A Laboratory Manual for

Kinematics and Theory of Machines (3131906)

B.E. Semester 3 (Mechanical)

Directorate of Technical Education, Gandhinagar, Gujarat

Vision of the DTE

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- Remove geographical imbalances and inconsistencies;
- Develop student friendly resources with a special focus on girls' education and support to weaker sections;
- Develop programs relevant to industry and create a vibrant pool of technical professionals.

Vision of the Institute

Mission of the Institute

MECHANICAL ENGINEERING DEPARTMENT

Vision of the Department

Mission of the Department

Lukhdhirji Engineering College, Morbi

Certificate

This is to certify that Mr./Miss._____ is the student of 3rd semester Mechanical Engineering Enrollment No._____ has satisfactorily completed the Practical/Tutorial work in "**Kinematics and Theory of Machines** (3131906)" within four walls of Lukhdhirji Engineering College, Morbi in year of 2023-23.

Date of Submission_____

Faculty Incharge	**External Examiner**	**Head of Department**

Practical – Course Outcome matrix

Course Outcomes (COs):

CO1: Understand basic structure and elements of machines.
CO2: Identify functional characteristics of various machine elements.
CO3: Synthesize various mechanisms based on position, velocity and acceleration requirement.
CO4: Determine position, velocity and acceleration of linkages in mechanism at any instant.
CO5: Understand basics related to friction and its practical application in mechanical engineering.

Sr. No.	Objective(s) of Experiment	CO 1	CO 2	CO 3	CO 4	CO 5
1.	Drawing work related to inversion of four bar mechanism and slider and crank mechanism	√				
2.	Drawing work related to velocity and acceleration diagram of various mechanisms.				√	
3.	Drawing work related to cam profile.		√		√	
4.	Drawing work and computation related to synthesis.			√		
5.	Computerized Synthesis.			√		
6.	Analysis related to belt, rope, and chain drive.					√
7.	Analysis related to brakes, and clutches.					√
8.	Analysis related to gears and gear train.		√			

Lukhdhirji Engineering College, Morbi

Mechanical Engineering Department

B.E. Semester – III

Kinematics and Theory of Machines (3131906)

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Sr. No.	Objective(s) of Experiment	Page No.	Date of Performance	Date of submission	Assessment Marks	Sign.
1	Drawing work related to inversion of four bar mechanism and slider and crank mechanism					
2	Drawing work related to velocity and acceleration diagram of various mechanisms.					
3	Drawing work related to cam profile.					
4	Drawing work and computation related to synthesis.					
5	Computerized Synthesis.					
6	Analysis related to belt, rope, and chain drive.					
7	Analysis related to brakes, and clutches.					
8	Analysis related to gears and gear train.					
				Total		

Experiment No: 1
Drawing work related to inversion of four-bar & slider crank mechanism

Date:

Relevant CO: Understand basic structure and elements of machines.

Define:

(1) Link:

(2) Kinematic pair:

(3) Degrees of freedom:

(4) Kinematic chain:

(5) Structure:

(6) Inversion of mechanism:

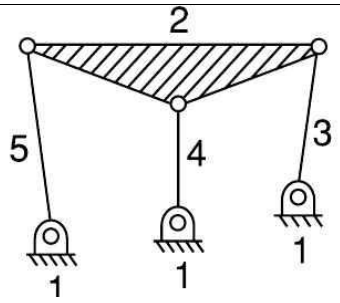
(7) Name inversions of four-bar chain:

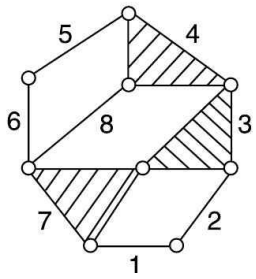
(8) Draw neat sketch of any two inversions of four-bar chain:

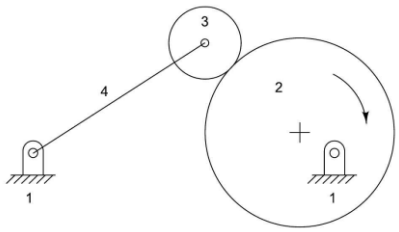
(9) Draw neat sketch of any two inversions of single slider crank chain:

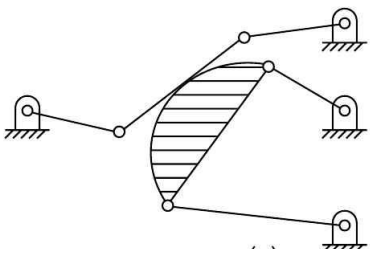
(10) Draw neat sketch of any two inversions of double slider crank chain:

(11) Find degree of freedom of given mechanism using Kutzbach mobility criterion.









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Teacher Sign

Experiment No: 2

Drawing work related to velocity and acceleration diagram of various mechanisms.

Date:

Relevant CO: Determine position, velocity and acceleration of linkages in mechanism at any instant.

Define:

(1) Instantaneous Centre:

(2) Fixed instantaneous centre:

(3) Permanent instantaneous centre:

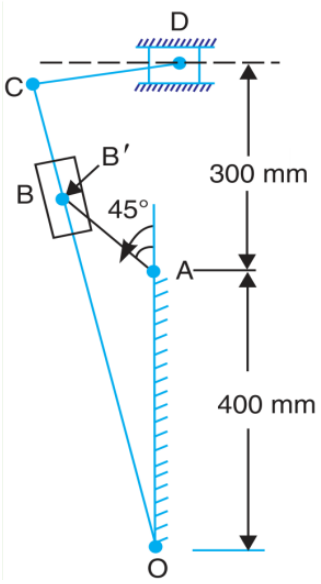
(4) Rubbing Velocity:

(5) Relative Velocity:

(6) The link lengths of a four bar chain mechanism ABCD are AB=300 mm, BC=CD=360 mm and AD=550 mm. The crank angle BAD is 60 degree, Angular speed is 60 rad/s, Draw the velocity and acceleration diagram. Also find velocity and acceleration for midpoint of connecting rod (Link BC).

(7) The length of crank and connecting rod of a crank slider mechanism are 100 mm and 400 mm respectively. If the crank angle is 45 degree from inner dead centre, locate all the instantaneous centers of the mechanism and determine velocity of all links.

(8) A mechanism of a crank and slotted lever quick return motion is shown in Fig. If the crank rotates counter clockwise at 120 r.p.m., determine for the configuration shown, the velocity and acceleration of the ram D. Also determine the angular acceleration of the slotted lever. Crank, AB = 150 mm; Slotted arm, OC = 700 mm and link CD = 200 mm



(9) Explain and prove Arnold Kennedy theorem.

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Teacher Sign

Experiment No: 3

Drawing work related to cam profile.

Date:

Relevant CO: Identify functional characteristics of various machine elements.
Determine position, velocity and acceleration of linkages in mechanism at any instant.

Define:

(1) Draw neat sketch of knife edge, roller and flat faced follower.

(2) Draw neat sketch of oscillating and offset follower.

(3) Draw neat sketch of wedge cam, Radial cam, Spiral cam, Cylindrical cam, Conjugate cam and Spherical cam.

Define:

(4) Trace point:

(5) Pressure angle:

(6) Pitch point and pitch circle:

(7) Prime circle:

(8) Lift of follower:

(9) Draw the terminology of the cam profile.

(10) What are the different types of motion of the follower?

(11) Draw only displacement diagram for the following data: Lift = 40 mm, angle of ascent = 90°, angle of dwell=30°, angle of return=60° dwell for the rest period. Ascent motion is with simple harmonic and return is with uniform velocity.

(12) A cam with 50 mm minimum diameter is rotating clockwise at a uniform speed of 700 rpm and has to give the motion to the follower of 10 mm diameter as below; i) Follower to complete outward stroke of 25 mm during 120 degree of cam rotation with equal acceleration and retardation. ii) Follower to dwell for 60 degree of cam rotation iii) Follower to return to initial position during 90 degree of cam rotation with SHM. iv) Dwell period is for remaining period. Draw the cam profile when the roller follower axis is offsetted to the right by 5mm.

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Teacher Sign

Experiment No: 4

Drawing work and computation related to synthesis.

Date:

Relevant CO: Synthesize various mechanisms based on position, velocity and acceleration requirement.

Explain**:**

(1) Type synthesis.

(2) Number synthesis.

(3) Dimensional synthesis.

(4) Application of synthesis for function generation.

(5) Application of synthesis for path generation.

(6) Application of synthesis body guidance.

(7) Determine three precision points and corresponding input and output link angles of a four-bar chain mechanism to generate function y = 1.5*x in the range 1 to 4. Starting input link angle = 0° & range of 100°, Starting output link angle=45° and range of 100°.

(8) Draw two position synthesis and three position synthesis of four bar mechanism and slider crank mechanism using inversion method.

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Teacher Sign

Experiment No: 5

Computerized Synthesis.

Date:

Relevant CO: Synthesize various mechanisms based on position, velocity and acceleration requirement.

Task: Develop program in any programming language (e.g. C, C++, Java, MATLAB, SciLab etc) or excel tool for synthesis of four bar chain mechanism.
(1) Function Generation Problem (2) Path Generation Problem

Attach the print of the program and its input/output screen.

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Teacher Sign

Experiment No: 6

Analysis related to Belt, Rope, and Chain drive.

Date:

Relevant CO: Understand basics related to friction and its practical application in mechanical engineering.

(1) Draw neat sketch of open belt drive

(2) Draw neat sketch of crossed belt drive

(3) Draw neat sketch of belt drive with idler pulley

(4) Draw neat sketch of Compound pulley belt drive.

(5) Draw neat sketch of Stepped pulley belt drive

(6) Find the power transmitted by a belt running over a pulley of 600 mm diameter at 200 RPM. The co-efficient of friction between the belt and the pulley is 0.25 and angle of lap160° and maximum tension in the belt is 2500 N

(7) What is centrifugal tension? Discuss the effect of it on power transmitted by a belt drive.

(8) List the advantages of fibre rope drives.

(9) Define Pitch of the chain.

(10) Define pitch circle diameter of the chain sprocket

(11) List advantages and disadvantages of chain drive over other power drives.

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Teacher Sign

Experiment No: 7
Analysis related to Brakes, and Clutches.

Date:

Relevant CO: Understand basics related to friction and its practical application in mechanical engineering.

(1) Distinguish between brakes and clutch.

(2) Derive the equation of braking torque for single shoe brake with clockwise brake drum rotation and line of action of tangential force is passing through pivot point.

(3) Describe with the help of a neat sketch the principles of operation of an internal expanding shoe brake. Derive the expression for the breaking torque.

(4) Describe with a neat sketch the working of single plate clutch.

(5) Describe with a neat sketch a centrifugal clutch and deduce an equation for the total torque transmitted.

(6) A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 rpm. Determine the outer and inner radii of frictional surface if the coefficient of friction is 0.255, the ratio of radii is 1.25 and the maximum pressure is not to exceed 0.1 N/mm^2. Also determine the axial thrust to be provided by springs. Assume the theory of uniform wear.

(7) A differential band brake acting on the 3/4th of the circumference of a drum of 450 mm diameter is to provide a braking torque of 225 N-m. One end of the band is attached to a pin 100 mm from the fulcrum of the lever and the other end to another pin 25 mm from the fulcrum on the other side of it where the operating force is also acting. If the operating force is applied at 500 mm from the fulcrum and the co-efficient of friction is 0.25 find the two tensions and operating force for clockwise rotation of brake drum.

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Teacher Sign

Experiment No: 8

Analysis related to Gears and Gear train.

Date:

Relevant CO: Identify functional characteristics of various machine elements.

Explain:

(1) Giving limitations of non-positive drives explain the importance of gear drive as a positive drive.

(2) Enlist various applications of gear drives.

(3) Differential single helical gear and double helical gear, which one is preferable for heavy load? Why?

Define:

(4) Pitch circle diameter:

(5) Pressure angle or angle of obliquity:

(6) Addendum:

(7) Dedendum:

(8) Circular pitch:

(9) Diametral pitch:

(10) Module:

(11) Backlash:

(12) Clearance:

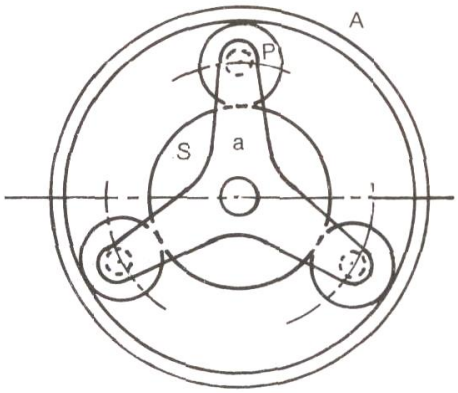
(13) Draw neat sketch of gear terminology.

(14) Draw and explain simple gear train and compound gear train.

(15) Describe with a sketch Reverted gear train.

(16) Sketch epicyclic gear train & explain.

(17) The annulus A in the gear shown in Fig. a rotates at 300 rpm about the axis of the fixed wheel S which has 80 teeth. The three-armed spider (only one arm a is shown in Fig. a) is driven at 180 rpm. Determine the number of teeth required on the wheel P.



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Kinematics and Theory of Machines

3131906

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