KINGS

COLLEGE OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION BANK

Subject code/Name: Kinematics of Machinery Year/Sem: II/III

UNIT- I (Basics of Mechanism)

PART-A (2 Marks)

1. Define resistant body.
2. Define Link or Element
3. Differentiate Machine and Structure
4. Define Kinematic Pair.
5. Define Kinematic Chain.
6. What are the types of joints?
7. Define Degrees of Freedom (Mobility).
8. Write down the Kutzbach criterion for plane mechanism.
9. What is meant by spatial mechanism?
10. Differentiate Machine and Mechanism.
11. Define Inversion of Mechanism
12. Define Grashof's Law.
13. Define Pantograph.
14. What is Elliptical Trammel?
15. Define Transmission Angle and Mechanical Advantage
16. What is a straight line Mechanism?.

PART-B (16 Marks)

1. a) Explain different types of Link. **(8)**
   b) Classify and explain the Kinematic pair. **(8)**

2. a) Explain any two inversion of four bar chain. **(8)**

   b) Explain the first inversion of Single Slider Crank Chain. **(8)**

3. a) Explain first inversion of Double Slider crank chain. **(8)**

   b) Explain third inversion of double slider crank chain. **(8)**

4. a) Explain the offset slider crank mechanism. **(8)**

   b) Explain Straight line mechanism with neat sketch **(8)**

5. a)With the help of a neat sketch explain the working of Oldham's coupling. **(8)**
   b) Explain steering gear mechanism with neat sketch **(8)**

6. With the help of a neat sketch explain the working of Whitworth quick return mechanism..
7. With the help of a neat sketch explain the working of Single slider and double slider crank chain mechanism.

UNIT II (Kinematics)

PART-A (2 Marks)

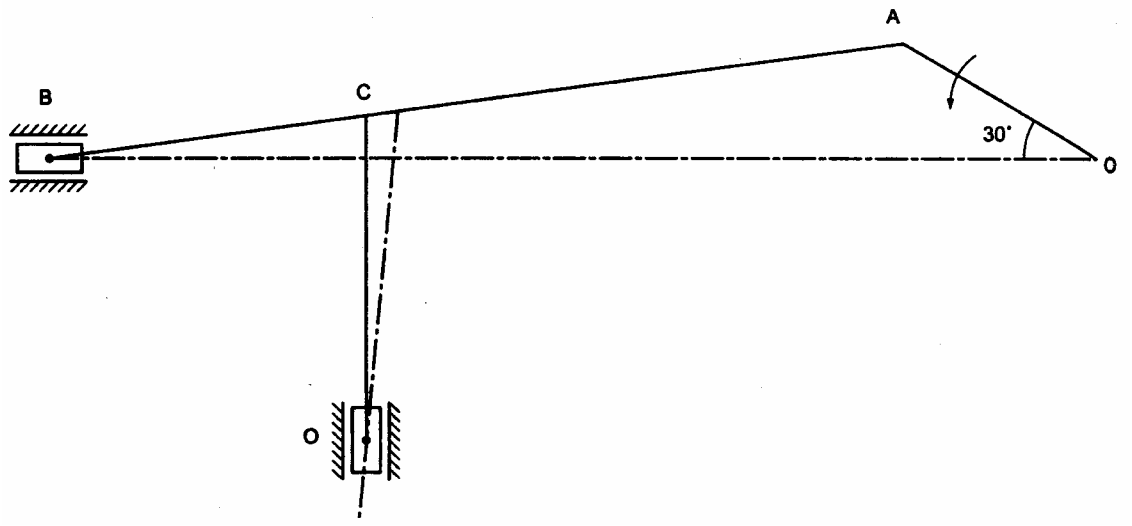
1. What are the types of motion?
2. What is configuration diagram or space diagram?
3. Define Coincident points
4. Define Coriolis Component
5. Write down the expression for Coriolis component of acceleration defining each of terms in the expression.
6. What are the types of instantaneous Centres?
7. Define Kennedy's theorem.
8. Define rubbing velocity at a pin joint.
9. What are the various methods used for finding out velocity of mechanism?
10. Define Instantaneous centre..
11. Define Angular Velocity ratio theorem.

PART-B (16 Marks)

1. The Crank of a slider crank mechanisms rotates clockwise at a Constant speed of 600 r.p.m. The crank is 125 mm and connecting rod is 500 mm long. Determine 1. Linear velocity and acceleration of the mid Point of the connecting rod, and 2. Angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position.

2. In a four link mechanism, the dimensions of the links are AB=200 mm, BC=400mm, CD=450 mm and AD=600mm. At the instant when DAB=90°, the link AB has angular velocity of 36 rad/s in the clockwise direction. Determine (i) The velocity of point C, (ii) The velocity of point E on the link BC When BE =200 mm (iii) the angular velocities of links BC and CD, iv) acceleration of link of link BC.

3. The dimensions of the various links of a mechanism, as shown in fig. are as follows: OA=300 mm; AB=1200; BC=450 mm and CD=450 mm. if the crank OA rotates at 20 r.p.m. in the anticlockwise direction and gives motion to the sliding blocks B and D, find, for given configuration: (1) Velocity of sliding at B and D, (2) Angular velocity of CD (3) Linear acceleration of D and (4) angular acceleration of CD.



4 a)Derive the expressions for Velocity and acceleration of piston in reciprocating steam engine mechanism with neat sketch

5 b).Derive the expression for Coriolis component of acceleration with neat sketch

6. In a slider crank mechanism, the length of the crank and the connecting rod are 100 mm and 400 mm respectively./ The crank [position is 45° from IDC, the crank shaft speed is 600 r.p.m. clockwise. Using analytical method Determine (1)Velocity and acceleration of the slider, and (2) Angular velocity and angular acceleration of the connecting rod.

7. Locate all instantaneous centers of the slider crank mechanism; the length of crank OB and Connecting rod AB are 125 mm and 500 mm respectively. The crank speed is 600 rpm clockwise. When the crank has turned 45° from the IDC. Determine (i)velocity of slider' A' (ii)Angular Velocity of connecting rod 'AB'.

UNIT III (Kinematics of Cam)

PART-A (2 Marks)

1. What is a cam?
2. Give some examples for cams.
3. What are the types of follower?
4. Define tangent cam.
5. Distinguish radial and cylindrical cams.
6. What are the different motions of the follower?
7. Define trace point in the study of cams.
8. Define pressure angle with respect to cams.
9. Where are the roller follower extensively used?
10. Define dwell period.
11. Explain offset follower..

PART-B (16 Marks)

1. A cam is to give the following motion to a knife edged follower:
   (a) Outstroke during 60° of cam rotation
   (b) Dwell for the next 45° of cam rotation
   (c) Return stroke during next 90° of cam rotation and
   (d) Dwell for the remaining of cam rotation

The stroke of the follower is 40 mm and the minimum radius of the cam is 50 mm. The follower moves with uniform velocity during both the outstroke and return strokes. Draw the profile of the cam when (a) the axis of the follower passes through the axis of the cam shaft, and (b) the axis of the follower is offset by 20 mm from the axis of the cam shaft.

2. Draw the profile of a cam operating a Knife-edged follower from the following data: (a) Follower to move outward through 40 mm during 60° of a cam rotation; (b) Follower to dwell for the next 45° (c) Follower to return its original position during next 90° (d)Follower to dwell for the rest of cam rotation. The displacement of the follower is to take place with simple harmonic motion during both the outward and return strokes. The least radius of the cam is 50mm. If the cam rotates at 300 r.p.m., determine the maximum velocity and acceleration of the follower during the outward stroke and return stroke.

3. A cam, with a minimum radius of 50 mm, rotating clockwise at a uniform speed, is required to giver a knife-edged follower the motion as described below: (a) To move outwards through 40 mm during 100° rotation of the cam; (b) to dwell for next 80° (c) To return to its starting position during next 90 ° and (d) To dwell for the rest period of revolution. Draw the profile of the cam (i) When the line of stroke of the follower passes through the centre of the cam shaft and (ii) When the line of stroke of the follower is to take place with Uniform acceleration and uniform retardation. Determine the maximum velocity and acceleration of the follower when the cam shaft rotates at 900 r.p.m.

4. Draw the profile of a cam operating a roller reciprocating follower and with the following data: Minimum radius of cam =25 mm; lift=30mm; Roller diameter= 15mm. The cam lifts the follower for 120° with SHM, followed by a dwell period of 30°. Then the follower lowers down during 150° of cam rotation with uniform acceleration and retardation followed by a dwell period. If the cam rotates at a uniform speed of 150 RPM. Calculate the maximum velocity and acceleration of follower during the descent period.

5. 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 surface: (i) Follower to have a stroke of 20 mm during 120° of cam rotation, (ii) Follower to dwell for 30° of cam rotation, (iii) Follower to return to its initial position during 120° of cam rotation, (iv) Follower to dwell for remaining 90° of cam rotation. The minimum radius of the cam is 25 mm. The out stroke of the follower is performed with SHM and return stroke with equal uniform acceleration and retardation.

6. A tangent cam to drive a roller follower through a total lift of 12.5 mm for a cam rotation of 75°. The cam speed is 600 rpm . The distance between cam centre and follower centre at full lift is 45 mm and the roller is 20 mm in diameter. Find the cam proportions and plot displacement, velocity and acceleration for one full cycle.

UNIT-IV (Gears)

PART-A (2 Marks)

1. What is an angle of obliquity in gears?
2. What is bevel gearing?
3. State law of Gearing.
4. What are the methods to avoid interference?
5. Define contact ratio.
6. What do you know about tumbler gear?
7. Define cycloidal tooth profile and involute tooth profile.
8. Define circular pitch and diametral pitch in spur gear
9. Define Backlash.
10. What is gear train?
11. What are the types of gear train?
12. What is reverted gear train?
13. In watch mechanism, what type of gear train is used?
14. How epicyclic gear train differs from the other type of gear trains?.
15. State methods to find the velocity ratio of epicyclic gear train..
16. Where the epicyclic gear trains are used?
17. What are the externally applied torques used to keep the gear train in equilibrium?

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PART-B (16 Marks)

1. a) Two mating spur gear with module pitch of 6.5 mm have 19 ad 47 teeth of 20° pressure angle and 6.5 mm addendum. Determine the number of pair of teeth and angle turned through by the larger wheel for one pair of teeth in contact. Determine also the sliding velocity at the instant (i) engagement commences (ii) engagement terminates . When the pitch line velocity is 1.2 m/s. **(8)**

b) The number of teeth on each of the two spur gears in mesh is 40. The teeth have 20° involute profile and the module is 6mm. If the arc of contact is 1.75 times the circular pitch. Find the addendum. **(8)**

2. a) Two 20° involute spur gears have a module of 10 mm. The addendum is one module. The larger gear has 50 teeth and pinion 13 teeth. Does the interference occur? If it occurs, to what value should the pressure angle be changed to eliminate interference? **(8)**

b) Two mating involute spur gears 20° pressure angle have a gear ratio of 2. the number of teeth on the pinion is 20 and its speed is 250 rpm. The module pitch of the teeth is 12 mm. if the addendum on each wheel wheel recess on each side are half the maximum possible length each, find (1) the addendum for pinion and gear wheel (2) the length of arc of contact (3 the maximum velocity of sliding during approach and recess. Assume pinion to be driver. **(8)**

3.a) A pair of spur gear with involute teeth is to give a gear ratio of 4:1. The arc of approach is not be less than the circular pitch and the smaller wheel is the driver. The angle of pressure is 14.5 ° What is the least number of teeth can be used on each wheel? (2) What is the addendum of the wheel in terms of circular pitch? **(8)**

b). A pair 20° full depth involute spur gear having 30 and 50 teeth respectively module 4 mm arc in mesh, the smaller gear rotates at 1000 rpm. Determine (a) Sliding velocities at engagement and disengagement of a pair of teeth and (b) Contact ratio. **(8)**

3. In an epicyclic gear train the internal wheels A and B and compound wheels C and D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G. E gears with A and C . Wheel F gear with B and D. All the wheels have the same module and the number of teeth are: T_C =28 T_D=26; T_E = T_F=18. (1) Sketch the arrangement, (2) Find the number of teeth on A and B, (3)If the arm G makes 100 rpm clockwise and A is fixed, find the speed of B , and (4) If the arm G makes 100 rpm clockwise and wheel A makes 10 rpm counter clockwise; Find the speed of wheel B.

4. Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth are of involute form; module=6mm, addendum=one module, pressure angle= 20°. The pinion rotates at 90 rpm. Determine (1) the number of teeth on the pinion to avoid interference on it and the corresponding number of teeth on the wheel, (2) The length of path and arc of contact, (3) the number of pairs of teeth in contact.

5. The arm of an epicyclic gear train rotates at 100 rpm in the anticlock wise direction. The arm carries two wheels A and B having 36 and 45 teeth respectively. The wheel A is fixed and the arm rotates about the centre of wheel A. Find the speed of wheel B. What will be the speed of B, if the wheel A instead of being fixed, makes 200 rpm (clockwise).

6. In a reverted epicyclic train, the arm F carries two wheels A and D and a compound wheel B-C. Wheel A meshes with wheel B and Wheel D meshes with wheel C. Ther number of teeth on wheel A, D and C are 80, 48, and 72. Find the speed and direction of wheel D , when wheel A is fixed and arm F makes 200 rpm clockwise.
7. An epicyclic train is composed of a fixed annular wheel A having 150 teeth. Meshing with A is a wheel B which drives wheel D through an idle wheel C, D being concentric with A. Wheels B and C are carried on arm which revolves clockwise at 100 rpm about the axis of A or D. If the wheels B and D are having 25 teeth and 40 teeth respectively, find the number of teeth of C and the speed and sense of rotation of C.
8. The sun planet gear of an epicyclic gear train, the annular D has 100 internal teeth, the sun gear A has 50 external teeth and planet gear B has 25 external teeth. The gear B meshes with gear D and gear A. The gear B is carried on arm E, which rotates about the centre of annular gear D. If the gear D is fixed and arm rotates at 20 rpm, then find the speeds of gear A and B.

UNIT-V (Friction)

PART-A (2 Marks)

1. De fine dry, greasy and fluid friction.
2. What is meant by slope of a thread?
3. Differentiate between angle of repose and limiting angle of friction.
4. What are effects of limiting angle of friction?
5. Define Coefficient of friction.
6. State laws of solid friction.
7. What is the efficiency of inclined plane?
8. Why self locking screws have lesser efficiency?
9. What are the functions of clutches?
10. What is the difference between cone clutch and centrifugal clutch?
11. Define velocity ratio.
12. What is meant by angle of contact?
13. Compare slip and creep.
14. Define the term tractive resistance.
15. Define efficiency of an inclined plane.
16. Write an expression for the ratio of tension between the tight and slack sides of a band and block brake.

PART-B (16 Marks)

1. a) For a flat belt, prove that $T_1/T_2=e^{\mu\theta}$ Where T_1 and $T_{2=}$ Tension in the tight and slack sides of the belt, θ= Angle of contact between the belt and the pulley, and μ= Coefficient of friction between the belt and the pulley. **(8)**

2. b) An open belt running over two pulley of 1.5 m and 1.0 m diameters connects two parallel shafts 4.8 m apart. The initial ten in the belt is 3000 N. The smaller pulley is rotating at 600 rpm. The mass of belt is 0.6703 kg/m length. The coefficient of friction between the belt and pulleys is 0.3. Find (1) the exact length of the belt required (2) the power transmitted taking c.f tension into account. **(8)**

3. a) A multiplate disc clutch transmits 55 KW of power at 1800 rpm. Coefficient of friction for the friction surfaces is 0.1. Axial intensity at pressure is not to exceed 160

KN/m^2. The internal radius is 80 mm and is 0.7 times the external radius. Find the number of plates needed to transmit the required torque. **(8)**

4. b) A rope drive is required to transmit 230 KW from a pulley of 1m diameter running at 450 rpm. The safe pull in each rope is 800 N and the mass of the rope is 0.4 kg per meter length. The angle of lap and groove angle 160^0 and 45^0 respectively. If coefficient of friction is 0.3, find the number of ropes required. **(8)**

5. The mean diameter of the screw jack having pitch of 10 mm is 50 mm. A load of 20 KN is lifted through a distance of 170 mm. 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 screw. The external and internal diameter of the bearing surface of the loose head is 60 mm and 10mm respectively. The coefficient of friction for the screw as well as the bearing surface may be taken as 0.08.

6. a).A leather belt is required to transmit 7.5 kw from a pulley 1.2 m in diameter, running at 250 rpm. The angle entranced is 165^0 and the coefficient of friction between the belt6 and the pulley is 0.3. If safe working stress for the leather belt is 1.5 MPa, density of leather is 1 kg/ m^3 end thickness of belt is 10 mm. Determine the width of the belt taking C.F tension into account. **(8)**

b).Two pulley one 450 mm diameter and other 200mm dia are on parallel shaft 2.1 m apart and are connected by a cross 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 can be transmitted. **(8)**

7. Two shaft whose centers are 1m apart are connected by a V belt drive. The driving pulley is supplied with 100 KW and has an effective diameter of 300 mm. It runs at 375 rpm. The angle of groove on the pulley is 40^0 The permissible tension in 400 mm^2 cross sectional area of the belt is 2.1 MPa. The density of the belt is 1100 kg/ mm^3 coefficient of friction is 0.28. Estimate number of belts required.

8. The simple band brake system, as shown in fig, is applied to a shaft carrying a flywheel of mass 400kg. The radius of gyration of the fly wheel is 450mm and runs at 300rpm. The coefficient of friction is 0.2. and the brake drum diameter is 240mm. The dimensions 'a' and 'l' are 120mm and 300mm respectively and $\beta = 150^0$. Determine (1) the torque applied due to a hand load of 100N, (2) The number of turns of the wheel before it is brought to rest, and (3) the time required to bring it to rest, from the moment of the application of the brake.

l=300 mm
a=120 mm