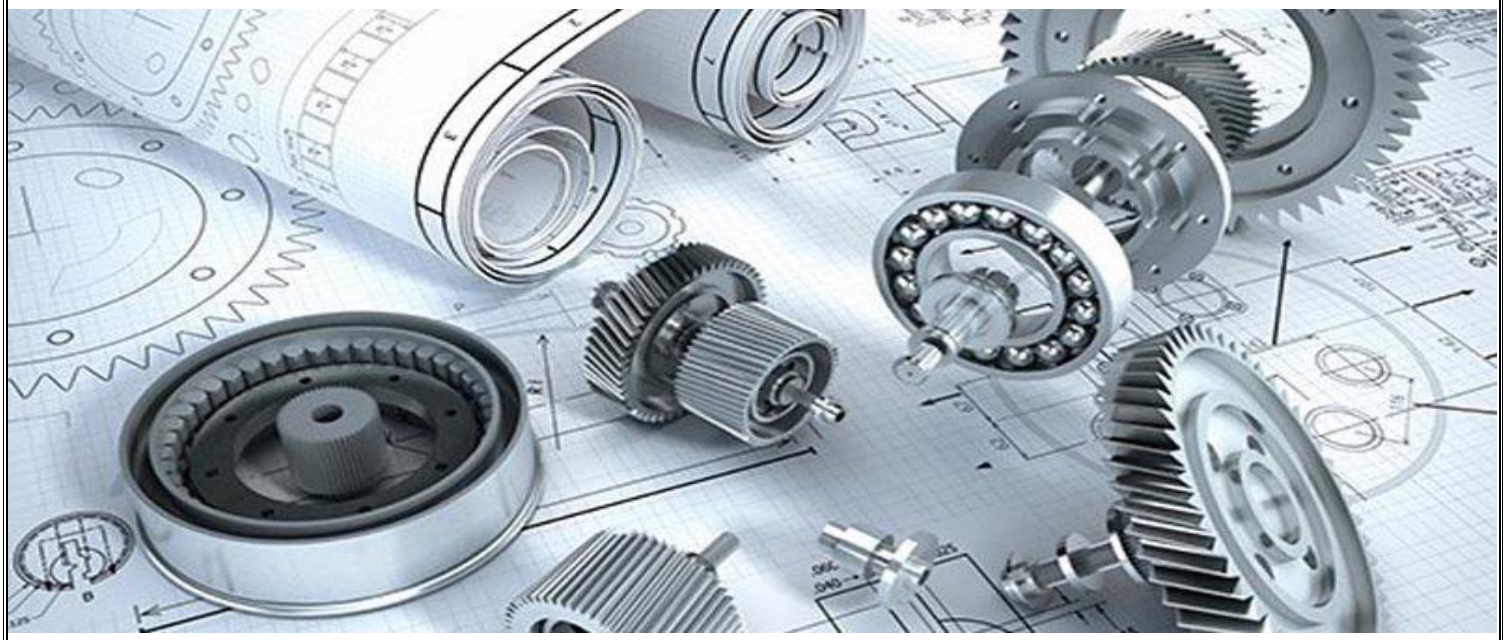
C.V. RAMAN POLYTECHNIC, BHUBANESWAR

DEPARTMENT OF MECHANICAL ENGINEERING

THEORY OF MECHINES AND MEASUREMENT LAB



PR-1 THEORY OF MACHINES AND MEASUREMENTS LAB

Name of the Course : Diploma in **Mech/ & Other Mechanical Allied Branches**

Course code:		Semester	4th
Total Period:	90	Examination	3 hrs
Lab. periods:	6 P/W	Term Work	25
Maximum marks:	100	End Semester Examination:	75

SL. No	Content
1	Determination of centrifugal force of a governor (Hart Nell / Watt/Porter).
2	Study & demonstration of static balancing apparatus.
3	Study & demonstration of journal bearing apparatus.
4	Study of different types of Cam and followers.
5	Study & demonstration of epicyclic gear train.
6	Determination of the thickness of ground M.S flat to an accuracy of 0.02mm using Vernier Caliper.
7	Determination of diameter of a cylindrical component to an accuracy of 0.01mm using micrometer.
8.	Determine the heights of gauge blocks or parallel bars to accuracy of 0.02mm using Vernier height gauge.
9.	Determine the thickness of ground MS plates using slip gauges.
10.	Determination of angel of Machined surfaces of components using sin bar with slip gauges.

TOM Laboratory (4th semester) **Code-Pr-1** **Full marks: 100**

Pr.1 Theory of Machine and Measurement lab		Levels
CO1	learn and calculate centrifugal force of governors.	3
CO2	get knowledge about static balancing, journal bearing apparatus & different types of Cam and followers. study about epicyclic gear train.	2
CO3	determine thickness, diameter and height using vernier caliper, micrometer and vernier height gauge.	3
CO4	analyze thickness of ground MS plates using slip gauges.	4
CO5	determine angle of machine surfaces using sine bar with slip gauges.	4

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Average CO
CO1	3.00	2.00	-	-	1.00	-	-	2.00
CO2	3.00	1.00	-	1.00	2.00	1.00	-	1.60
CO3	3.00	2.00	1.00	1.00	1.00	-	-	1.60
CO4	3.00	2.00	1.00	1.00	1.00	1.00	-	1.50
CO5	3.00	3.00	2.00	1.00	2.00	-	-	2.20
Average PO	3.00	2.00	1.33	1.00	1.40	1.00	-	**1.78** / **1.62**

Sessional Rubrics (25)

	Attendance (3)			Record (5)			Experiment/Job (12)			Viva (5)		
	The student attends all the classes.			Presentation with good technical details and good communication skills, refers to the slides to explain the points and completely engaged with audience.			The seminar report is accroding to the specified format. The content is written with clarity and in organized manner. There is a logical flow in the text.			Defends all questions by providing clear and insightful answers to the equestions.		
Rating/Performance criteria	12	11	10	9	8	7	6	5	4	3	2	1
Attendance (3)										Fulfills to 100% of set criteria	Fulfills to 70% of set criteria	Fulfills to 50% of set criteria
Record (5)								Fulfills to 100% of set criteria	Fulfills to 80% of set criteria	Fulfills to 60% of set criteria	Fulfills to 50% of set criteria	Fulfills to 30% of set criteria
Experiment/ Job (12)	Fulfills to 100% of set criteria		Fulfills to 90% of set criteria	Fulfills to 80% of set criteria	Fulfills to 70% of set criteria	Fulfills to 60% of set criteria	Fulfills to 50% of set criteria	Fulfills to 40% of set criteria	Fulfills to 30% of set criteria			
Viva (5)								Fulfills to 100% of set criteria	Fulfills to 80% of set criteria	Fulfills to 60% of set criteria	Fulfills to 50% of set criteria	Fulfills to 30% of set criteria

Sessional (25)

Sl. No.	Name of student	Registration number	Attendance (3)	Record (5)	Experiment (12)	Viva (5)	Total (25)

Practical Rubrics (75)

	Report (20)			Experiment/Job (40)				Answering viva questions (15)				
	Report is well written. The Contents are equipped with neat sketch, error free calculations and free from grammatical errors.			Identifying equipment, instruments and material and setting up of machine tool. Exhibits proper knowledge of the lab procedure. Runs the machine independently. Takes all the readings from machine/apparatus during experiment. The obtained result is calculated correctly to find the result. Analyses if any error occurred with the reason. The experiment is completed within the time limit with taking proper safety precautions.				A set of questions is asked relating to the experiment and subject.				
Rating/Performance	40	38	33	28	24	20	15	12	10	8	6	4
Report						Answers to 100% of questions asked	Answers to 80% of questions asked	Answers to 60% of questions asked	Answers to 50% of questions asked	Answers to 40% of questions asked	Answers to 30% of questions asked	
Experiment/ Job	Follows 100% of the criteria	Follows 90% of the criteria	Follows 80% of the criteria	Follows 70% of the criteria	Follows 60% of the criteria	Follows 50% of the criteria	Follows 40% of the criteria	Follows 30% of the criteria	Answers to 25% of questions asked			
Viva							Answers to 100% of questions asked	Answers to 90% of questions asked	Answers to 75% of questions asked	Answers to 60% of questions asked	Answers to 45% of questions asked	Answers to 30% of questions asked

Practical (75)

Sl. No.	Name of student	Registration number	Report (20)	Experiment (40)	Viva (15)	Total (75)

Programme outcomes (POs) and Programme specific outcomes (PSOs) to be achieved through the practical of this course:-

1. **Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
2. **Problem analysis:** Identify and analyze well-defined engineering problems using codified standard methods.
3. **Design/development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
4. **Engineering Tools, Experimentation and Testing:** Apply mode m engineering tools and appropriate technique to conduct standard tests and measurements.
5. **Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.
6. **Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
7. **Life-long learning:** Ability to analyses individual needs and engage in updating in the context of technological changes.

Program Specific Outcomes (PSOs)

PSO-1	Discipline knowledge	Demonstration and understanding of tools with advanced software for design specification and operation of Mechanical Engineering systems, components and processes.
PSO-2	Professional Skills	Apply contextual knowledge to analyze social, environmental, health, safety, legal, and cultural issues with professional ethics as part of the lifelong learning process. To be equipped to lead a team or operate successfully alone as an individual managing tasks in trans-disciplinary areas.

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List of practical and progressive assessment sheet

Sl. No.	Title of experiment	Date of experiment	Date of Submission	Remarks
1	Determination of centrifugal force of a governor (Hart Nell / Watt/Porter)			
2	Study & demonstration of static balancing apparatus.			
3	Study & demonstration of journal bearing apparatus.			
4	Study of different types of Cam and followers.			
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6	Determination of the thickness of ground M.S flat to an accuracy of 0.02mm using Vernier Caliper.			
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9	Determine the thickness of ground MS plates using slip gauges.			
10	Determination of angel of Machined surfaces of components using sin bar with slip gauges.			

EXPERIMENT NO: 1

Aim of the experiment:

Determination of the thickness of ground M.S.Flat to an accuracy of 0.02mm using Venire caliper.

Apparatus required:

SL.NO	Name of the Items	Specification	Quantity
01.	Vernier caliper	150mn.	01
02.	M.S Flat	(150x50x6)mm (100x50x6)mm	02.

Theory:

A vernier caliper is a precision measuring instrument used to measure inside & outside diameter and depth up to an accuracy of 0.02mm. Lower jaw is used to measure external diameter, upper jaw is used to internal and depth bar is used to measure depth or thickness of a job. The graduation on the vernier scale and main scale gives the reading. Vernier calipers are available in the size of 150mm, 225mm, 900mm and 1200mm.

Procedure:

1. At first, we took the vernier caliper and adjusted it correctly So that the vernier scale zero and main scale zero coincide each other.
2. Then we calculate the least count of the vernier scale.
3. Then we took the M.S Flat and kept it inside the external die measuring jaw.
4. We took the main scale reading and vernier scale division.
5. Then we noted down in the table.
6. In this way we take 5 observations.

Observation:

50 V.S.D = 49 M.S.D 1 V.S.D =49/50

1 M.S.D =1mm. Least count = 1 M.S.D-1 V.S.D

=1mm-49/50 =0.02mm.

Tabulation :-(All units are in mm)

SL.NO.	M.S.R in mm	V.S.D	L.C in mm	V.S.R(V.S.D x L.C)	M.S.R +V.S.R	Reading in mm	Remarks
01			0.02				
02			0.02				
03			0.02				
04			0.02				
05			0.02				

Conclusion:

Hence, we measure the dimensions of ground M.S Flat correctly.

EXPERIMENT NO: 2

Aim of the experiment:

Determination of diameter of a cylindrical component to an accuracy of 0.01mm using micrometer and check the result with digital micrometer.

Apparatus required:

SL.NO	Name of the Items	Specification	Quantity
01	Outside Micrometer	(0.25mm)	01
02	Digital Micrometer	(0.25mm)	01
03	Cylindrical component	20x50mm	02

Theory:

A micrometer is a precision measuring instrument used to measure a job generally with an accuracy of 0.01mm. Micrometers used to take the outside measurements are known as outside micrometer. The frame is the main part in which all other parts of the micrometers are attached to it. The datum line and graduations are marked on barrel. Graduations are also marked on **beveled** surface of the **thimble**. One end of spindle and anvil are measuring faces. To lock the spindle at desired position lock nut is used, the ratchet stop gives uniform pressure between measuring surfaces.

Procedure:

1. At first, we took the micrometer and adjust it correctly.
2. Then we calculated the least count of the micrometer.
3. Then we took the cylindrical component and kept it in between spindle and anvil.
4. Then we noted the reading.
5. Then took the reading by digital micrometer.
6. Repeating the above procedure for 5observations.

Observation:

Least count:

The distance moved by the spindle during one rotation of thimble is 0. 5mm.Movement of one division of the

Thimble = 0.5 x 1/50 = 0.01mm.

Tabulation:-(All units are in mm)

SL.NO	Barrel Reading(x)	Thimble Division	Least Count	Thimble(y) Reading L.C x T.D	X +Y	Reading	Digital micrometer Reading	Error
01								
02								
03								
04								
05								

Conclusion:

Hence the diameter of the cylindrical component is checked to an accuracy of 0.01mm in micrometer and the result has compared with the digital micrometer. The reading of digital micrometer found to be mere accurate.

EXPERIMENT NO: 3

Aim of the experiment:

Determination of the heights of gauge blocks or parallel bars to an accuracy of 0.02mm using vernier height gauge and check the result with digital vernier height gauge.

Apparatus required:

SL.NO	Name of the Items	Specification	Quantity
01	Vernier height gauge	300mm	01
02	Digital Vernier height gauge	300mm	01
03	Parallel bars	100 x50 x 6mm	02`
04	Gauge blocks	1 boxes(81 pc s)	1 box

Theory-

Vernier height gauge is a special type of vernier instruments which is used to measure heights of different engineering objects up to high precision and accuracy during many of industrial jobs where measuring process is require.

Procedure:

1. At first the base of the instrument is held firmly on the reference surface.
2. Then we calculated the least count of the vernier height gauge.
3. Moves the beam upwards until it contacts the upper surface of parallel bars.
4. Then final adjustment is done by fine adjustment screw.
5. The clamping screw is then tightened.
6. Take the reading and note.

Tabulations:

SL.NO	MSR	VSD	L.C	VSR=VSD X L.C	MSR +VSR	Reading	Digital Reading	Error
1 2 3 4 5								

Conclusion:

Hence the height of gauge blocks or parallel bars are checked by vernier height gauge and compare with digital vernier height gauge &found to be more accurate.

EXPERIMENT NO: 4

Aim of the experiment:

Determination the thickness of M.S. Plates using slip gauges.

Apparatus required:

SL.NO	Name of the Items	Specification	Quantity
01	M.S Plates	(100 x 50 x06)mm	02
02	Slip gauge	**(0-83),** 30mmx 9mm size	1 box
03	Surface Plate	300 x 300	01
04	Vernier height gauge	300mm	01

Theory:

A slip gauge is a rectangular block of hardened ground lapped steel with extremely high degree of flatness. Slip gauge are used as standard for precision length measurement. These are made in set and consist of a number of hardened blocks with low thermal expansion. The two opposite measuring faces of definite size is extremely close tolerance. The size of the slip gauges is 30mmx 9mm.

Procedure:

1. At first, we cleaned the surface of slip gauge.
2. Then we inserted the slip gauge for measuring the thickness by taking attention such that minimum number of slip gauges is used.
3. Then we removed the gauge from jobs.
4. We calculated the thickness by adding individual slip gauge reading which is mentioned on the surface of slip gauge.
5. In this way by repeating above procedure we took 5 reading.

For measuring the thickness of M.S plate by using set of 112 pieces.

Range in mm	Steps	No of pieces
1.005		01
1.001 to 1.009	0.001	09
1.01 to 1.49	0.01	49
05 to 24.5	0.05	49
25 to 100	25.00	04

Tabulation:

SL .NO	Select the slip gauges	Select the slip	Select 2nd	Select 3rd	Select 4th	Total reading	Average reading
01	1.005	1.002	1.37	1.5	0	4.8725	4.1515
02	1.0005	1.003	1.25	2	0	5.2535	
03	1.0005	1.001	1.15	1.2	0	4.1515	
04	1.0005	0.008	1.13	0.5	0	3.6385	
05	1.0005	1.008	1.45	2.5	0	5.9585	

Conclusion:

From the above experiment we find the thickness of M.S plate by using the range of slip gauges.

EXPERIMENT NO: 5

Aim of the experiment:

To determine the angle of machined surfaces of components using sin bar with slip gauges.

Apparatus required:

SL.NO	Name of the Items	Specification	Quantity
01	One machined surface in any angle		01
02	Sine bar	200mm	01
03	Slip gauge box	(0-83) pcs	01 set

Theory:

Sin bar:

It is based on the sin angle of the right-angle triangle. That's why it is known as sin bar. Sin of an angle of a right-angled triangle its perpendicular is divided by hypotenuses. Sine bars are available in size of 5", 10" and 20" and its accuracy of grade- "A" is 0.00001" per inch for grade- "B" is 0.002" per inch.

Slip gauges:

For measuring and checking the size of such jobs slip gauge are used. There are generally made of tool steel. Their gauging surface is quite plain. When two pieces of gauges are kept properly one over the other, they stick to each other, so it gives high accuracy measurement as the gap between the slip gauges is negligible.

Procedure:

1. At first keep the sine bar on the machined surface.
2. Keep the slip gauges below the two ends of the sine bar.
3. From that compute h1, h2 height and length L of sine bar and put it in the following table.

Tabulation:

SL.NO	h1 in mm.	h2 in mm.	h1-h2 in mm.	L in mm	Sin Q=h1-h2/e in(0)	Q=sin h1-h2/e in radian
1	3.25	1.5	1.75	200	1.75/200	5radiam=28.72

Conclusion:

From the above experiment we calculated the angle of machined surface is 28.72

EXPERIMENT NO: 6

Aim of the experiment:

To determine the centrifugal force of a governor.

APPARATUS REQURIED:

SLNO	Equipment	Specification	Quantity
01	Centrifugal governor	watt	
02	Steel rule	0-30cm	03
03	tachometer		01

Theory:

Governor is a device which automatically controls the supply of working fluid to the engine with the varying load conditions and keeps the mean speed with contain limit. The main function of a governor is to regulate the mean speed an engine, when

There are variations in the load by controlling the supply of working fluid. Governors

are of two types:

(I) Centrifugal governor
(II) Inertia governor

Generally centrifugal type governor are used in the practical field, In centrifugal governor forces of the rotating masses due to change in speed of the engine is used for the movement of the governor sleeve which is also controlled by dead weight of the sleeve or the spring.

Technical specification of the apparatus:

Length of the link (l)

Initial height (ho) initial
radius (r)

Distance(y) Twilight

of ball (wb)

Radius of rotation(r)

Tabulation:

SL NO	EEVE MOVING UPWARDS (Increasing speed)		SLEEVE MOVIHG DOWNWARD (decreasing speed)	
	Speed in RAM(N1)	SLEEVE LIFT In MM(h1)	SPEED IN RAM(N2)	SLEEVE LIFT In MM(h2)
01				
02				
03				
04				
05				
Mean speed				

Calculation:

Radius of rotation(r)

Centrifugal force (f) =

% of sensitivity

Conclusion:

From the above experiment, we study and calculate the percentage in sensitivity of watt governor.

EXPERIMENT NO: 7

Aim of the experiment:

To study about static balancing apparatus.

Apparatus Required:

SL NO	Equipment	Specification	Quantity
01	Static blanching Apparatus		01
02	Block of different weight		06
03	Iron balls	Small size	
04	Allen Key		
05	Weight pans		

Theory:

The term "static" dates back to the days before sophisticated balancing machines were available to measure unbalance static balance is where the main axis is displaced only parallel to the shaft axis. The un-balance is correct in one axial plane.

The **balancing of rotating bodies** is important to avoid vibration. In heavy industrial machines such as gas turbines and electric generators, vibration can cause catastrophic failure, as well as noise and discomfort. In the case of a narrow wheel, balancing simply involves moving the center of gravity to the center of rotation. For a system to be in complete balance both force and couple polygons should be closed.

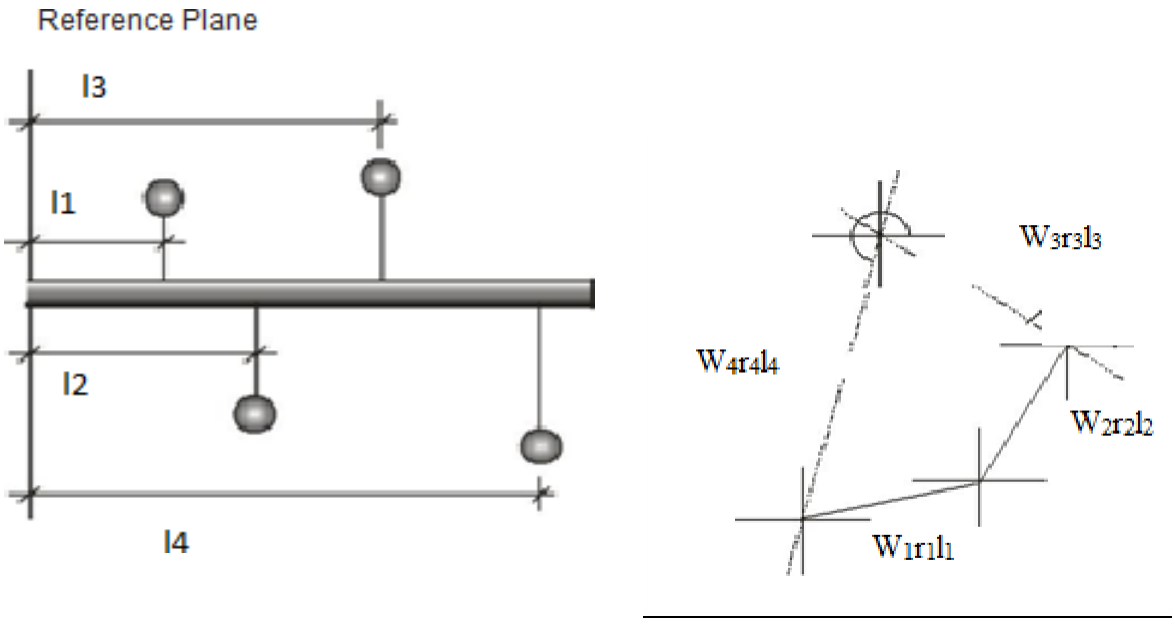
Static balancing:

A shaft is said to be statically balanced if the shaft can rest, without turning, at any angular position in its bearings. This condition is attained when the sum of the centrifugal forces on the shaft due to unbalanced masses is zero in any radial direction. The centrifugal force due to unbalanced mass of weight W_i with its center of gravity at a radial distance r_i is proportional to $W_i\ r_i$. For a shaft to be statically balanced, the summation of components of all such forces should be zero in any radial direction. That is

$$\sum W_i\ r_i = 0$$

Procedure:

1. Remove the belt.
2. Screw the combined hook to the pulley with groove.
3. Attach the cord ends of the pans to the above combined hook.
4. Attach the block No.1 of the shaft at any convenient position and in vertical downward direction.
5. Put steel balls in one of the pans till the block starts moving up. (up to horizontal position).
6. No. of balls give the WR. value of block No.1.
7. Repeat this for 2-3 times and find the average No. of balls.
8. Repeat the procedure for another block.



Observation table :

Sl No	Block No.	Weight of the block(W)	Mass center distance(r)

Conclusion:

Finally, we study the average WR. Weight for static balancing apparatus.

EXPERIMENT NO: 8

Aim of the experiment:

To study and demonstration of journal bearing apparatus.

Apparatus required:

SL. NO.	Equipment	Specification	Quantity
01	M.S bearing mounted freely on journal shaft		01
02	Motor A.C	0.5HP	01
03	Balancing weight	1kg	01
04	Manometer Board	--	01
05	Flexible tube	--	16.
06	Oil reservoir	--	01
07	Collecting tank oil	--	01
08	Oil (Red color)	SEA40	--

Specification:

1. Diameter of journal = 47mm
2. Bearing length = 70 mm
3. voltage = 230v
4. Motor= ½ HP
5. Motor Control= Dimmer start
6. Manometer board with 16 tubes with suitable scales and oil supply tank.
7. Recommended oil= SAE-40

Theory:

Journal bearing is designed on the basis if hydrodynamic bearing action used in practice to formulate the bearing action accurate in mathematical terms is a more complex job.

However, one can visualize pattern of bearing pressure distribution due to hydrodynamic action with the help of experimental rig. This helps to understand the subject properly. The experimental test rig consists of small journal bearing. This apparatus helps to demonstrate and study effect of important variables such as-speed, viscosity and load on the pressure distribution can be verified with summer field equation.

Experimental procedure: -

Fill the oil tank by using SAE-40 oil and position the tank at desired height.

Drain out the air from the tubes on the manometer and check level balance with supply level. Check the

direction of rotation (it should be clock wise) and increase the speed of motor slowly.

Set the speed and put the load on the bearing and let the journal run for about twenty minutes until the oil in the bearing warms and check the steady oil level at various tubes on manometer.

1. when manometer levels have settled down take the pressure readings on 16 manometer tubes
2. See that the balancing rod in horizontal position and observe steady levels
3. Repeat the experiment for various speeds and lends.
4. After the test is over set the dimmer to zero &switch off the power.
5. Keep the oil tank at lower most position so that there will be leant leakage in ideal period

Conclusion:

Form the above experiment, we have successful studies and verify about journal bearing apparatus.

EXPERIMENT NO: 9

Aim of the experiment: -

To study about cam analysis apparatus and Follower.

Apparatus required:

SL NO	Equipment	Specification	Quantity
01	CAM analysis apparatus		
02	Tachometer		
03	Weight		

Theory:

: -A cam is a rotating machine element which gives reciprocating or oscillating motion to another element known as follower.

: -The cam and follower have a line contact and constitute a higher pair. The cams are rotated at uniform speed by a shaft, but the follower motion is predetermined and will be according to the shape of the cam.

The cams are widely used for operating the inlet and exhaust values of an internal combustion engine, automatic attachment of machineries, paper cutting machines, spinning and weaving textile machineries, feed mechanism and automatic lathe machine.

Procedure:

1. Select the suitable cams & follower c0nbination.
2. Fix the driving speed.
3. Fix the follower on the pushrod and properly tighter the check nut, such that knife edge if the follower or axis or roller follower is parallel to the axis of cam shaft.
4. Choose the suitable weights to be added for follower
5. See the knob of dimmer start is at zero position.
6. Now switch on the supply and increase speed gradually and take the reading.

Tabulation:

SL NO	Weight added on follower (w)kg	Jump speed (N)RPM	
01			
02			
03			
04			

From the above observation table, we conclude that when the load increases the speed decreases.

Conclusion:

We have successfully studied about cam axis apparatus.

EXPERIMENT NO: 10

Aim of the experiment:

To study and demonstration of epicyclic great train

Apparatus required:

Epicyclic gear train

Theory

Any combination of gear wheels by means of which motion is transmitted from one shaft to another shaft is called as Gear-Train. In case of Epicyclic Gear-Train the axis of the shaft on which the gear are mounted may move relative to a fixed axis. In this apparatus Internal Type (Experimentation Model) Epicyclic Gear-train is demonstrated.

Description

Internal Epicyclic Gear Train:

It consists of SUN gear mounted on the input shaft. Two planet gear are on the both side meshes with SUN gear and which also meshes with the internal teeth of the annual gear. Two planet gear are mounted on the pins which are fitted into both ends of the arms. Output shaft is connected to the arm on which drum is fixed.

Specification

1. Epicyclic Gear-train.
2. Belt / rope and spring balance arrangement to measure output torque and holding torque.
3. 1 H.P. D.C. shunt motor, 1500 rpm, 230 v, 4Amp.
4. Control panel with dimmer (DC) for speed variation and Ammeter and Voltmeter to get input power, RPM Indicator.
5. Internal Epicyclic Gear

See that MA+ MO+ ME= 0.

Holding torque, ME = - (MO+ $MA_{)}$.

Tooth load and torques in Epicyclic Gear Trains:

If the parts of epicyclic gear trains are all moving at uniform speeds, so that angular acceleration are involved, the algebraic sum of all the external torques applied to train must be zero, or

$\sum$ (M) = 0 ... . (1)

There are at least three external torque for every train, and in many cases, there are only three. these are

MA the input torque on the driving member.

MO the resisting, or load, torque on the driven member.

ME the holding, or braking torque on the fixed member.

if there is no acceleration,

MA + MO + ME = 0 ... . (2)

Experimental procedure

1) Check the experimental set-up.
2) Give supply to the motor from the control panel.
3) Adjust the speed of input shaft to some fix value.
4) Apply holding torque just to hold the drum. This must be done carefully.
5) Apply load to the output shaft.

Experiment

Ti + Th + To = 0

were,

Ti = Input Torque.

Th = Holding Torque.

To = Output Torque.

Calculations

a) Ti = Input Torque. This can be calculated as below.....

V = Motor input Voltage & I = Motor input current.

Motor Input Power = V x I

Motor Output Power = V x I x Efficiency

$$Ti = \frac{V \times I}{746} \times n \times \frac{4500}{2\pi N}$$

Were,

N = Speed of motor &

n = efficiency of motor – 80% = 0.8

b) Holding Torque

Th = T x r x 9.81 Nm Where T is the readings of tension on spring balances.

Where,

r = Radius of Holding Drum = 0.055 m

c) Output Torque

To = (T1 - T2) x R x 9.81 Nm Where T1 - T2 - Readings of Tension on spring balances .

Where,

R = Radius of Output Drum = 0.090 m

Take following steps to verify the Torque Relationship.

- Put on the spring balances on gear unit and output shaft pulley.
- Connect the control panel to motor.
- Start the motor and measure input & output shaft speeds.
- Note down the readings of T on Gear Unit and T1 & T2 on Pulley Unit. Find out Th,Ti & To.
- We find that Ti + Th = To

SAMPLE CALCULATIONS

Observation table

SL.NO.	Input Torque		Holding Torque	Output Torque	Output Torque	N1
	V	I	T	T1	T2	
01	54	2.1	800	600	50	808
02	53	2.38	1.75	200	1.10	795
03	54	2.44	2	300	1.6	796

Calculations – For Reading No -1

$$Ti = \frac{V \times I}{746} \times n \times \frac{4500}{2\pi N}$$

$$\frac{54 \times 2.21 \times 0.8 \times 4500}{746 \times 2 \times 3.14 \times 808}$$

= 0.113 Nm

Th = T x r = 0.8 x 9.81x 0.55 = 0.431 Nm

To = (T1 - T2) x R = (0.6 – 0.05) x 0.1 = 0.539

Th+ Ti = 0.431 + 0.113 = 0.544

Conclusion :-

We have successfully studied about Epicyclic Gear Train.