the sleeve is known as the governor effect.

7. What is controlling force diagram? When the graph is drawn between the controlling force as ordinate and radius of rotation of the balls as abscissa, the graph so obtained is called controlling force diagram.

8. What is a gyroscope
   Gyroscope is a spinning body rotating about its own axis and is able to move on other directions

9. What is meant by axis of precession
   The spinning axis of a body will precess about an axis perpendicular axis when a moment is applied on spinning body, this perpendicular axis is known as axis of precession.

7. DETERMINATION OF MASS MOMENT OF INTERIA USING TURN TABLE APPARATUS

Exp No: **Date:**

AIM:

To determine angular velocity ,angular acceleration moment of inertia ,centrifugal force of turn table.Experimental setup:

*rotary disc: 390mm dial×12 thick with central bush ,weight hanger

*motor: variable spur 0-800rpm,0-30VDC,compact 2.5amps mount vertically top plate and shaft is extended on top

*control panel: it is combined panel and section at hours DC motor, inside meter /control comprises following

*variac: 0-2A, 0-230v,heavy duty

*RPM meter: digital 0-9999rpm, led display

*fuse: 2A and main switch

*rectifier: bridge rectifier

*sliding weight: it is mount on 2set,2 brackets one side

*weights: 3numbers for each side

*dial weights: 1NO

OBSERVATION:

(DISC) axial load W: 0.1kg

FORMULA:

Initial velocity $v_1 = \pi D_1 N/60$

$D_1 = 2r_1$

Final velocity $v_2 = \pi D_2 N/60$

$D_2 = 2r_2$

Angular acceleration = $(r_2v_2 - r_1v_1)/t$ m./sq.sec

Centrifugal force $f = [m(v_2)^2]/v_2$

Moment of inertia I= $m\times(v_2)^2$ kgm^2

V2= final velocity v1= initial velocity M=mass of disc with weight added

PROCEDURE:

1. Weight were added on each side of table.
2. Switched on the motor to turn the table.
3. The voltage 24 volts was set on the voltage regulation
4. Time taken for the sliding of weight is measured by stopwatch.
5. Speed of disc is measured by tachometer.
6. Step 3,4,5, were repeated for adding move masses on each side.

TABULATION:

Weigh t added on each side(m) In kg	Weight Of a disc (m+2m)	Speed of the disc(rpm)	Time take n In changing position(t) sec	R1	V1 m/s	R2	V2 m/s	Momen t of inertia (kgm²)	Angular Accerlatio n R2v2-r1v1/t (Rad/s)	C.F=MV2²/V 2 (N)

RESULT:

Thus the angular velocity ,angular acceleration mass moment of inertia centrifugal force of theturn table are observed and calculated.

Questions

1. Define linear momentum
   Linear momentum= mv
   m- mass of the body
   v- velocity of the body
2. Define angular momentum
   Angular momentum= Iw
   I- Moment of Inertia
   w- Angular velocity of the body
3. What is mass moment of Inertia
   Second moment about an axis due to mass is termed as Mass moment of Inertia
4. Significant of mass moment of inertia
   Mass moment of inertia of a body will resist rotational effects
5. What is area moment of inertia
   Second moment about an axis due to area is termed as area moment of inertia
6. Significant of area moment of inertia
   Area moment of inertia of a plane will resist bending effects
7. What is general plane motion
   The motion which has both the effect of translation as well as rotation
8. What are the types of motion
   Rectilinear motion, curve linear motion, pure rotation, General plane motion
9. Give examples for general plane motion
   The motion of connecting rod in a reciprocation mechanism, The motion of rope over a cylindrical pulley
10. Define Inertia force
    It's a property of matter by virtue of which a body resist any change in velocity.

8. DETERMINATION OF RADIUS OF GYRATION USING BIFILAR SUSPENSION

Date:
Exp No:
AIM:

To determine the radius of gyration and the moment of inertia of a given rectangular plate.

APPARATUS USED:

1. Main frame
2. Bifilar plane
3. Weight
4. Stop watch

FORMULA:

Time period T=t/n

Natural Frequency $f_n = 1/T$

Radius of gyration K=T/2π$\sqrt{g/l}$ in mm

a- distance of string from Centre of Gravity

T-Time period

L-Length of spring

N-No of oscillation

t- time taken for N oscillations

F_{exp}=1/T (HZ)

F_{th}= 1/2π($\sqrt{2ga/l}K^2_{th}$

K_{th}=L/2$\sqrt{3}$

a=13.5cm a=13.5*10^{-2}m

PROCEDURE:

1. Select the bifilar plane.
2. With the help of chuck tighter the spring at the top.
3. Adjust the length of spring to desired valve.
4. Give a small horizontal displacement about vertical axis.
5. Start the stop watch and note down the time required for N-oscillation.
6. Repeat the experiment by adding weight and also by changing the length of the spring.
7. Do the model calculation.

S. NO	Length of spring (m)	Time taken for 10 oscillation (s)	Mean time(t) (sec)	Time period (T=t/n)	F_{exp} = 1/T	Experimental K_{exp}(COG) (m)	Theoritical radius of gyration K_{th}(m)	F_{th} (Hz)

RESULT:

Thus radius of gyration and moment of inertia are calculated by using Bifilar suspension.

Questions

1. Define logarithmic decrement. Logarithmic decrement is defined as the natural logarithm of the amplitude reduction factor. The amplitude reduction factor is the ratio of any two successive amplitudes on the same side of the mean position.

2. Specify the importance of vibration isolation? When an unbalanced machine is installed on the foundation, it produces vibration in the foundation. So, in order to prevent these vibrations or to minimize the transmission of forces tothe foundation, vibration isolation is important.

3. What are the functions of Governor? The function of a governor is to maintain the speed of an engine within specified limits whenever there is a variation of load. Governors control the throttle valve and hence the fuel supply to carter the load variation on engines.

4.How governors are classified?1. Centrifugal governors.(a) Pendulum type: Example: Watt governor(b) Gravity controlled type: Example: Porter and proell governors) Spring controlled type: Example:Harnell and Hartung governors

5.Differentiate between governor and flywheel?
governor is provided on prime movers such as engines and turbines It is provided on engine and fabricating machines rolling mills, punching machines, shear machines, presses etc.flywheel works intermittently, i.e., only when there is change in load. It works continuously from cycle to cycle.

6. What is meant by sensitiveness of governors?
The sensitiveness is defined as the ratio of the mean speed to the difference between the maximum and minimum speeds. A governor is said to be sensitive, when it really toa small change of speed.

7.What is gyroscopic torque?
Whenever a rotating body changes its axis of rotation, a torque is applied on the rotating body.
State different method of finding natural frequency of a system.1. Equilibrium method,2. Energy method,3. Rayleigh method.

8 What is meant by free vibration and forced vibration? Free (or) natural vibration: When no external force acts on the body, after giving it an initial displacement, then the body is to said to be Free (or) natural vibration Forced Vibration: When the body vibrates under the influences of external forces, then the body is said to be under Forced vibration.

9. Define resonance.
When the frequency of external forces is equal frequency of a vibrating body, the amplitude of vibration becomes excessively large. This phenomenon is known

10. What is meant by degrees of freedom in a vibrating system?
The number of independent coordinate required to completely define the motion of a system is known as degree of freedom of the system

9. TRANSVERSE VIBRATION OF FREE BEAM SETUP

Date:
Exp No

AIM:

To study transverse vibration of a beam subjected to uniform load and concentrated load. The setup is as follows.

Main Frame;

Turnion: 2 brackets of turnion bearing with slots to insert at approx 1metre apart

Weighs; 100 gms * 5nos

Specification:

Length of beam = 1300mm

Width of beam =25mm

Weight of beam =1.6 kg

Procedure:

1. fit beam into both the slots of turnion bearing and tighten them rigidly

2. add weights, either concentrated at center or uniformly

3. Give a swing to beam

$. Note down the time required for 5 oscillation.

5. repeat experiments for different weights

6. Change the position of weights

7. repeat the experiments

8.Find out the deflection for different weights

FORMULA:

1. Theoritical frequency Fth= $0.4985/\sqrt{(d1 + (ds/1.27))}$

$d1$ – deflectio due to weight added

W-Weight applied

$$d1 = \frac{wl^3}{48EI}$$

L= length of beam

E= 200x10^9N/m^2

I= bh^3/12

b- breadth of beam

H- thickness of beam

ds – deflection due to self weight of beam

$$ds = \frac{dwl^4}{384EI}$$

w- weight of beam = bhl x p x g = 1.6kg

c-density of beam material = 8000kg/m^3

b,h- breadth & thickness beam g= 9.81 m/s^2

Time period T = Time taken/no.of. oscillation

Experimental frequency Fexp =1/T

OBSERVATION

length of beam = 109cm

breadth of beam =2.5cm

thickness of beam =0.5cm

TABULATION :

sl.no.	weight added gm	Time taken for n=5 oscillation	mean time (t)	Time period T=t/n	Experimental frequency Fexp =1/T	Deflection d_1 Measured actual	Theoritical frequency Fth= $0.4985/\sqrt{(d_1 + (d_s/1.27))}$

Result

Thus the transverse vibration of the beam subjected to uniform and concentrated load is studied

Questions

1. What are the causes and effect of vibration?The causes of vibration are unbalanced forces, elastic nature of the system, selfexcitation, wind and earthquakes.The existence of vibration elements in any mechanical system produces unwantednoise, high stress, poor reliability and premature failure of one or more of the parts.

2. Define frequency, cycle, period.Frequency: It is the number of cycles described in one secondCycle: It is defined as the motion completed during one time periodPeriod: It is the time interval after which the motion the motion is repeat itself.

2.Define free vibration.

Free vibrations: if the periodic motion continues after the causes of original disturbance is removed, then the body is said to be under free vibrations.

3. What are the different types of vibrations?

1. Free vibrations,2. Forced vibrations,
3. Damped vibrations.

4. State different method of finding natural frequency of a system.1. Equilibrium method,2. Energy method,3. Rayleigh method.

5. What is meant by free vibration and forced vibration? Free (or) natural vibration: When no external force acts on the body, after giving it an initial displacement, then the body is to said to be Free (or) natural vibration Forced Vibration: When the body vibrates under the influences of external forces, then the body is said to be under Forced vibration.

6. Define resonance.

When the frequency of external forces is equal frequency of a vibrating body, the amplitude of vibration becomes excessively large. This phenomenon is known as resonance.

7. What is meant by degrees of freedom in a vibrating system? The number of independent coordinate required to completely define the motion of a system is known as degree of freedom of the system.

8. What is the natural frequency of simple spring mass system?

Natural Frequency, fn=1/2π

√ ⊔⊥ ⊥

S=Stiffness of the spring M= Mass of the body suspended from the spring,
δ = Static deflection of the spring due to the weight.

9. Give examples for the desirable effects of vibration

Alarms, toys

10. What type of dampers are provided in two wheelers?

Viscous damping

10. DETERMINE NATURAL FREQUENCY OF TORSIONAL VIBRATION IN TWO ROTOR SYSTEM

Date:
Exp No

AIM:
To determine period and frequency of turned vibration of two rotor system and compare it with theoretical value.

APPRATUS REQUIRED:

Shaft, measuring tape, stopwatch, chuck key, weight

FORMULA:

Time period T= t/n (sec)

n- no of oscillation

Natural frequency fn: 1/T (HZ)

Theoretical frequency :Fth= $1/2\pi\sqrt{GJ/IaLa}$

G- modulus of rigidity (24×10^{9} n/m²)

J- polar moment of inertia $\pi d^4/32$ mm⁴

Ia- ma d²/8

Ib- mb d²/8

L= la+lb

L= Ia/Ib× La+Lb

PROCEDURE:

1. Fix the disc A and B to the shaft and fix it shaft in bearing.
2. Deflect the disc A+B in opposite direction
3. Notedown the time acquired for N=5 osscilation
4. Fit the cross to the disc
5. Repeat the procedure

TABULATION:

Weight of disc (kg)	Time for oscillation (sec)	Time period T=t/n	Experimental natural frequency Fn(HZ)	Moment of inertia Disc A (Ia)	Moment of inertia of disc B (Ib)	Distance of node disc A La(m)	Distance of node of disc(ψ) La(m)	Theoretical frequency

RESULT:

Thus the period and frequency of torsional vibration of two rotor system is determined

Questions

1. What is node in a multi rotor system
   Node is section at which the shaft will not undergo any twist
2. Define torsional equivalent shaft
   A shaft having variable diameter for different lengths can be replaced by an equivalent uniform dia such that they have same total angle of twist when equal opposing torques are applied.
3. What are the conditions to be satisfied for an equivalent system that of geared system in torsional vibrations
   1.the kinetic energy of the equivalent system must be equal to the kinetic energy of the original system.
   2.the strain energy of the equivalent system must be equal to the strain energy of the original system.

4. What is the relation between damped and undamped vibration
   Undamped frequency=$(1-E^2)$damped frequency
   E- Damping factor
5. Define free vibration.
   Free vibrations: if the periodic motion continues after the causes of original disturbance is removed, then the body is said to be under free vibrations.

6. What is meant by free vibration and forced vibration? Free (or) natural vibration: When no external force acts on the body, after giving it an initial displacement, then the body is to said to be Free (or) natural vibration Forced Vibration: When the body vibrates under the influences of external forces, then the body is said to be under Forced vibration.

7. Define resonance.
When the frequency of external forces is equal frequency of a vibrating body, the amplitude of vibration becomes excessively large. This phenomenon is known as resonance.

8. What type of motion is exhibited by a vibrating system when it is critically damped? A periodic motion is exhibited

9. What is the limit beyond which damping is detrimental and why?
When the damping factor £=1.the aperiodic motion is resulted .That is ,aperiodicmotion means the system cannot vibrate due to over damping. Once the system isdisturbed, it will take infinite time to come back to equilibrium.

10. Differentiate between transverse and torsional vibrations.
In transverse vibration, the particles of the shaft approximately perpendicular tothe the axis of the shaft.Due to transverse vibration, tensile and compressive stresses are induced
Due to torsional vibration, torsional shear stresses are induced in the shaft.

11. DETERMINATION OF WHIRILING OF SHAFT

Date:

Exp No:
AIM:

To study the winding of shaft and to determine the critical speed of the shaft

APPARATUS REQUIRED:

Meter scale

Whirling of the shaft set ups

DESCRIPTION:

The speed at which the shaft runs so that the additional deflection of shaft from the axis of rotation becomes infinite is known as critical speed. Normally the shaft will always displacement from axis of rotation although the amount of displacement may be very small as a radius of shaft rotates.

FORMULA USED:

Critical speed of the shaft (radian)

where,

g = 9.81 m/s² (acceleration due to gravity)

δ = 5wl^4/384EI (deflection)
Young"s modulus, E (for stainless steel) = 1.8 x 10_{11} N/ m2
E = 200*10^9 N/m^2(Steel)(young's modulus)

I = π/64 (D^4) - - - ☾ Intertia ,ρ = 8000 kg /m^3

Mass=ρ*area*L, Area=π/4 *D^2*L

W=Mass*9.81/length

Fn= √5×g/384δ

V = π/4×d²l

Theoretical whirling speed, Nctheo = {0.4985 / [sqrt (δs / 1.27)]} x60
NC=60×Fn

OBSERVATION:

Young"s modulus, E (for stainless steel) = 1.8 x 1011 N/ m2
Length of the shaft, L = 1 m
Shaft 1 (stainless steel) Shaft 2 (stainless steel)
m1 = 0.075 kg, m2 = 0.085 kg, m3 = 0.150 kg
d1 = 0.003 m
d2 = 0.004 m
d3 = 0.008 m

GRAPH:

Deflection vs critical speed

PROCEDURE:

1. Take the given rod specimen rod and fix it in the chuck.
2. Using various speed measure the deflection of the rod in mm.
3. Tabulate the reading for different speed and note down the deflection.
4. Calculate the critical speed by using given formula.

TABULATION:

Diameter of the shaft (cm)	Distance between chuck & free end (cm)	Deflection δ	Speed observed	Critical speed	Theoretical Critical speed

RESULT:

Thus the critical speed of the shaft has been obtained.

Questions

1 .What is the limit beyond which damping is detrimental and why?
When the damping factor £=1.the aperiodic motion is resulted, a periodic motion means the system cannot vibrate due to over damping. Once the system is disturbed, it will take infinite time to come back to equilibrium.

2. What is meant by critical damping? The system is said to be critically damped when the damping factor £=1.If then system is critically damped, the mass moves back very quickly to its equilibrium position within no time.

3. What type of motion is exhibited by a vibrating system when it is critically damped? A periodic motion is exhibited

4.Define critical or whirling speed. The speed at which resonance occurs is called critical speed of the shaft. In other words ,the speed at which the shaft runs so that the additional deflection of the shaft from the axis of the rotation becomes infinite ,is known as critical speed.

5. What are the factors that affect the critical speed of a shaft? The critical speed essential depends on;The eccentricity of the C.G.of the rotating masses from the axis of rotation of the shaft.
Diameter of the disc
Span (Length) of the shaft,
Type of supports connections at its ends.

6. What are the causes of critical speed? The Critical Speed occurs due to the one or more following reasons:1. Eccentricity mounting like gear, flywheel, pulleys, etc2. Bending of the shaft due to own weight3. Non-uniform distribution of the rotor material,etc

7. Differentiate between transverse and torsional vibrations.
In transverse vibration, the particles of the shaft approximately perpendicular to the the axis of the shaft.Due to transverse vibration, tensile and compressive stresses are induced
Due to torsional vibration, torsional shear stresses are induced in the shaft.

8. What are the causes and effect of vibration? The causes of vibration are unbalanced forces, elastic nature of the system, self excitation, wind and earthquakes. The existence of vibration elements in any mechanical system produces unwanted noise, high stress, poor reliability and premature failure of one or more of the parts.

9. Define frequency, cycle, period. Frequency: It is the number of cycles described in one second
Cycle: It is defined as the motion completed during one time period
Period: It is the time interval after which the motion the motion is repeat itself.

10. Define free vibration.
Free vibrations: if the periodic motion continues after the causes of original disturbance is removed, then the body is said to be under free vibrations.

12. FREE VIBRATION OF SPRING MASS SYSTEM

Ex. No.:
Date:

AIM:

To determine the natural frequency of spring mass system.

Appratus required:

1. Spring mass setup
2. Masses
3. Stop watch
4. Scale

Experimental setup:

Spring mass system is a setup used to determine the experimental frequency. The body whose frequency is to be determined is suspended by two springs. When the body is moved through a small distance along a vertical axis through the centre of gravity, it will acclelerate in a vertical plane, then by taking the following readings with the single mass system we can determine the frequency of a body.

Formula

1. Time period Tp=n/t
   n- no of oscillations
   t- time taken
2. Natural frequency Fn= 1/ Tp
3. Theoritical frequency Fn=1/2π√ k/m
   k-Stiffness of spring= load /deflection N/m
   m- mass suspended

Procedure

1. Take the reading for free vibration by manual jerk
2. Note down the time period
3. Now switch on the motor
4. Regulate the required speed
5. Take the reading for forced vibration.

Tabulation

Sl no	Mass added M (kg)	Length of the Spring L (mm)		Deflection (mm)		Stiffness k (N/m)	Timefor 10 oscillation T(sec)	Time periodfor one tp (sec)	Experimental natural frequency, $f_{n(exp)}$, Hz	Theoretical natural frequency $f_{n(the)}$, Hz
		Initial	Final	Initial	Final					

Graph:

Load vs Deflection

Load vs Theoretical natural frequency

Load vs Experimental natural frequency

Result:

Thus the Natural frequency of the spring mass system is found out.

Questions

1. Determine the natural frequency of mass of 10kgsuspended at the bottom of two springs (of stiffness: 5N/mm and 8N/mm) in parallel.
Natural Frequency ,fn=1/2π√ k/m
fn=1/2π√ 13/10 =.74 Hz

2. What is the effect of inertia on the shaft in longitudinal and transverse vibrations? In longitudinal vibrations, he inertia effect of the shaft is equal to the that of a mass one third of the mass of the shaft concentrated at its free end.11. State the expression for the frequency of simple pendulum. Natural Frequency, fn =1/2π√ k/m

Where L = Length of the string.

3.Give the expression for natural frequency of water, which oscillates in a „U"tube manometer?
Natural Frequency, fn =1/2π√ g/L
Where L = Column length of the liquid.

4. What are the different types of damping?
Viscous damping,
Coulomb or dry friction damping
Solid or structural damping
Slip or interfacial damping

5. What is meant by Dynamic magnifier
It is the ratio of maximum displacement of forced vibration to the deflection due to the static force.

1. What is the equivalent stiffness when two springs are in series and are in parallel
In series Seq= $1/s_1+1/s_2$
In parallel Seq= $s_1+ s_2$

7. How the mass moment of inertia is related with natural frequency of the system

fn=1/2π√ s/m
$I= mk^2$

m- Mass of the body
s- stiffness of spring
k- radius of gyration

8. What is amplitude of vibration
Maximum displacement of vibrating body from the mean position.
9. Define Natural frequency
Frequency of free vibration of the system
10. What is longitudinal vibrations
When the particles of the shaft or disc moves parallel to the axis of the shaft then the vibrations are known as longitudinal vibrations.

13. DETERMINE NATURAL FREQUENCY OF TORSIONAL VIBRATION IN SINGLE ROTOR SYSTEM

Date:

Aim

to determine the natural frequency of torsional vibration in single rotor system .

Appratus required

1. Single rotor set up
2. Steel rule
3. Stop watch
4. Chuck key.

Procedure:

1. Length of the shaft is adjusted by loosening the chuck using chuck key and the length of the shat is measured.
2. The rotor is deflected in angular direction
3. The time taken for 5 oscillations are noted
4. Three trials are made and the reading are noted.
5. For different lengths of shaft by adjusting length of shaft, the readings are noted
6. The above procedure is repeated for various shaft material.

Formula:

1. Natural frequency of the shaft Fn=1/2π√GJ/Il
   G-Modulus of rigidity= $2x10^9$
   Polar moment of inertia J=πd4/32

   Torsional stiffness =GJ/2

   T theo =2π√ I/K_t

Sr. No.	Length Of Shaft	No. of oscillation	Time	K	Tth	Texp	Fnth	Fnexp
Steel	10mm							
	20mm							
	30mm							
Copper	10mm							
	20mm							
	30mm							

Result:

The natural frequency of the torsional vibration in single rotorsystemis- Hz

14. UNIVERSAL GOVERNOR APPARATUS

EX.NO:17 DATE:
AIM:

To determine the radius of rotation, Centrifugal force, Sensitivity, effort, power and draw the characteristics Curves of Watt, Porter, Proell and Hartnell governor.

APPARATUS REQUIRED:

Proell,Porter and Hartnell Governor
Digital Electronic Control Unit
Tachometer

FORMULA:

Where,

Governor Height (h) = ho – X/2 (mm)
Radius of Rotation (r) = √l 2-h (mm)
Centrifugal Force (f)= mω2r (N)
Sensitivity (s) = 2(N2-N1)/(N2+N1)
Percentage Increase in Speed (c) = (N2-N1)/ N1×100
Governor Effort (e) = [c(m+M)g] (N)
Governor Power (p) = ex (N-mm)

N2, N1 are maximum and minimum speed respectively
x= Sleeve displacement, m=mass of the ball in kg, r=radius of rotation

DESCRIPTION:

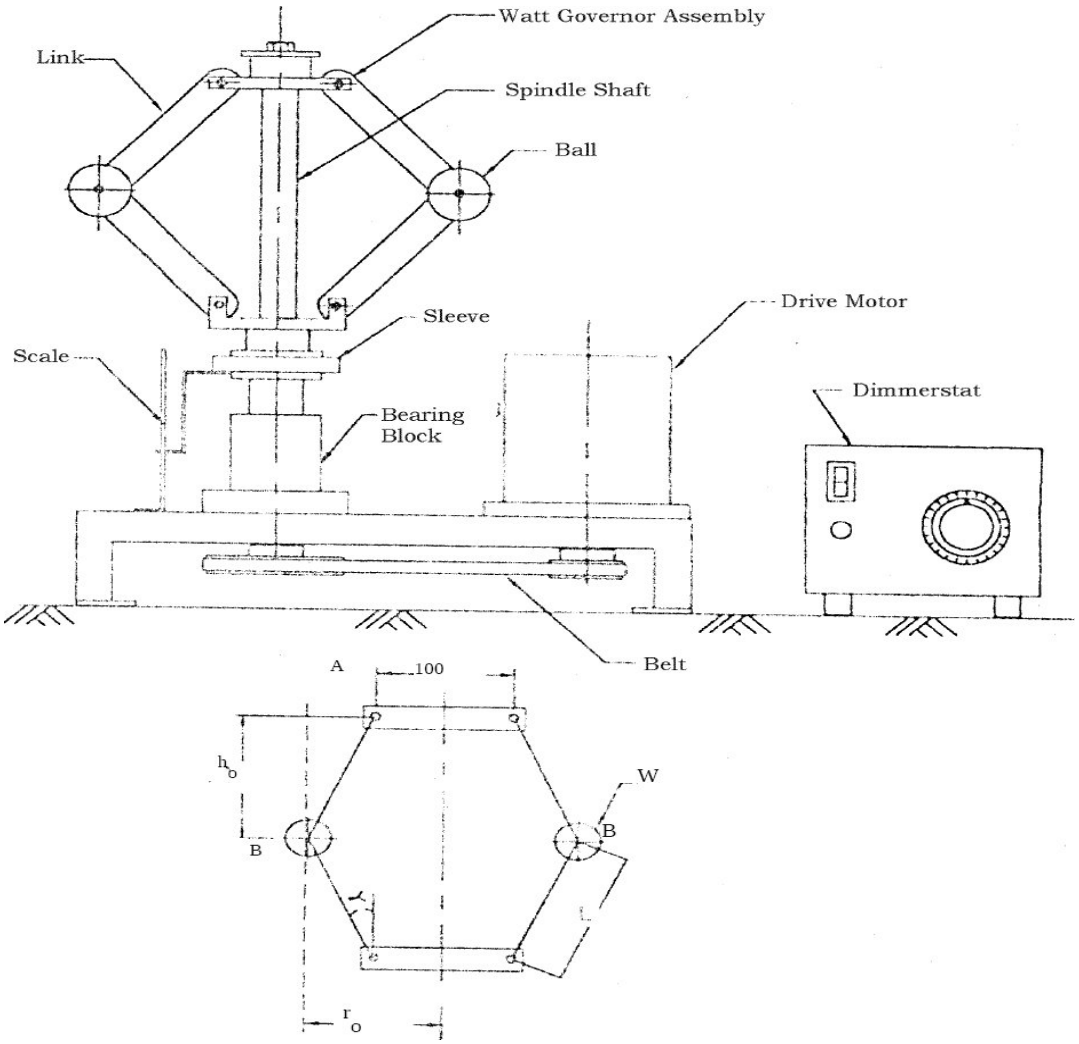
The drive unit consists of a DC electronic motor connected through belt and pulley arrangement. Motor and test set up mounted on a M.S fabricated fram.The governor spindle is driven by motor through V-belt and is supported in a ball bearing.

The optional governor mechanism can be mounted on spindle. Digital speed is controlled by the electronic control unit. A rpm indicate with sensor is to determine the speed. A graduated scale is fixed to the sleeved and guided in vertical direction.

The centre sleeve of the porter, proell and Hartnell governors incorporates a weight sleeve to which weights may be added.

EX.NO:14A Determination Of Range Sensitivity, Effort Etc., for Watts Governor

DATEDIAGRAMATICAL REPRESENTATION OF WATT GOVERNOR:



TABULATION:

S.No	Sleeve Displacement (X) 'mm'	Height of the Governor (h) 'mm'	Speed (N) 'rpm'	Radius of rotation (r) 'mm'	Centrifugal force 'F'	Sensitivity (s)	Effort (e) 'N'	Power (P) 'Nmm'

1. WATT GOVERNOR :-

Arrange the set-up as shown in Fig.5 by using the proper linkages provided. Tighten the bolts and nuts properly. The assembly is ready for conducting the experiment. Now follow experimental procedure as mentioned above.

Go on increasing the speed gradually and take the readings of speed

of rotation `N` and corresponding sleeve displacement `X`.

DIMENSIONS :-

a) Length of each link - L = 0.125 m.

b) Initial height of Governor – ho = 0.105 m.

c) Initial radius of rotation – ro = 0.120 m.

d) Weight of each ball - W = 0.6 kgs.

Radius of rotation `r` at any position could be found as follows

a) Find height h = ho – X/2 mtr.

b) Find " α " by using $\alpha = \cos^{-1}(h/L)$ in Degrees

c) Then r = 0.05 + L Sin α mtr.

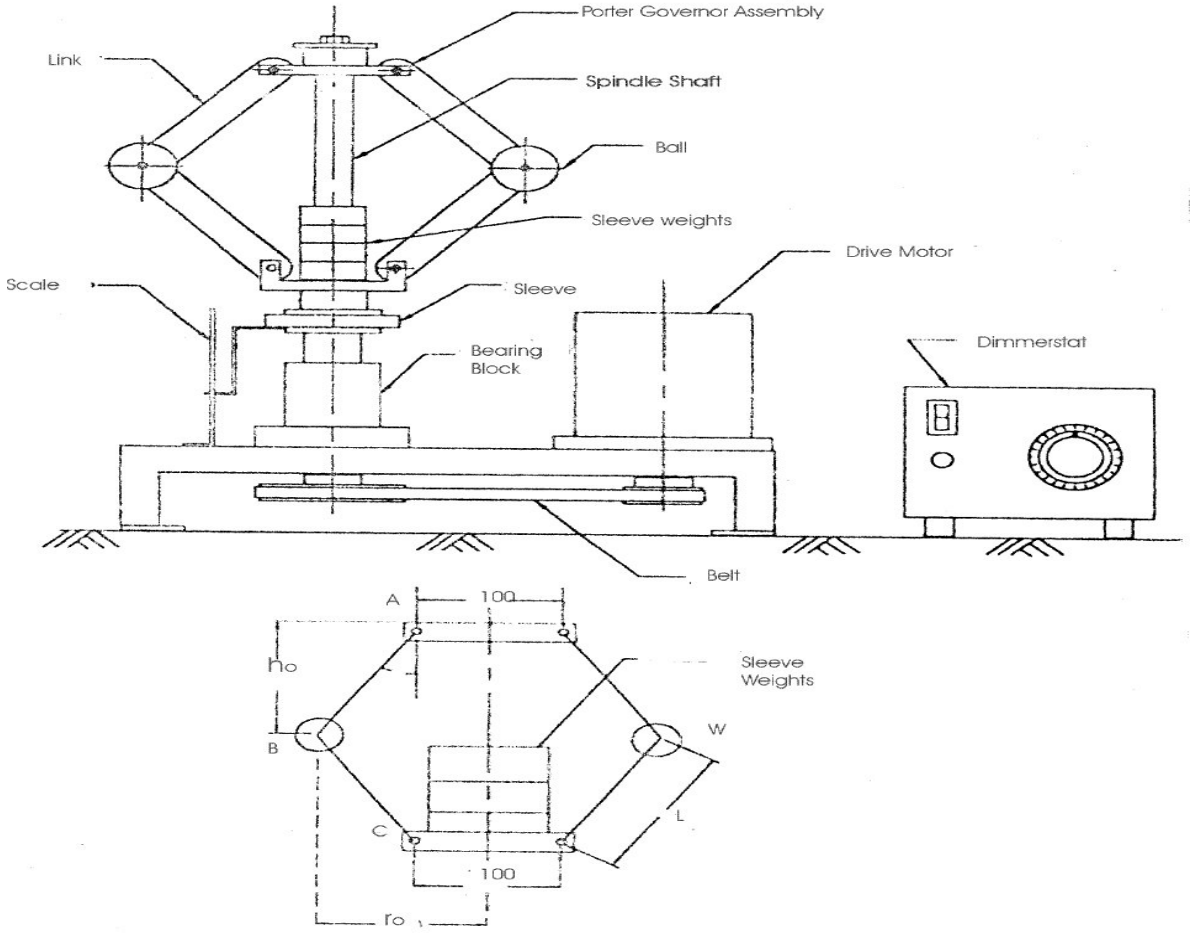
d) Angular Velocity 'ω' = 2π N/60 rad/sec

Graph:

Speed Vs Sleeve Displacement
Centrifugal Force Vs Radius of Rotation

EX.NO:14B Determination Of Range Sensitivity, Effort Etc., for porter Governor

DIAGRAMATICAL REPRESENTATION OF PORTER GOVERNOR



Schematic Layout of Governor Apparatus

S.No	Sleeve Displacement (X) 'mm'	Height of the Governor (h) 'mm'	Speed (N) 'rpm'	Radius (r) 'mm'	Centrifugal force 'N'	Sensitivity (s)	Effort (e) 'N'	Power (P) 'Nmm'

2) PORTER GOVERNOR

Arrange the set-up as shown in Fig. 5 by using the proper linkages & weights provided. Tighten the bolts and nuts properly. The assembly is ready for conducting the experiment. Now follow experimental procedure as mentioned above.

Go on increasing the speed gradually and take the readings of speed of rotation `N` and corresponding sleeve displacement `X`.

Dimensions

a) Length of each link - L = 0.125 m.
b) Initial height of Governor – ho = 0.105 m.
c) Initial radius of rotation – ro = 0.120 m.
d) Weight of each ball - W = 0.6 kgs.
e) Weight of Sleeve weight = 0.5 kgs.

Radius of rotation `r` at any position could be found as follows

a) Find height h = ho – X/2 mtr. ho = 0.10 m
b) Find " α " by using $\alpha = \cos^{-1}(h/L)$ in Degrees
c) Then $r = 0.05 + L \sin \alpha$ mtr.
d) Angular Velocity 'ω ' = 2π N/60 rad/sec

Graph:

Speed Vs Sleeve Displacement

Centrifugal Force Vs Radius of Rotation

Questions

1. What are the functions of Governor?
   The function of a governor is to maintain the speed of an engine within specified limits whenever there is a variation of load. Governors control the throttle valve and hence the fuel supply to carter the load variation on engines.

2. How governors are classified?
   1. Centrifugal governors.(a) Pendulum type: Example: Watt governor(b) Gravity controlled type: Example: Porter and proell governors) Spring controlled type: Example: Harnell and Hartung governors

3. Differentiate between governor and flywheel?
   governor is provided on prime movers such as engines and turbines It is provided on engine and fabricating machines rolling mills, punching machines, shear machines, presses etc. flywheel works intermittently, i.e., only when there is change in load. It works continuously from cycle to cycle.

4. What is meant by sensitiveness of governors?
   The sensitiveness is defined as the ratio of the mean speed to the difference between the maximum and minimum speeds. A governor is said to be sensitive, when it really to a small change of speed.

5. What is gyroscopic torque?
   Whenever a rotating body changes its axis of rotation, a torque is applied on the rotating body.
6. What is the effect of friction on the governor
   The effect of friction on the governor is to increase the range of speed, governor effort and power of governor

7. What is stability of governor? Governor is stable if there is only one radius of rotation for all equilibrium speeds of balls within the working range

8. What is controlling force in a governor?
   Centripetal
   force acting on the flyballs is known as controlling force of a governors

9. What is meant by hunting of governor.
   The phenomenon of continuous fluctuation of engine speed above and below the mean speed is termed as hunting.

10. What is meant by isochrnous governors
    A governor with zero range of speed is known as isochronous governor. It is the stage of infinite sensitivity.