M.A.M. SCHOOL OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION BANK

ME1202 – KINEMATICS OF MACHINERY

SEMESTER: III

UNIT – I (PART – A)

1. How many inversions are possible from a four-bar kinematic chain? Name them based on their input-output motions.
2. What are the three conditions to obtain a four-bar crank – rocker mechanism?
3. Sketch the Geneva when indexing mechanism and state its applications.
4. State at least one similarity and on e difference between a Helical pair and cylindrical pair.
5. Define transmission angle of a four-bar mechanism. What are the worst values of transmission angle?
6. Define instantaneous centre of rotation and write the equation to determine the number of instantaneous centre's of a mechanism.
7. Define a kinematic chain and write the relation between the number of pairs and links.
8. Differentiate between closed pair and unclosed pair in kinematic mechanism.
9. Define the term instantaneous centre of rotation and how to find the number of instantaneous centers in a mechanism.
10. State any four types of kinematic pairs according to the types of relative motion between them.
11. Explain with a neat sketch, the space cent rode and body centrode.
12. What is a machine? Give two examples; differentiate between a machine and a structure.
13. Explain Grubler's criterion for determining degree of freedom for mechanism.
14. Briefly explain the types of instantaneous centres.
15. Define kinematic pair and illustrate any two types of constrained pair.
16. Explain Kutzbach criterion for the movability of a mechanism having plane motion.
17. Illustrate the space centrode and body centrode.
18. Write expression governing Kutzbach criterion for mobility of a planer mechanism.
19. Name any four common mechanism with specific application.
20. What is the specialty of a planar of a planar four bar linkage with regard to coupler curve?
21. Enumerate the difference between a machine and a structure.
22. List out the inversions of a double slider crank chain.
23. State the Kutzbach criterion.
24. What are toggle positions?
25. What is an inversion?
26. Define Kinematic pair.
27. Define instantaneous centre.
28. What is meant by Transmission angle"?
29. What do you mean by inversion of a mechanism?
30. What is mechanical advantage in a mechanism?
31. Define instantaneous centre.
32. What is Grashoff's law for a four bar linkage?

33. Sketch an offset slider crank mechanism.
34. Explain the Kutzbach criterion for movability of a mechanism having plane motion.
35. Describe the working of Oldham's coupling with a neat sketch.
36. State and prove kennedy's three centre theorem.
37. State at least one similarity and one difference between a helical pair and cylindrical pair.
38. Define kinematics chain.
39. Briefly explain the types of instantaneous centres.
40. Define DOF of a mechanism.
41. State Grubbler's criterion for planar mechanisms
42. Define "Actual Mechanical Advantage".
43. How the direction of coriolis component of acceleration is determined?
44. Illustrate completely constrained motion and incompletely constrained motion.
45. Distinguish between kinematics pair and kinematics chain.
46. What is kutzbach criterion for planar mechanism?
47. Sketch and exact straight line mechanism, with link proportions.
48. Illustrate the instantaneous centers of a typical four bar mechanism.
49. Define a kinematic pair and illustrate the working of a screw pair and a turning pair.
50. List the types of kinematic chains, with four lower pairs of importance.
51. Write the relation between the number of instantaneous centers and the number of links in a mechanism.

UNIT – I (PART – B)

1. Define transmission angle. Sketch a drag-link mechanism in maximum transmission angle and minimum transmission angle positions.
2. Define kinematic inversion. Describe in detail with neat sketches an elliptic trammel.
3. Design a four-bar crank rocker quick return mechanism for the following date : Rocker swing angle = 90^0, Time ratio = 1.25 and output link length = 60mm
4. Derive the equation to determine the degree of freedom of a planar mechanism. Prove that a cam-roller follower mechanism is an exception for the above equation.
5. Explain with neat sketches and their kinematic differences, two different inversions of a single slider crank chain that can be used for the same application in machine tools.
6. What do you mean by inversion of a mechanism?
7. Sketch and explain all the inversions of a double-slider crank mechanism.
8. Sketch and describe the working of two different types of quick return mechanisms. Derive an expression for the ratio of time taken in forward and return stroke for one of these mechanism.
9. Sketch and explain the inversion of a 4bar mechanism, all the four pairs are turning pairs. And also sketch and explain any two types of straight line motion generating mechanism
10. Sketch a slider crank chain and its various inversions stating actual machines which they are used in practice.

11. Draw the sketch of a mechanism in which a point traces an exact straight line. The mechanism must of only revolute pairs prove that the point traces an exact straight line motion.
12. Explain different kinds of kinematic pairs with examples.
13. Sketch and explain any two inversions of single slider crank chain.
14. Explain the following i) Mechanical advantages 2) Grashoff's Law, iii) Mobility of a mechanism
15. Sketch and explain any two inversions of double slider crank chain.
16. i) Define the transmission angle of a four bar linkage. What is the effect of transmission angle on mechanical advantage? Ii) Briefly explain various types of constrained motions. Iii) Illustrate crank and slotted mechanism as an inversion of single slider crank chain. Deduce an expression for length of stroke in terms of link lengths.
17. Analytically perform the displacement analysis of four bar mechanism.
18. Define kinematic pair and discuss various types of kinematic pairs with examples.
19. Draw a neat sketch and explain any one approximate straight line generating mechanism.
20. Sketch and explain the mechanism obtained by double slider crank mechanism.
21. Explain the following mechanism with sketches a) ratchet and escapement mechanism b) Indexing mechanism.
22. In a slider crank mechanism, the length of crank is100mm and length of connecting rod is 375mm. The crank has an angular velocity of 20 rad/s in clockwise direction and retardation of 40 rad/s2. When the crank has turned 1200 from the inner dead centre find: a) the velocity and acceleration of piston b) angular velocity and acceleration of connecting rod.
23. Explain klein's construction for slider crank mechanism when the crank rotates with uniform angular velocity.
24. Sketch and explain the various inversions of a four bar chain, What is meant by degrees of freedom of a mechanism? Explain Kutzbach criterion for determining degree of freedom for mechanisms.
25. Sketch and explain any three kinematic inversion of a single slider crank chain.
26. Explain the following with neat sketches. i) Quick return mechanism ii) Indexing mechanism.
27. In a whitworth quick return mechanism, driving crank is 15cm long. The distance between the fixed center is 10cm. The line of stroke of ram passes through the centre of rotation of slotted lever, whose free end is connected to the ram by a connecting link. Determine the ratio of time of cutting to time of return.
28. Sketch the following straight line generators and show the path traced by the point i) Peaucillier mechanism ii) pantograph linkage.
29. Explain with sketches any two inversions of a double slider crank mechanism.
30. In a quick return motion mechanism of crank and slotted lever type the ratio of the maximum velocities is 2. If the length of stroke is 25cm find i) the length of the slotted lever, ii) the ratio of times of cutting and return strokes iii) the maximum cutting velocity per second if the crank rotates at 300 rpm.

31. Extend grublers criterion for planar mechanism to obtain the Degree of freedom of a space mechanism as F = 6(L-1) – 5g -4c – 4s. where g= total number of sliding pairs, c = total number of cylindrical pairs, s = total number of spherical pairs, L = total number of links.
32. Sketch and explain any two inversions of single slider crank chain.
33. Sketch slider crank chain and its various inversions stating actual machines in which these are used in practice.
34. Sketch and explain the inversion of a 4 bar mechanism, all the four pairs are turning pairs, ii) sketch and explain any two types of straight line motion generating mechanism.
35. Explain the following mechanisms in kinematics point of view i) ratchet and pawl mechanism ii) indexing mechanism.
36. State and prove the Kutzbach criteria for the following kinematic chains i) cam with roller follower ii) two bar chain.
37. Sketch and explain any three inversions of a double slider crank chain.
38. In a crank and slotted lever quick return motion mechanism, the distance between the fixed centers is 240mm and the length of the driving crank is 120mm. Determine the inclination of the slotted bar with the vertical in the extreme position and the time ratio of the cutting stroke to the return stroke.
39. Sketch and describe the various inversions of a double slider crank chain.
40. Explain the working of the following i) whitworth quick return mechanism ii) straight-line generator mechanism iii) snap-action mechanism.

UNIT – II (PART – A)

1. Distinguish normal component of acceleration and tangential component of acceleration.
2. In a revolving stage with a speed of 3rpm, a person is walking with a speed of 0.5m/sec along a radial path. Determine the magnitude of the coriolis component of acceleration in this motion.
3. When coriolis component of acceleration will occur? And what is the magnitude in terms of velocities?
4. Define rubbing velocity at a pint joint, what will be the rubbing velocity at pin joint when the two links move in the opposite directions.
5. When coriolis component of acceleration occur?
6. What type of link will have only centripetal component of acceleration and what types of link will have only linear acceleration?
7. Write the condition for coriolis component of acceleration.
8. Define instantaneous centre of velocity?
9. Define the rubbing velocity.
10. Define corioli's component of accelerations
11. What is the magnitude of linear velocity of a point B on a link AB relative to A?
12. What are the two components of accelerations?
13. State coriolis components of acceleration.
14. What is the expression for coriolis component of acceleration?
15. Define rubbing velocity.
16. What are the two components of accelerations?
17. How angular velocity of a link is calculated from a velocity diagram?
18. In context with cam define pitch point.
19. Define coriolis component of acceleration.
20. What is the condition for occurance of coriolis acceleration in kinematics chain?
21. Find the expression to determine the relative velocity of a point "A" in a rigid link rotating about a fixed centre O.
22. What is the condition for occurrence of coriolis acceleration in a kinematics chain and give the expression to find its magnitude.
23. State the condition for al ink to experience coriolis acceleration.
24. Define rubbing velocity at a pin joint, what will be the rubbing velocity at pin joint when the two links moves in the same direction.

UNIT – II (PART – B)

1. In a four-bar mechanism ABCD, the link lengths in mm are as follows: Input AB = 25, coupler BC = 85, output CD = 50 and frame AD = 60. The angle between the frame and the input is 100^0 measured anti-clockwise. The velocity of point B is 1.25 m/sec in the clockwise direction. Sketch the mechanism and determine the velocity

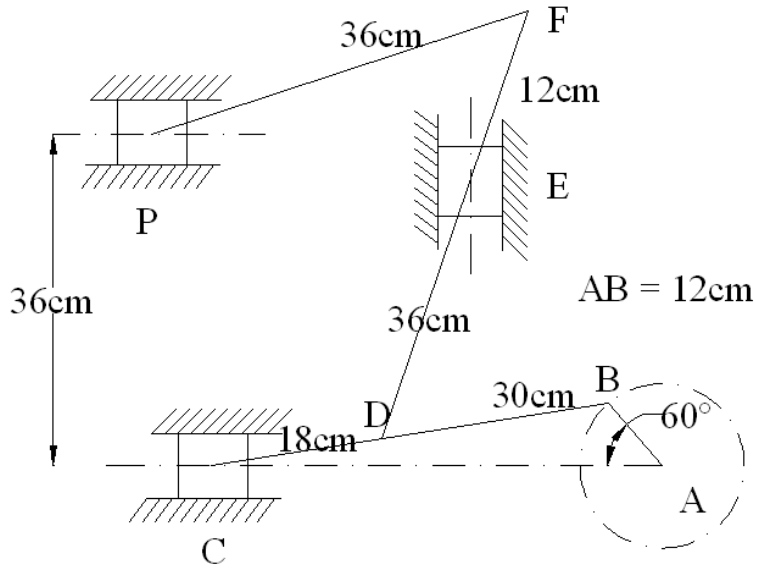
and acceleration of the mid-point of the link BC. Also, find the angular velocity and angular accelerations of the links BC and CD.

2. How will you determine the magnitude and direction of the Coriolis Acceleration Vector?
3. State and prove the ARONHOLD-KENNERY theorem involving instantaneous centres.
4. State the reasons for velocity and acceleration analysis.
5. Derive the analytical expression to determine the angular position of the coupler and angular position of the out put link of a four bar crank-rocker mechanism in terms of the link lengths and input angular position.
6. The following data refer to the lengths of links of a six-link mechanism in which the rotary motion of the input link2 is transformed to the horizontal linear motion of the output slider 6.
    i. Fixed link 1, A_0B_0 = 60MM
    ii. Input link 2, A_0A = 25MM
    iii. Coupler link 3, AB = 85mm
    iv. Follower link 4, BB_0 = 55m
    v. Connecting rod 5, CD = 60mm

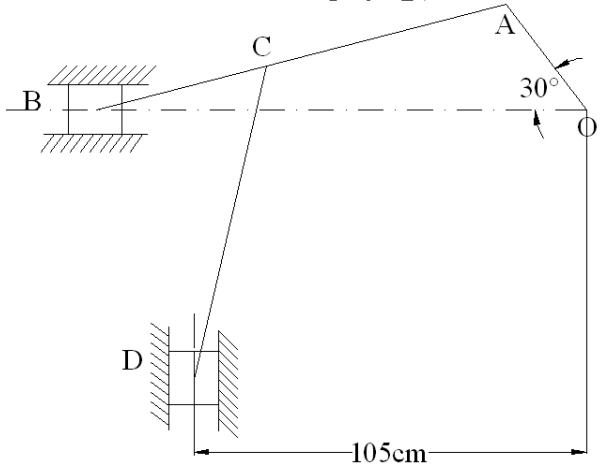
    b. The pin joint C is at the centre of the link BB_0. The horizontal line of stroke of the slider passes through the fixed link pivots A_0 and B_0. The angle B_0A_0A is 60^0. IN this position, (i) Sketch the mechanism and indicate the data, 2) Draw the velocity diagram and determine the linear velocity of the slider, if the input link constant speed is 2 rad/sec clockwise and (3) Draw the acceleration diagram and determine the linear acceleration of the slider, which is connected at one end of the connecting rod, CD.
7. A four-bar mechanism has the following link length in mm. Input, A_0A = 25, AB = 70, output B0B = 45 and frame A_0B_0 = 60. Coupler point A is above and B is below the horizontal frame link A_0B_0, respectively. When the input link is in an angular position of 105^0 counter clockwise from the frame link, draw the four bar mehcnism and locate all the instantaneous centres. If the input link rotates with a constant angular velocity of 2.5 rad/sec clockwise, determine the linear velocity of B of the output link and the angular velocity of the output link.
8. What is meant by coincident points in mechanisms? State their significance.
9. Derive the analytical expression to determine the transmission angle of a four-bar mechanism in terms of the link length and input crank angular position.
10. PQRS is a four bar chain with link PD fixed. The lengths of the links are PQ = 62.5mm, QR = 175mm; RS = 112.5mm; and PS = 200mm. The crank PQ rotates at 10 rad/se. Draw the velocity and acceleration diagram when angle QPS = 60^0 and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of links QR and RS.
11. In a slider crank mechanism, the length of crank is 200mm and length of connecting rod 825mm. The angular velocity and acceleration of crank is 60 rad/se and 110 rad/s^2. When the crank has turned 120^0 from the inner dead centre, find a) the

velocity and acceleration of piston b) angular velocity and acceleration of connecting rod.

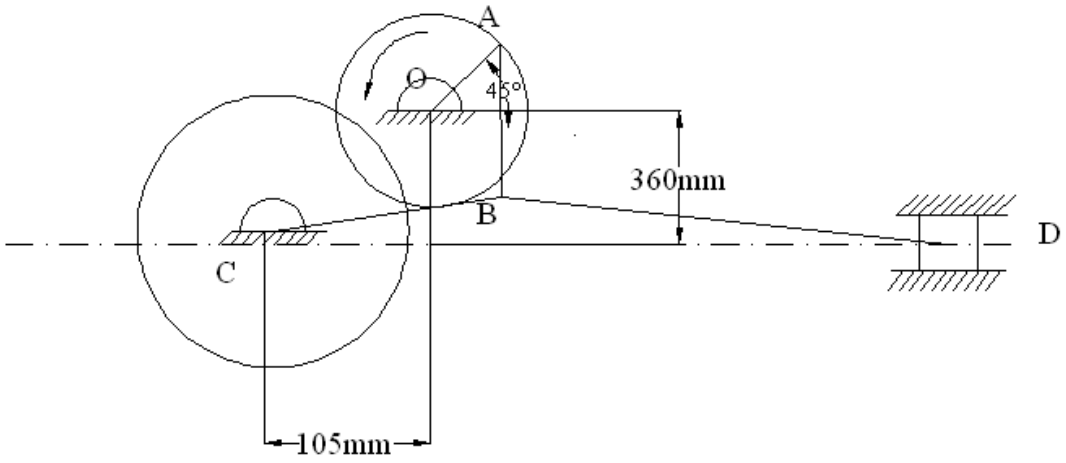
12. The crank and connecting rod of a theoretical steam engine are 0.5 m and 2m long respectively. The crank makes 180 rpm in the clockwise direction. When it has turned 45^0 from the inner dead centre position, determine : a) Velocity of piston b) Angular velocity of connecting rod. C) Velocity of point E on the connecting rod 1.5m from the gudgeon pin. D) velocity of rubbing at the pins of the crank shaft, crank and crank cross head when the diameters of their pins are 50mm and 60mm and 30mm respectively.
13. In a four link mechanism, the crank AB rotates at 36 rad/sec. The length of the links are AB = 200mm, BC =400mm, CD = 450mm and AD = 600nmm. AD is the fixed link. AT the instant when AB is at right angle to AD, determine the velocity and acceleration at the midpoint of the line BC.
14. In four bas chain ABCD, AD is fixed and is 120mm long. The crank AB is 30mm long and rotates at 100 rpm clockwise. While the link CD = 60mm, oscillates about D; BC and AD are equal length. Find the angular velocity of link CD when angle BAD = 60^0.
15. Define the term coriolis component of acceleration and derive its equation.
16. The following data refer to the lengths of links of a six-link mechanism in which the rotary motion of the input link 2 is transformed to the horizontal linear motion of the output slider 6. i) Fixed link 1, A_0B_0 =60mm, ii) Input link 2, A_0A = 25mm, iii) Coupler link 3, AB = 85mm, Follower link 4, BB_0 = 55mm, v) Connecting rod 5, CD = 60mm. The pin joint C is at the centre of the link BB_0 horizontal line of stroke of the slider passes through the fixed link pivots A_0 and B_0 <<B_0A_0A is 60^0. In this position, i) sketches the mechanism and indicate the data, ii) Draw the velocity diagram and determine the linear velocity of the slider, if the input link constant speed is 2 rad/s clockwise, iii) Draw the acceleration diagram and determine the linear acceleration of the slider, which is connected at one end of the connecting rod, CD.
17. A four-bar mechanism has the following link lengths in mm, Input, A_0A =25, coupler, AB = 70, Output B_0B=45, and frame A_0B_0 =60. Coupler point A is above and B is below the horizontal frame link A_0B_0, respectively. When the input link is an angular position of 105^0 counter clockwise from the frame link, draw the four bar mechanism and locate all the instantaneous centres. If the input link rotates with a constant angular velocity is 2.5 rad/s clockwise, determine the linear velocity of B of the output link and the angular velocity of the output link.
18. What is meant by coincident points in mechanisms? State their significance.
19. Derive the expression for determining the angular position of the coupler link and the output link of a four bar mechanism.
20. In a steam engine mechanism shown in figure a) the crank AB rotates at 200 rpm. The dimensions of various links are AB = 12cm, BC = 48cm, CD = 18cm and DE = 36cm, EF = 12 cm and FP = 36cm. Find the velocities of C,D,E,F and P.



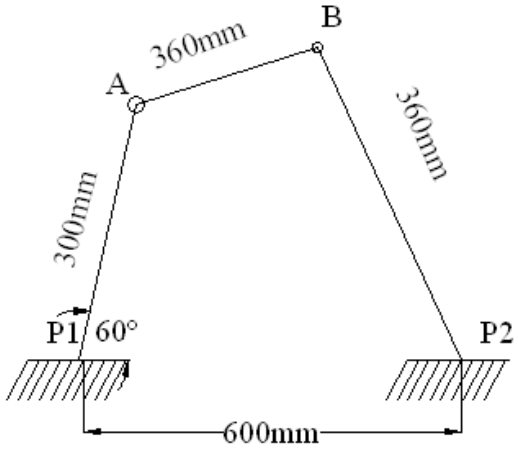
21. In the mechanism shown in figure , the crank OA rotates at 20 rpm anticlockwise and gives motion of sliding blocks B and D. The dimensions of various links are OA = 300mm, AB = 1200 mm, BC = 450 mm and CD = 450 mm. For the given configuration determine i) velocities of sliding at B and D, ii) angular velocity of CD iii) Linear acceleration of D and iv) angular acceleration of CD.



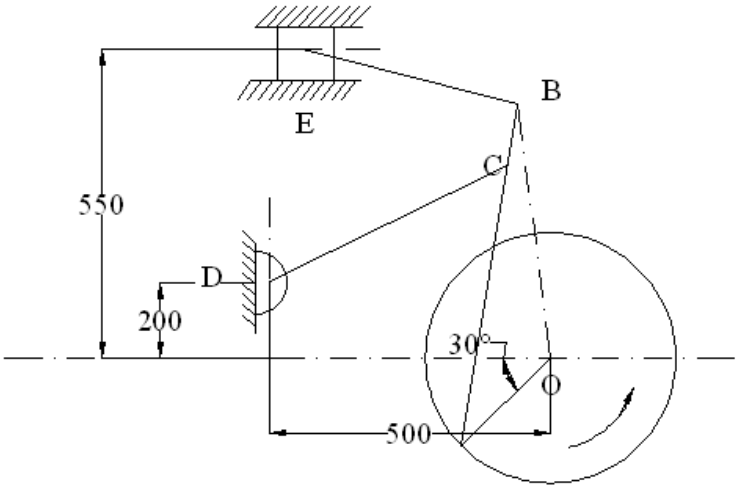
22. In a toggle mechanism shown in figure a) the slider D is constrained to move on a horizontal path. The crank OA is rotating in the counter clockwise direction at a speed of 180 rpm. The dimensions of various links are as follows OA = 180mm, CB = 240mm, AB = 360mm and BD = 540mm. For the given configuration, find, i) velocity of slider D, ii) Angular velocity of links AB, CB and BD, iii) Velocities of rubbing on the pins of diameter 30mm at A and D and iv) Torque applied to the crank OA, for a force of 2 KN at D.



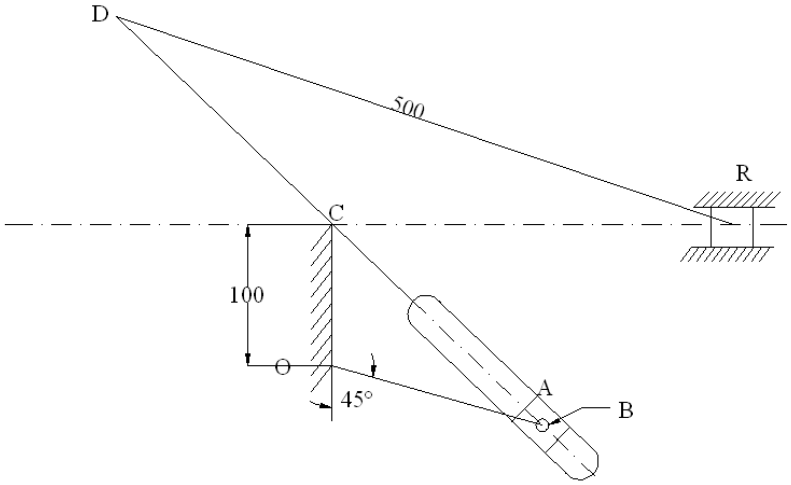
23. The dimensions and configuration of the four bar mechanism as shown in figure. P_1A = 300 mm; P_1B = 360mm; AB = 360mm and P_1P_2 = 600mm. The angle $AP_1P_2 = 60^0$. The crank P_1A has an angular velocity of 10 radian/sec and an angular acceleration of 30 rad/s2, both clockwise. Determine the angular velocity and angular accelerations of P_2B and AB and the velocity and acceleration of the joint B.



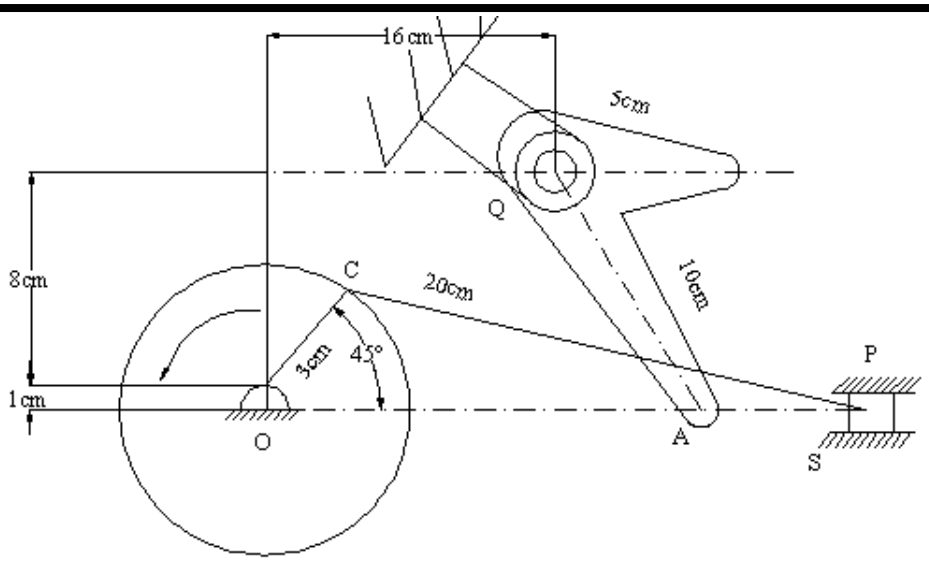
24. Figure show the mechanism of a radial valve gear. The crank OA turns uniformly at 150 revolution per minute and is pinned at A to rod AB. The point C in the rod is guided in the circular path with D as centre and CD as radius. The dimensions of various links are : OA = 150mm; AB = 550mm; AC = 450mm; DC = 500mm; BE = 350mm. Determine the velocity and acceleration of the ram E for the given position of the mechanism.



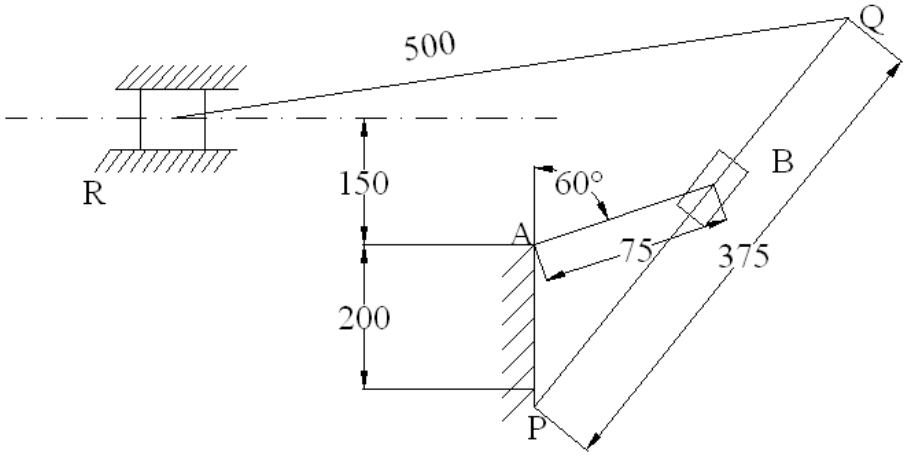
25. In a Whitworth quick return motion, as shown in figure. OA is a crank rotating at 30 revolutions per minute in a clockwise direction. The dimensions of various links are OA = 150mm; OC = 10mm; CD = 125mm; and DR = 500mm. Determine the acceleration of the sliding block R and the angular accelerating of the slotted level CA.



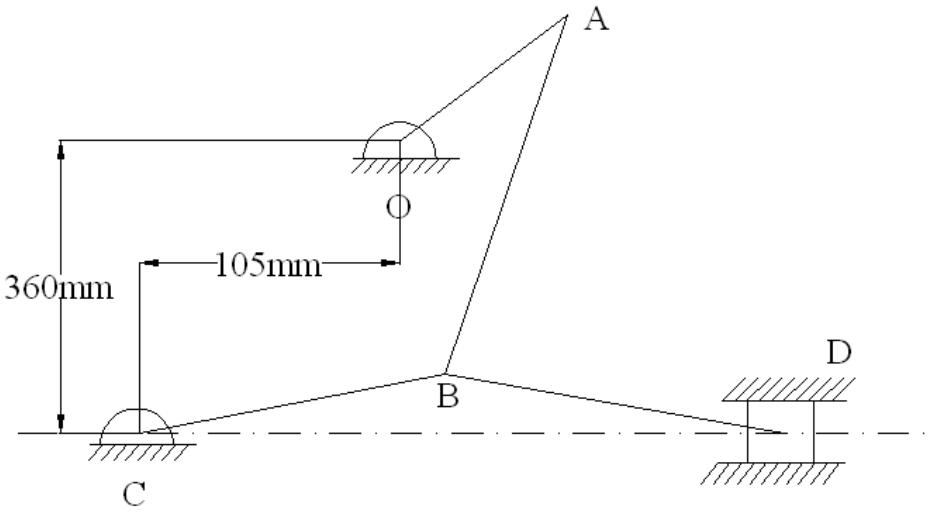
26. In the mechanism shown in figure, O and Q are fixed centers. The crank OC revolves at uniform speed of 120 rpm. Draw the velocity diagram and find the velocity of C in the given configuration. Find the angular acceleration of links CP, PA and AQ.



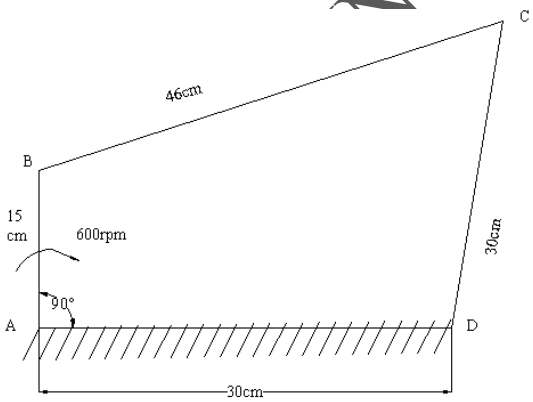
27. The driving crank AD of the quick – return mechanism as shown in figure. Revolves at a uniform speed of 200 rpm. Find the velocity and acceleration of the tool-box R, in the position shown, when the crank makes an angle of 60^0 with the vertical line of centers PA. What is the acceleration of sliding of the block at B along the slotted lever PQ?



28. For the toggle mechanism as shown in figure, the slider D is constrained to move along horizontal direction. The crank rotates at 180 rpm. The dimensions of various links are as follows. OA = 180mm; CB = 240mm; AB = 360mm; BD = 540mm. For the given configuration determine the velocity of the solider and angular velocity of links AB, BC and BD. Also determine the linear acceleration of the slider D



29. A four bar chain mechanism ABCD with its dimensions is shown in figure. It is driven by the crank AB which rotates at 600 rpm in clock wise direction. The link AD is fixed. Find the absolute velocity of point C and angular velocity of links CB and CD.



UNIT – III (PART – A)

1. State the advantages of cam mechanism over linkage mechanisms.
2. Briefly write about undercutting in cam mechanisms.
3. Define pressure angle of a cam mechanism and state the best value of the pressure angle.
4. State the advantages of tangent cam and sketch it.
5. What are the different types of followers? And sketch them.
6. Write the equation for the maximum velocity and maximum acceleration of a follower move with (S.H.M).
7. Sketch any four types of cam followers.
8. Sketch a cylindrical cam, the follower reciprocates in a direction parallel to the cam axis and also a cylindrical cam with oscillating follower.
9. Derive the equation to determine the maximum velocity and the maximum acceleration when the follower has simple harmonic motion.

10. What are the advantages of roller follower than knife-edge follower?
11. Sketch the displacement velocity and acceleration diagram when a follower moves with uniform velocity.
12. What are high speed cams? Give examples?
13. Construct the displacement diagram for the follower motion to be cycloidal.
14. State the expressions for the maximum velocity and acceleration of a follower moves with cycloidal motion
15. What is prime circle of a cam? What is the radial distance between the prime circle and base circle for a cam with knife edge follower?
16. Where are the roller follower extensively used?
17. Define pressure angle with respect to cams.
18. Define a cam.
19. What are the motions of follower?
20. What is cam?
21. What are the different motions of the follower?
22. Sketch any four types of follower used in cam.
23. Give some examples for cams.
24. What is high speed cam?
25. What type of follower is suitable for high speed cam? Give reasons.
26. Discuss the effect of pressure angle and under cutting in cams.
27. Sketch any four types of follower with cam arrangement.
28. State the advantages of tangent cam and sketch it.
29. Draw at least any four types of cam with followers.
30. What are the different types of motion with which a follower can move?
31. Illustrate the profile of displacement velocity and acceleration of a point moves with cycloidal motion.
32. What are the advantages of roller follower than knife edge follower?
33. Sketch th displacement, velocity and acceleration diagram when a follower moves with uniform velocity.
34. Define the following terms as applied to cam.
    a. Base circle
    b. Pitch circle
    c. Prime circle
35. Draw the displacement and velocity diagrams for a follower moves with simple harmonic motion.

UNIT – III (PART – B)

1. Sketch a cam-roller follower arrangement indicating important cam terminologies and explain them in detail.
2. Sketch and briefly compare the displacement, velocity and acceleration diagrams for uniform velocity, uniform acceleration and retardation, simple harmonic motion and cycloidal motion, used in cam mechanisms.

3. A disc cam used for moving a knife edge follower with simple harmonic motion during life and unofrm accelerations and retardation motion during return rotates in clockwise direction at 300 rpm. The line of motion of the follower has an offset 10mm to the right of camshaft axis. The minimum radius of the cam is 30mm. The lift of the follower is 40mm. The cam rotation angles are : Life 60^0, dwell 90^0, return 120^0 and remaining angle for dwell. Draw the cam profile and determine the maximum velocity and acceleration during the lift and return.
4. The following data are for a disc cam mechanism with roller follower. Minimum radius of the cam = 35, life of the follower = 40mm, offset of the follower =10mm right, Roller diameter = 15mm, Cam rotation angles are as mentioned below: During ascent + 120^0, Dwell = 80^0, During decent = 80^0, Dwell = 80^0. Cam rotates in clockwise direction and the follower motion is simple harmonic during both ascent and descent. I) Draw the displacement diagram of the follower and indicate the relevant data. 2) Draw the cam profile and indicate the relevant data.
5. Classify with neat sketches the cam followers according to their shape, location and motion. State also their advantages, if any, with respect to other follower.
6. Sketch neatly the displacement, velocity and acceleration curves of a cycloidal motion followers. Why is it superior over other motion curves?
7. Briefly explaining the undercutting in cam mechanisms.
8. A cam rotating clockwise with uniform speed is to give the roller follower of 20mm diameter of the following motion: i) Follower to move outwards through a distance of 30mm during 120^0 of cam rotation. Ii) Follower to dwell for 60^0 of cam rotation. Iii) Follower to return to its initial position during 90^0 of cam rotation. iv) Follower to dwell for the remaining 90^0 of the cam rotation. The minimum radius of cam is 45mm and the line of stroke of the follower is off-set 15mm from the axis of the cam and the displacement of the follower is to take pl ace with simple harmonic on both the outward and return stroke,. Draw the cam profile if the cam rotates at 360 rpm anticlockwise. Find the maximum velocity and acceleration of the follower during descent.
9. In a symmetrical tangent cam operating a roller follower, the least radius of cam is 30mm and roller radius is 17.5mm. The angle of ascent is 75^0 and total lift is 17.5mm. The speed of the cam shaft is 600 rpm. Calculate i) the principal dimension of cam ii) the acceleration of the follower at the beginning of the lift, where straight flank merges into the circular nose and the apex of the circular nose. Assume that the is no dwell between ascent and descent.
10. A cam is to be designed for a knife edge follower with the following data: i) cam lift = 40mm during 90^0 of cam rotation with simple harmonic motion. Ii) Dwell for the 30^0. Iii) During the next 60^0 of cam rotation, the follower return to its original position with simple harmonic motion. iv) Dwell for the remaining 180^0. Draw the profile of the cam when the line of stroke is offset 20mm from the axis of the cam shaft.
11. Draw the profile of the cam when the roller follower moves with cycloidal motion as given below: i) Outstroke with maximum displacement of 44mm during 180^0 of cam rotation. ii) Return stroke for the next 150^0 of cam rotation. iii) Dwell for the remaining 30^0 of the cam rotation. The minimum radius of the cam is 20mm and the

diameter of the roller is 10mm. The axis of the roller follower passes through the cam shaft axis.

12. The following particulars relate to a symmetrical circular cam operating a flat faced follower: Least radius = 16mm, nose radius = 3.2mm, distance between cam shaft centre and nose centre = 25mm, angle of action of cam = 150^0 and cam shaft speed = 600 rpm. Assuming that there is no dwell between ascent of descent, determine the lift of the valve, the flank radius and the acceleration and retardation of the follower at a point where circular nose merges into circular flank.
13. A cam rotating clockwise at a uniform speed of 100 revolutions per minutes is required to give motion to knife-edge follower as below: i) Follower to move outwards through 25mm during 120^0 of cam rotation. ii) Follower to dwell for the next 60^0 of cam rotation, iii) Follower to return to its starting position during next 90^0 of cam rotation with equal uniform acceleration and retardation. The minimum radius of the cam is 50mm and the line of stroke of the follower passes through the axis of the cam shaft. If the displacement of the follower takes place with uniform and equal acceleration and retardation on both the outward and return strokes, find the maximum velocity and acceleration during outstroke and return stroke and draw the profile of the cam.
14. The suction valve of a four stroke petrol engine is operated by a circular arc cam with a flat faced follower is 10mm; base circle diameter of the cam is 40mm and the nose radius is 2.5mm. The crank angle when suction valve opens is 4^0 after top dead centres and when the suction valve closes, the crank angle is 50^0 after bottom dead centre. If the cam shaft rotates at 600 revolutions per minutes determine i) maximum velocity of the valve and ii) maximum acceleration and retardation of the valve.
15. A cam drives a flat reciprocating follower in the following manner: Druing first 120^0 rotation of the cam, the follower moves outwards through a distance of 200mm with SHM. The follower dwells during 30^0 of cam rotation during next 120^0 of cam rotations, the follower moves inwards with SHM. The follower dwells for the next 90^0 of cam rotation. The minimum radius of the cam is 25mm. Draw the profile of the cam.
16. In a symmetrical tangent cam operating a roller follower, the least radius of the cam is 30mm and roller radius is 17.5mm. The angle of ascent is 750 and the total lift is 17.5mm. The speed of the cam shaft is 600 rpm. Calculate i) the principal dimensions of the cam ii) the acceleration of the follower at the beginning of the lift ii) the acceleration of the follower where straight flank merges into a circular nose.
17. A cam with minimum radius of 25mm, rotating in clockwise direction with a uniform speed of 100 rpm is to be designed to given motion for the follower followers.
18. Construct a tangent cam and mention the important terminologies on it. Also derive the expression for displacement, velocity, acceleration of a reciprocating roller follower when the roller has contact with the nose.
19. Draw the cam profile to operate a knife edged follower to ascent and descent in uniform velocity motion. Lift of the follower = 30mm; least diameter of cam = 60mm; angle of ascent = 90^0; angle of dwell after ascent = 40^0; angle of descent =

120^0; Follower to dwell for rest of the cam rotation. The axis of the follower passes through the axis of the cam.

20. Layout the profile of a cam operating a roller reciprocating follower for the following data. Lift of follower = 30mm; Angle during the follower rise period =120^0; angle during the follower after rise = 30^0; angle during the follower return period = 150^0. Angle during which follower dwell after return = 60^0; minimum radius of cam = 25mm; Roller diameter =10mm. The motion of follower is uniform acceleration and deceleration during the rise and return period.
21. Use the following data to draw the cam profile to operate the follower during the ascent and descent period in uniform velocity motion. 1) Lift of the follower = 40mm 2) least radius of cam = 50mm 3) angle of ascent = 60^0 4) angle of dwell between ascent and descent = 45^0 5) angle of descent = 90^0. Follower to dwell for the rest of the cam rotation. The axis of the follower passes through the axis of the cam. If the cam rotates at 200 rpm, determine the maximum velocity and acceleration during ascent and descent.
22. Lay out the profile of cam in which the follower moves with cycloidal motion during ascent and descent motion. Minimum radius of cam =50mm, angle of ascent = 60^0 angle of dwell between ascent and descent = 60, angle of descent = 120^0, remaining period is dwell, lift of follower = 40mm; the distance between line of action of follower and axis of cam = 20mm
23. Draw the displacement, velocity and acceleration diagrams for a follower when it moves with uniform acceleration and uniform retardation. Derive the expression for velocity and acceleration during out stroke and return stroke of the follower.
24. Draw the profile of an cam operating a knife-edge follower when the axis of the follower passes through the axis of cam shaft from the following data. 1) follower to move outwards through 40mm during 60^0 of cam rotation. 2) follower to dwell for the next 45^0 3) Follower to return to its original position during next 90^0. 4) Follower to dwell for the rest of the cam rotation. The displacement of the follower is to take place with SHM during both the outward and the return strokes. The least radius of cam is 50mm. If the cam rotates at 300 rpm, determine the maximum velocity and acceleration of the follower during the outward stroke and return stroke.
25. Draw the profile of a cam operating with a knife edge follower having a lift of 30mm. The cam rises the follower with SHM for 150^0 of its rotation followed by a period of dwell for 60^0. The follower descends for the next 100^0 rotation of the cam with uniform velocity, again followed by a dwell period. The cam rotates at a uniform velocity of 120 rpm and has least radius of 20mm what will be the maximum velocity and acceleration of the follower during the lift?
26. Write the short notes on : i) High speed cams ii) circular arc cams
    iii) Tangent cams
27. Design a cam to raise a valve with simple harmonic motion through 15mm is $1/3^{rd}$ of a revolution, keep it fully raised through $1/12^{th}$ of a revolution and to lower it with SHM in $1/6^{th}$ of a revolution. The valve remain closed during the rest of the revolution. The diameter of the roller is 20mm and the minimum radius of the cam is 25mm. The axis of the valve rod passes through the axis of the cam shaft. If the cam

shaft rotates at uniform speed of 100 rpm; find the maximum velocity and acceleration of the valve during raising and lowering. Also draw the profile of the cam.

28. A cam, with a minimum radius of 50mm, rotating clock wise at uniform speed, is required to give a knife edge follower the motion as described below; to move outwards through 40mm during 100^0 rotation of the cam; to dwell for next 80^0; to return to its starting position during next 90^0 and to dwell for the rest of the period of revolution. Draw the profile of the cam when the line of the follower is off-set by 15mm to the right. The displacement of the follower is to take place with uniform retardation. Determine the maximum velocity and acceleration of the follower when the cam shaft rotates at 900 rpm.
29. Classify with neat sketches the cam follower according to their shape, location and motion. State also their advantages, if any, with respect to other followers.
30. Sketches neatly the displacement, velocity and acceleration curves of a cycloidal motion follower. Why is it superior over other motion curves?
31. Briefly explain the undercutting in cam mechanisms.
32. Draw the profile of a cam for operating the exhaust valve of a oil engine. It is required to give equal uniform acceleration and retardation during opening and closing of the valve each of which corresponds to 60^0 of cam rotation. The valve must remain in the fully open position for 20^0 of the cam rotation. The lift of the valve is 37.5mm and the least radius of the cam is 40mm. The follower is provided with roller of radius 20mm and its line of stroke passes through the axis of the cam.
33. It is required to set out the profile of a cam to give the following motion to the reciprocating follower with a flat mushroom contact face: i) follower to have a stroke of 20mm during 120^0 of cam rotation. ii) follower to dwell for 30^0 of cam rotation iii) follower to return to its position during 120^0 of cam rotation. iv) follower to dwell for the remaining period. The minimum radius of the cam is 25mm. The outstroke of the follower is performed with simple harmonic motion and the return stroke with equal uniform acceleration and retardation. Draws the profile of the cam.
34. A symmetrical circular cam operating a flat faced follower has the following particulars: Minimum radius of the cam = 30mm; Total lift = 20mm; Angle of lift = 75^0; Nose radius = 5mm; speed = 600rpm. Determine i) the principal dimensions of the cam ii) acceleration of the follower at the beginning of lift, at the end of the contact with the circular flank, at the beginning of contact with the circular flank, at the beginning of contact with the nose and at the apex of the nose.
35. Draw the profile for the disc cam offset 20mm to the right of the centre of the cam shaft. The base circle diameter is 75mm and the diameter of the roller is 10mm. The follower is to move outward a distance 40mm with SHM in 140^0 of the cam rotation to dwell for 40^0 of cam rotation to move inward with 150^0 of cam rotation with uniform acceleration and retardation. Calculate the maximum velocity and acceleration of the follower during each stroke if the cam-shaft rotates at 120 rpm.
36. A cam of base circle diameter 50mm has tangent flanks and operates a follower through a roller of radius 5mm. The path of the roller centre is a straight line passing through the cam shaft axis, The follower acts against a spring of stiffness 5 N/mm

and initial compression is 8mm. The total effective mass of the follower is 3 Kg and the spring mass is 1 Kg. Assume 1/3 mass as the effective mass of spring due to inertia effects. Find the torque exerted on the cam shaft when it is rotating at 40 rad/s and the cam has turned through an angle 30^0 from the point at which the roller makes contact with the flank. Neglect the effect of friction.

UNIT – IV (PART – A)

1) State the relationship between circular pitch and the module.
2) Briefly write about reverted gear train with suitable sketch.
3) Prove or disprove that in a spur gear pair, pure rolling occurs only at one point along the path of contact.
4) What is meant by a n epicyclic gear train? Give a practical example.
5) Explain the term interference in gears? And write any one method to prevent it.
6) Differentiate between simple gear train and epicyclic gear train.
7) State law of gearing.
8) Explain the term interference as applied to gears.
9) Define: 1, normal pitch 2. Axial pitch relating to helical gears.
10) What is meant by contact ratio in gear? And writ the equation to determine this valve.
11) How to change the direction of rotation of the output gear in simple gear train without changing the direction of rotation of input gear.
12) State the condition for constant velocity ratio of toothed wheels.
13) Derive the minimum force required to slide a body on a rough horizontal surface.
14) Define the law of gearing with the equation.
15) What are the principal reasons for the use of non-standard gears?
16) What is axial pitch of a helical gear?
17) List out the applications of epicyclic gear train.
18) Define interference.
19) What is meant by compound gear train?
20) What is law of gearing?
21) What is epicyclic gear train?
22) State law of gearing?
23) What are the method to avoid interference?
24) Define circular pitch.
25) What are the types of gear trains?
26) What is the interference in involute teeth?
27) Define velocity ratio of an epicyclic gear train.
28) Define the term interference as applied to gears.
29) State and prove law of gearing.
30) State any two advantages of involute gears.
31) Define the following terms in a supper gear tooth. A) module b) Pressure angle.

32) What are the various types of torques in a n epicyclic gear train?
33) Define the following terms in a super gear tooth.
    Circular pitch
    Diametral pitch
    Module
    Pressure angle
34) Distinguish between simple gear train and epicyclic gear train.
35) Prove or disprove the pure rolling is possible at one point only, on the line of action, between two meshing gear teeth profiles.
36) Define the terms "interference" ass applied to gears. Suggest any one method to avoid the same.
37) What is the advantages of epicyclic gear train and state any two applications of it?

UNIT – IV (PART – B)

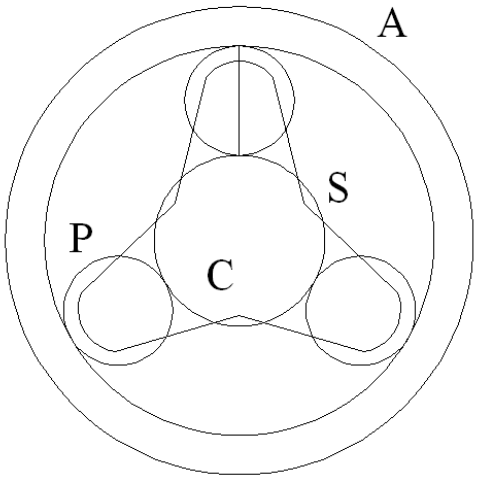
1. Two gear wheel mesh externally to give a velocity ratio of 3. The involute tooth has 6mm module and 20^0 pressure angle. Addendum is equal to one module. The pinion rotates at 90 rpm. Determine (i) number of teeth on pinion to avoid interference and the corresponding number on the wheel (ii) the length of path and arc of contact (iii) contact ratio and (iv) the maximum velocity of sliding.
2. In a reverted gear train, the arm A carries two gears S_1 and S_2 and a compound gear $P_1 – P_2$. The gear S_2 meshes with gear P_1 and gear S_2 meshes with gear P_2. The numbers of teeth on S_1, S_2 and P_2 are 80, 48 and 72 respectively. Find the speed and direction of gear S_2 when gear S_1 is fixed and arm A makes 400 rpm counter clockwise.
3. State the advantages of spur gear over helical gear, which type of gear pair is to be used to get very large speed reduction in a single stage? State the reason.
4. State and prove the fundamental law of gearing, determine the minimum number of teeth to avoid interference in worst case of meshing with 14 ½ ^{0} pressure angle.
5. Derive the equation to determine the length of path of contact between two spur gears of different size.
6. Briefly explain the sub-classification of compound gear trains, with neat sketches.
7. An epicyclic gear train consisting of fixed sun gear, S with 50 teeth meshing with a planet gear, P with 40 teeth. The planet gear meshes with a ring gear, R with 60 teeth. Determine the speed of the ring gear when the Arm A which carries the planet gear rotates at a speed of 100 rpm clockwise about the sun gear centre axis.
8. Find the length of arc of contact and maximum sliding velocity between mating gear teeth if module pitch = 4.25mm, addendum = 1 module, pressure angle 20^0, rpm of pinion = 150, no of teeth of gears 24 and 33.
9. A pair of 20^0 full depth involute spur gears having 30 and 50 teeth respectively of module 4mm are in mesh. The smaller gear rotates at 1000 rpm. Determine i) sliding velocities at engagement and at disengagement of pair of a teeth and ii) Contact ratio.
10. A pinion having 20 involute teeth of module pitch 6mm rotates at 200 revolutions per minutes and transmits 1.5KW to a gear wheel having 50 teeth. The addendum on

both the wheels is ¼ of the circular pitch. The angle of obliquity is 200. Find the i) length of the path of approach; ii) the length of the arc of approach, iii) the normal force between the teeth at an instant where there is only pair of teeth in contact.

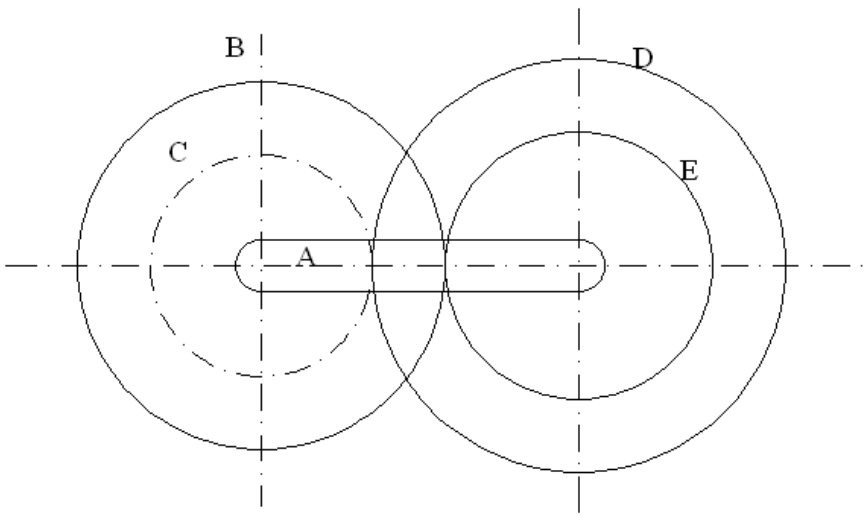
11. Two mating involute spur gears of 20^0 pressure angle have a gear ratio of 2. The number of teeth on the pinion of 20 and its speed is 250 revolution per minute. The module pitch of the teeth is 12mm. If the addendum on each wheel is such that the path of approach and the path of recess on each side are half the maximum possible length each, find i) the addendum for pinion and gear wheel; ii) the length of arc contact; iii) the maximum velocity of sliding during approach and recess. Assume pinion to be driver.
12. A pinion with 20 teeth and 125mm pitch circle diameter drives a rack. The addendum of both pinion and rack is 6.25mm. What is the least pressure angle which can be used to avoid interference? With this pressure angle, find the length of the arc of contact and the minimum number of teeth in contact at a time.
13. An Internal when B with 80 teeth is keyed to a shaft F. A fixed internal wheel C with 82 teeth is concentric with B. A compound wheel D_E gears with the two internal wheel; D has 28 teeth and gears with C while E gears with B. The compound wheels revolve freely on a pin which projects from a disc keyed to a shaft A makes 800 rpm, What is the speed of the shaft F?. Sketch the arrangements.
14. What is reverted gear train? Explain the arrangement of various gears in a reverted gear train and express the characteristic equation used to define their operation.
15. I) State and prove law of gearing, ii) A pair of involute spur gears with 16^0 pressure angle and pitch of module 6mm is in mesh. The number of teeth in pinion is 16 and its rotational speed is 240 rpm.
16. The gear ratio is 1.75. In order to avoid the interference, determine i) addenda on pinion and wheel. ii) length of path of contact iii) Maximum velocity of sliding on either side of pitch point.
17. Two 20^0 involute spur gears have a module of 10mm. The addendum is one module. The larger gear has 50 teeth and pinion has 13 teeth. Does the interference occur? If it occurs, to what value should the pressure angle be changed to eliminate interference?
18. Derive an expression for the minimum number of teeth required on the pinion to avoid the interference in involute gears.
19. A simple sun and planet gear consists of an annular gear having 120 teeth, a sun gear having 50 teeth and two identical planet gears. Determine a) Number of teeth on each planet gears. B) speed of the arm when gear A makes one revolution clock wise and gear D- makes ½ revolution anticlockwise.
20. Two 20^0 involute spur gears mesh externally and give a velocity ratio of 3. Module is 3mm and the addendum is equal to 1.1 module. If the pinion rotates at 120 rpm, determine i) the minimum number of teeth on each wheel to avoid interference, ii) the number of pairs of teeth in contact.
21. In an epicyclic gear train, an arm carries two gears A and B having 24 and 30 teeth respectively. The arm rotates at 100 rpm in the clockwise direction. Find the speed of gear B on its own axis, when the gear A is fixed. If instead of being fixed, the

wheel A rotates at 200 rpm in the counter clockwise direction, what will be the speed of B?

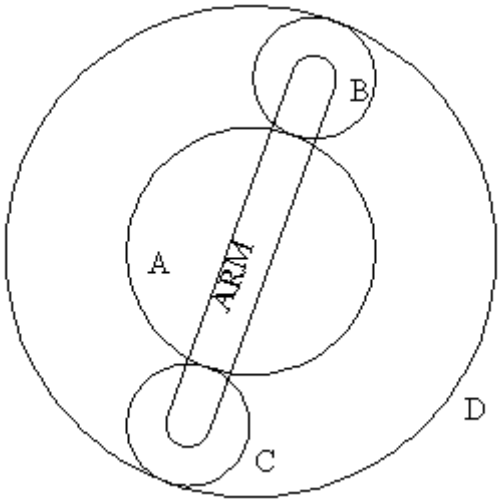
22. Draw a neat sketch of spur gear and explain the following : a) Module b) Circular pitch c) Diametric pitch d) pressure angle e) Addendum and f) Dedendum
23. In an epicyclic gear train an annular wheel A having 54 teeth meshes with a planet wheel B which gears with a sun wheel C, the wheels A and C being coaxial. The wheel B is carried on a pin fixed on one end of arm P which rotates about the axis of the wheels A and C. If the wheel A makes 20 rpm in a clockwise sense and the arm rotates at 100 rpm in the anticlockwise direction and the wheel C has 24 teeth, determine the speed and sense of rotation of wheel C.
24. Two gear wheels mesh externally and are to give a velocity ratio of 3. The teeth are of involute form of module 6. The standard addendum is 1 module. If the pressure angle is 180 and pinion rotates at 90 rpm, find i) the number of teeth on each wheel, so that the interference is just avoided, ii) the length of the path of contact and iii) the maximum velocity of sliding between the teeth.
25. State the advantages over spur gear over helical gear, ii) which type of fear pair is to be used to get very large speed reduction in a single stage? State the reason, iii) State and prove the fundamental law of gearing.
26. A pair of 20^0 full depth involute spur gears having 30 and 50 teeth respectively of module 4mm are in mesh. The smaller gear rotates at 1000 rpm. Determine i) sliding velocities at engagement and at disengagement of pair of a teeth and ii) contact ratio.
27. Derive an expression for minimum number of teeth on the wheel in order to avoid interference.
28. Two mating gear have 20 and 40 involute teeth of module 10mm and 20^0 pressure angle. The addendum on each wheel is to be made of such a length that the line of contact on each side of the pitch point has half of the maximum possible length. Determine the addendum height for each gear wheel, length of the path of contact, are of contact and contact ratio.
29. Explain the procedure adopted for designing the spur wheels.
30. A gear wheel having 20 teeth of involute form of module pitch 6mm an angle of obliquity of 20 degrees drives another wheel of the same dimensions. Calculate the length of the arc of contact is the addendum is one module. If the addendum was altered so that the arc of contact was the maximum possible what would be the length of this are, and the addendum required for this?
31. An epicyclic gear train for an electric motor , is shown in figure. The wheel S has 15 teeth and is fixed to motor shaft rotating at 1450 rpm. The planet P has 45 teeth, gears with fixed annular A and rotates on a spindle carried by an arm which fixed to output shaft. The planet P also gears with the sun when S. Find the speed of output shaft. If motor is transmitting 2 KW find the torque required to fix the annular.



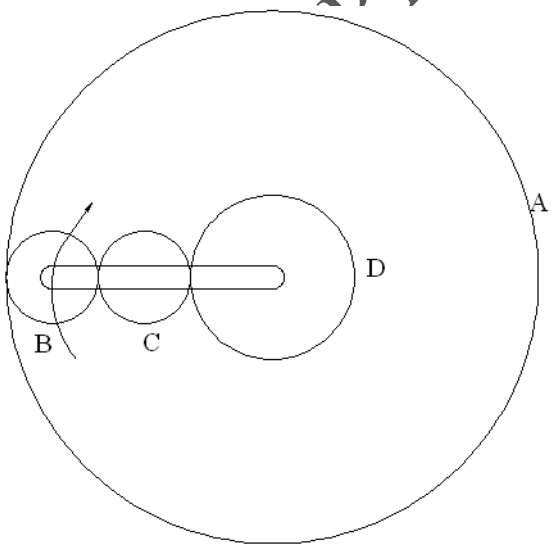
32. In a reverted epicyclic gear train as shown in figure; the arm A carries two gears B and C and a compound gear D-E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear is fixed and the arm A makes 100 rpm clockwise.



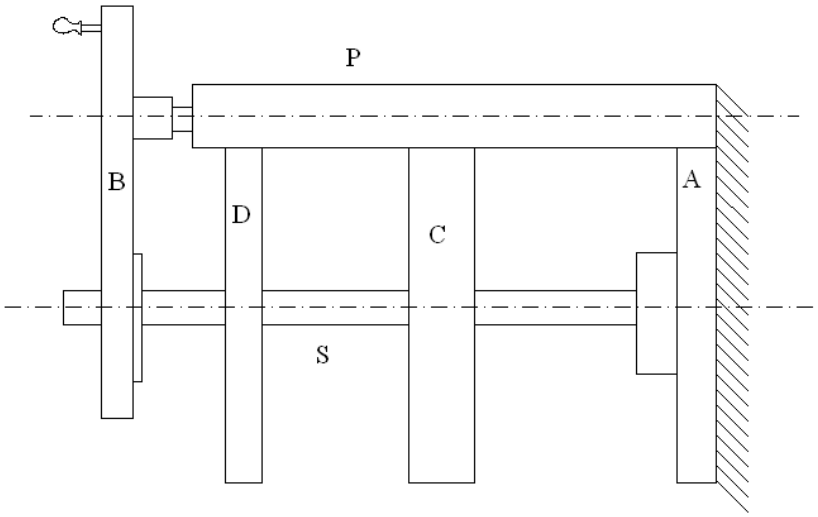
33. An epicyclic gear train is shown in the figure. How many revolutions does the arm makes. 1) When A makes one revolution in clockwise and D makes ½ a revolution in the opposite sense. 2) When A makes one revolution in clockwise and D remains stationary. The number of teeth in gears A and D are 40 and 90 respectively.



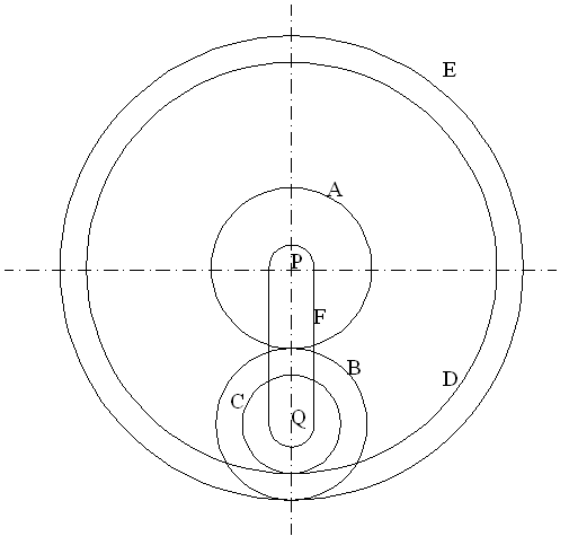
34. An epicyclic gear train as shown in figure is composed of a fixed annular wheel A having 150 teeth. The wheel A is meshing with wheel B which drives wheel D through an idle wheel C, D being concentric with A. The wheels B and C are carried on an arm which revolves clockwise at 100 rpm about the axis of A and D. If the wheels B and D have 25 and 40 teeth respectively, determine the number of teeth on C and speed and sense of rotation of wheel C.



35. Figure shown an epicyclic gear train known as ferguson's paradox. Gear A is fixed to the frame and is therefore stationary. The arm B and gears C and D are free to rotate on the shaft S. Gears A, C and D have 100,101, and 99 teeth respectively. The planet gear has 20 teeth. The pitch circle diameters of all are same so that the planet gear P meshes with all of them. Determine the revolutions of gears C and D for one revolution of the arm B.



36. A compound epicyclic gear is shown in figure. The gears A, D and E are free to rotate on axis P. The compound gears B and C rotate together on the axis Q at the end of arm F. All the gears have equal pitch. The number of external teeth on gears, A B and C are 18, 45 and 21 respectively. The gears D and E are annulus gears. The gear A rotates at 100 rpm in anticlockwise direction and the gear D rotates at 450 rpm clockwise. Find the speed and direction of the arm and the gear E.



UNIT – V (PART – A)

1. State the law of dry frictions.
2. The coefficient of friction between the belt and the pulley in a belt drive is 0.3. The angle of lap is 165^0. If the tension on the tight side is 3000N, determine the tension on the slack side.
3. Prove or disprove that the efficiency of a screw jack is independ3ent of the load raised.
4. State the condition and the equation for the velocity of the belt for the transmission of maximum power in a flat belt drive.

5. Sketch a compound epicyclic gear train.
6. State the laws of dry-fricition.
7. Obtain an expression for length of an open belt drive.
8. What is the minimum force required to slide a body on a rough horizontal plane?
9. What is the condition for self locking in screws?
10. Find the power transmitted by a flat belt over a pulley of 600mm in diameter at 200 revolutions pr minutes. The maximum and minimum tensions in the blt are 2500N and 124N.
11. Write the equation to determine the efficient of a screw jack.
12. Sketch the displacement velocity and acceleration diagram when a follower moves with uniform velocity.
13. What do you means by friction angle?
14. What are the significance of friction with regard to power transmission devices like clutches and bearings?
15. What is the condition of maximum efficiency of a screw jack?
16. What are the advantages of wire ropes over fabric ropes?
17. Why self-locking screws have lesser efficiency?
18. What are the functions of clutches?
19. What is dynamic friction?
20. What is the function of a clutch in automobiles?
21. What is the ratio of driving tension in flat belt?
22. State the laws of dry friction.
23. What is the effect of centrifugal tension in belt drives?
24. What do you mean by limiting frictions?
25. What is friction angle?
26. State the condition for self-locking of screw jack?
27. Which of the two assumptions – Uniform intensity of pressure or uniform rate of war would be recommended while designing a clutch?
28. Explain the terms slip and creep in a belt drive.
29. What is the condition for self-locking in screws.
30. How centrifugal tension affects the power transmission in belt drive?
31. Define the term “Limiting friction”.
32. What is the minimum force required to drag a body on a rough (friction) surface (a) when the force is horizontal and (b) the force is inclined at an angle of “θ” to the horizontal.
33. State the law of dry or solid friction.
34. Distinguish or disprove that the efficiency of a screw jack is independent of the load raised.
35. State the condition and equation for the velocity of the belt for the transmission of power in a flat belt drive.
36. What is the function of friction clutch? Name two types of friction clutch used in practice?
37. Define efficiency of a screw jack in term of helix angle of screw and friction angle.

UNIT – V (PART – B)

1. Prove or disprove the following statement – " Angle of friction is equal to angle of repose"
2. A bolt is having V-threads. The pitch of threads is 5mm and the V-angle is 550. The mean diameter of the bolt is 20mm. The bolt is tightened by screwing a nut. The mean radius of the bearing surface of the nut is 25mm. The load on the bolt is 5000N. The co-efficient of friction for nut and bolt is 0.1 whereas for nut and bearing surface is 0.16. Determine the force required at the end of a spanner 0.6m long.
3. Briefly explain the following : 1) Slip of the belt 2) Creep of the belt.
4. An open belt drive connects two pulleys of 1.2m and 0.5m diameters on parallel shafts 4m apart. The maximum tensions in the belt is 1800N. The coefficient of friction is 0.3. The driven pulley of diameter 1.2m runs at 250 rpm. Calculate the length of the belt required, the power transmitted and the torque on each of the two shafts.
5. An effort of 1200N is required to just to move a certain body up an inclined plane of angle 12^0 with force acting parallel to the plane. If the angle of inclination is increased to 15^0, then the effort required is 1400N. Find the co-efficient of friction and the weight of the body.
6. The efficiency of a screw jack is 55%, when a load of 1500N is lifted by an effort applied at the end of a handle of length 0.5m. Determine the effort applied if the pitch of the screw thread is 10mm.
7. Prove and disprove the following statement : " A V-belt drive with same co-efficient of friction and angle of wrap as flat-belt drive will transmit less power than flat-belt drive".
8. Two pulleys, one 450mm diameter and the other 200mm diameter are on parallel shaft 2.1m apart and are connected by a crossed belt. The larger pulley rotates at 225 rpm. The maximum permissible tension in the belt is 1 KN and the coefficient of friction between the belt and the pulley is 0.25. Find the length of the belt required and the power that can be transmitted.
9. Derive an equation to determine the length of a crossed belt. (approximate). Two parallel shafts 6000mm apart are to be connected by a belt running over pulleys of diameter 600mm and 400mm respectively. Determine the approximate length if the belt is crossed.
10. Determine the external and internal radius of the friction plate of a single clutch if maximum torque transmitted is 90 N-m. The external radius of the friction plate is 1.5 times the internal radius and the maximum intensity of pressure at any point of contact surface should not exceed 0.8 X 10^5 N/m^2. Take both sides of the plate as effective and co0efficient of friction = 0.3. Assume uniform wear. Also calculate the axial force exerted by the springs.
11. Deduce an expression for determination frictional torque in a conical pivot bearing considering uniform wear.

12. A conical pivot bearing supports a vertical shaft of 200mm diameter. It is subjected to a load of 30KN. The angle of cone is 120^0 and the co-efficient of friction is 0.025. Find the power lost in friction when the speed is 140 rpm assuming i) Uniform pressure and ii) Uniform wear.
13. Derive an first principles and expression for the effort required to raise a load with a screw jack taking friction into consideration.
14. A 150mm diameter valve, against a steam pressure of 2 MN/m^2 is acting, is closed by means of a square threaded screw 50mm in external diameter with 6mm pitch. If the coefficient of friction is 0.12, find the torque required to turn the handle.
15. The mean diameter of the screw jack having pitch of 10mm is 50mm. A load of 20 KN is lifted through a distance of 170mm. Find the work done in lifting the load and efficiency of the screw jack when i) the load rotates with the screw and ii) the load rests on the loose head which does not rotate with the screw. The external and internal diameter of the bearing surface of the loose head are 60mm and 100 respectively. The coefficient of friction for the screw as well the bearing surface may be taken as 0.08.
16. A single dry plate clutch transmits 7.5KW at 900 revolutions per minutes. The axial pressure is limited to 0.07 N/mm2. If the coefficient of friction is 0.25, find i) mean radius and face width of the friction lining assuming the ratio of the mean radius to the face width as 4 and 2, ii) outer and inner radius of the clutch plate.
17. A screw jack has a square thread of mean diameter 6cm and pitch 0.8cm. The coefficient of friction at the screw thread is 0.09. A load of 3 KN is to be lifted through 12cm. Determine the torque required and the work done in lifting the load through 12cm. Find the efficiency of the jack also.
18. A load of 25 KN is supported by a conical pivot with angle of cone as 1200. The intensity of pressure is not to exceed 350 KN/m2. The external radius is 2 times the internal radius. The shaft is rotating at 180 revolution per minute and coefficient of friction is 0.05. Find the power absorbed in friction assuming uniform pressure.
19. An open belt running over two pulleys 1.5m and 1.0m diameters connected two parallel shafts 4.8m apart. The initial tension in the belt when stationary is 3000N. If the smaller pulley is rotating at 600 revolution per minute and coefficient of friction between the belt and the pulley is 0.3, determine the power transmitted taking centrifugal tension into account. The mass of the belt is given as 0.673 Kg/length.
20. The thrust of a propeller shaft is marine engine is taken up by a number of collars integral with the shaft which 300mmin diameter, the thrust on the shaft is 200 KN and the speed is 75 rpm. Taking coefficient of friction is 0.05 and assuming intensity of pressure as uniform and equal to 0.3 N/mm2, find the external diameter of the collars and the number of collars required, if the power lost in friction is not to exceed 16 KW.
21. A leather belt is required to transmit 7.5 KW from a pulley 1.2m in diameter, running at 250 rpm. The angle embraced is 165^0 and the coefficient of friction between the belt and the pulley is 0.3 . If safe working stress for the leather belt is 1.5 MPa, density of leather is 1 Mf/m^3 and thickness of belt is 10mm. Determine the width of the belt taking centrifugal tension into account.

22. A square threaded bolt of root diameter 22.5mm and pitch 5mm is tightened by screwing a nut whose mean diameter of bearing surface is 50mm. If the coefficient of friction between the nut and bolt is 0.1. and the nut and bearing surface is 0.16, determine the force required at the end of the spanner 500mm long when the load on the bolt is 10KN.
23. A leather faced conical clutch has a cone angle of 300. If the intensity of pressure between the contact surfaces is limited to 0.35 N/mm2 and breadth of the conical surface is not to exceed 1/3 rd of the mean radius. Determine the dimensions of the contact surfaces to transmit 22.5 KW at 2000 rpm. Assume uniform wear rate and coefficient of friction is 0.15.
24. Derive the expression for frictional torque on cone clutch based on uniform pressure theory.
25. A single plate friction clutch with both sides of plate being effective is used to transmit power at an engine speed of 2000 rpm. It has outer and inner radius 10cm and 8cm respectively. Find the maximum power transmitted and the corresponding axial thrust. If the maximum intensity of pressure is not to exceed 0.08 N/mm^2. Assume coefficient of friction as 0.25.
26. Flat belt runs on a pulley 1m in diameter and transmits 8 KW at 200 rpm. Assuming angle of lap as 1700 and coefficient of friction as 0.25. Find the necessary width of belt if the pull is not to exceed 200 N/cm width of the belt. Neglect centrifugal tension.
27. Find the force required to be applied at the end of 500mm long of a screw jack. The threads are single start square with 12mm pitch and 65mm mean diameter. The load does not rotate with screw spindle. The coefficient of friction for threads is 0.15 and for collar it is 0.12 which is having 40mm mean radius. Also find the efficiency of the screw jack if the load to be lifted is 8 KN.
28. A multiple plate disc clutch transmits 75 KW of power at 2000 rpm, coefficient of friction for the friction surfaces is 0.2. Axial intensity of pressure is not to exceed 180 KN/m2. Internal radius is 100mm and is 0.8 times the external radius. Find the number of plates needed to transmit the required torque. Assume uniform wear conditions.
29. A single plate clutch transmits 25 KW at 900 rpm. The maximum pressure intensity between the plates is 85 KN/m^2. The outer diameter of the plate is 360mm. Both the sides of the plate are effective and the coefficient of friction is 0.25. Determine i) the inner diameter of the plate ii) the axial force to engage the clutch.
30. A belt drive is required to transmit 10 KW from a motor running at 600 rpm. The belt is 12mm thick and has a mass density of 0.001 g/mm^3. Safe stress in the belt is not exceeding 2.5 N/mm^2. Diameter of the driving pulley is 25omm, whereas the speed of the driven pulley is 22o rpm. The two shafts are 1.25m apart. The coefficient of friction is 0.25. Determine the width of the belt.
31. A single plate clutch is required to transmit 8 KW at 1000 rpm. The axis pressure is limited to 70 KN/m^2. The mean radius of the plate is 4.5 times the radial width of the friction surface. If both the sides of the plate are effective and the coefficient of

friction is 0.25. find a) the inner and the outer radius of the plate and the mean radius, b) the width of the friction lining.

32. Find the width of the belt necessary to transmit 75 KW to a pulley 300mm diameter, if the pulley makes 1600 rpm and the coefficient of friction between the belt and the pulley is 0.22. Assume the angle of contact as 210^0 and the maximum tension in the belt is not to exceed 8 N/mm widths.
33. The mean diameter of a square threaded screw jack is 55mm. The pitch of a thread is 10mm the coefficient of friction is 0.15. What force must be applied at the end of 0.7m long, which is perpendicular to the longitudinal axis of the screw to raise a load of 20KN, and to lower it?
34. Single plate clutch, effective on both sides is required to transmit 25KW at 3000 rpm. Determine the outer and inner radius of frictional surface if the coefficient of friction is 0.2555. The ratio of radius is 1.25 and the maximum pressure is not to exceed of 0.1 N/mm2. Also determine the axial thrust to be provided by springs. Assume uniform wear.
35. An open belt drive connects two pulleys 1.2m and 0.5m diameter, on parallel shafts 4m apart. The mass of the belt is 0.9Kg/m length and the maximum tension is not to exceed 2000N. The coefficient of friction is 0.3. The 1.2 m pulley which is the driver runs at 200 rpm. Due to belt slip on one of the pulleys, the velocity of the driver shaft is only 450 rpm. Calculate the torque on each of the two shafts, the power transmitted and the power lost in friction. What is the efficiency of the drive?
36. The mean diameter of the screw jack having pitch of 10mm is 50mm. A load of 20 KN is lifted through a distance of 170mm. Find the work done in lifting the load and efficiency of the screw jack when i) the load rotates with screw. ii) the load rests on the loose head which does not rotate with the screw. Iii) the external and internal diameters of the bearing surface of the loose head are 60mm, and 10mm respectively. The coefficient of friction for the screw as well the bearing surface may be taken as 0.08.
37. Determine the equation to determine the torque required to lift the load by screw jack. Ii) a square threaded bolt of root diameter 22.5mm and pitch 5mm is tightened by screwing nut whose mean diameter of bearing surface is 50mm. If coefficient of friction for nut and bolt is 0.1 and for nut and bearing surface 0.16, find the force required at the end of a spanner 500mm long when the load on the bolt is 10 KN.
38. Derive an expression for the torque required to lift a load by a screw jack, if l is the length of the arm.
39. A leather faced conical clutch has a cone angle of 300. If the intensity of pressure between the contact surfaces is limited to 0.35 MPa and the breadth of the conical surface is not to exceed one-third of the mean radius, find the dimensions of the contact surfaces to transmit 22.5v KW at 2000 rpm. Assume uniform rate of wear and take coefficient of friction as 0.15.
40. A compressor required 90 KW to operate at 250 rpm. The drive is by V-belts from an electric motor running at 750 rpm. The diameter of the pulley on the compressor shaft must not be greater than 1 meter while the centre distance between the pulleys is limited to 1.75m. The belt speed should not exceed 1600 m/min. Determine the

number of V belts required to transmit the power if each belt has a cross sectional are of 375mm^2; density 1000 Kg/m^3 and an allowable tensile stress of 2.5 MPa. The groove angle of the pulley is 350. The coefficient of friction between the belt and the pulley is 0.25. Also calculate the length required for each belt.

41. Derive an expression for braking torque on the drum of simple band brake.
42. The mean diameter of the screw jack having pitch of 10mm is 50mm. A load of 20 KN is lifted through a distance of 170mm. Find the work done in lifting the load and efficiency of the screw jack when i) the load rotates with the screw and ii) the load rests on the loose head which does not rotate with the screw. Iii) the external and internal diameters of the bearing surface of the loose head are 60mm, and 10mm respectively. The coefficient of friction for the screw as well the bearing surface may be taken as 0.08.
43. Deduce the expression for the friction moment of a collar thrust bearing, stating clearly the assumption made.
44. A shaft has a number of collars integral with it. The external diameter of the collars is 400mm and the shaft diameter is 250mm. If the uniform intensity of pressure is 0.35N/mm2 and its coefficient of friction is 0.05, estimate i) power absorbed in overcoming friction when the shaft runs at 105 rpm and carries a load of 150KN and ii) number of collars required.
45. The brake whose dimensions are shown in figure has coefficient of friction of 0.3 and is to have a maximum pressure of 1000 KPa against the friction material. 1) Using an actuating force of 1750N, determine the face width of the shoes (both shoes have same width) and 2) what torque will the brake absorb?