

# C. U. SHAH UNIVERSITY

## Summer Examination-2020

**Subject Name: Kinematics of Machines**

**Subject Code: 4TE03KOM1**

**Branch: B.Tech (Mechanical)**

**Semester :3**

**Date: 29/02/2020**

**Time : 02:30 To 05:30**

**Marks : 70**

**Instructions:**

- (1) Use of Programmable calculator & any other electronic instrument is prohibited.
- (2) Instructions written on main answer book are strictly to be obeyed.
- (3) Draw neat diagrams and figures (if necessary) at right places.
- (4) Assume suitable data if needed.

**Q-1**

**Attempt the following questions:**

**(14)**

- (a) In a four bar chain or quadric cycle chain
  - (a) each of the four pairs is a turning pair
  - (b) one is a turning pair and three are sliding pairs
  - (c) three are turning pairs and one is sliding pair
  - (d) each of the four pairs is a sliding pair.
- (b) The Grubler's criterion for determining the degrees of freedom ( $n$ ) of a mechanism having plane motion is
 

(a) $n = (l - 1) - j$	(b) $n = 2(l - 1) - 2$
(c) $n = 3(l - 1) - 2j$	(d) $n = 4(l - 1) - 3j$

Where  $l$  = Number of links, and  $j$  = Number of binary joints.
- (c) Which of the following mechanism is used to enlarge or reduce the size of a drawing?
 

(a) Grasshopper mechanism	(b) Watt mechanism
(c) Pantograph	(d) none of these
- (d) The instantaneous centres which vary with the configuration of the mechanism, are called
  - (a) permanent instantaneous centres
  - (b) fixed instantaneous centres
  - (c) neither fixed nor permanent instantaneous centres
  - (d) none of these
- (e) In the above question, if both the links OA and OB turn in clockwise direction, then the rubbing velocity at the pin joint O is
 

(a) $\omega_1 \cdot \omega_2 \cdot r$	(b) $(\omega_1 - \omega_2) r$	(c) $(\omega_1 + \omega_2) r$	(d) $(\omega_1 - \omega_2) 2 r$
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- (f) The coriolis component of acceleration is taken into account for
 

(a) slider crank mechanism	(b) four bar chain mechanism
(c) quick return motion mechanism	(d) none of these
- (g) The velocity ratio of two pulleys connected by an open belt or crossed belt is
  - (a) directly proportional to their diameters
  - (b) inversely proportional to their diameters
  - (c) directly proportional to the square of their diameters
  - (d) inversely proportional to the square of their diameters



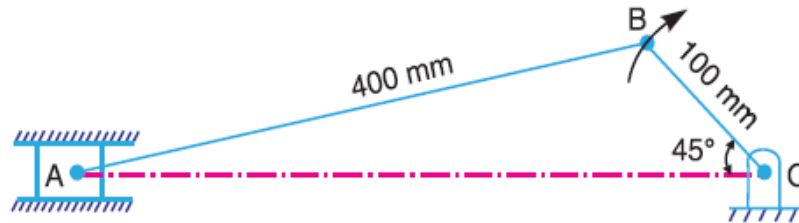
- (h) The centrifugal tension in belts  
 (a) increases power transmitted  
 (b) decreases power transmitted  
 (c) have no effect on the power transmitted  
 (d) increases power transmitted up to a certain speed and then decreases
- (i) The module is the reciprocal of  
 (a) diametral pitch (b) circular pitch (c) pitch diameter (d) none of these
- (j) A differential gear in an automobile is a  
 (a) simple gear train (b) epicyclic gear train  
 (c) compound gear train (d) none of these
- (k) A radial follower is one  
 (a) that reciprocates in the guides (b) that oscillates  
 (c) In which the follower translates along an axis passing through the cam centre of rotation. (d) none of the above
- (l) For a given lift of the follower of a cam follower mechanism, a smaller base circle diameter is desired.  
 (a) Because it will give a steeper cam and higher pressure angle.  
 (b) Because it will give a profile with lower pressure angle  
 (c) Because it will avoid jumping  
 (d) None of the above.
- (m) In a screw jack, the effort required to lift the load  $W$  is given by  
 (a)  $P = W \tan (\alpha - \phi)$  (b)  $P = W \tan (\alpha + \phi)$   
 (c)  $P = W \cos (\alpha - \phi)$  (d)  $P = W \cos (\alpha + \phi)$   
 Where  $\alpha$  = Helix angle, and  $\phi$  = Angle of friction.
- (n) The efficiency of a screw jack is maximum, when (where  $\alpha$  = Helix angle, and  $\phi$  = Angle of friction.)  
 (a)  $\alpha = 45^\circ + \phi/2$  (b)  $\alpha = 45^\circ - \phi/2$  (c)  $\alpha = 90^\circ + \phi$  (d)  $\alpha = 90^\circ - \phi$

Attempt any four questions from Q-2 to Q-8.

Q-2

Attempt all questions

- (a) Explain different kinds of kinematic pairs giving example for each one of them. (07)
- (b) Locate all the instantaneous centres of the slider crank mechanism as shown in Fig. (07)  
 The lengths of crank  $OB$  and connecting rod  $AB$  are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s, find:  
 1. Velocity of the slider  $A$ , and 2. Angular velocity of the connecting rod  $AB$ .



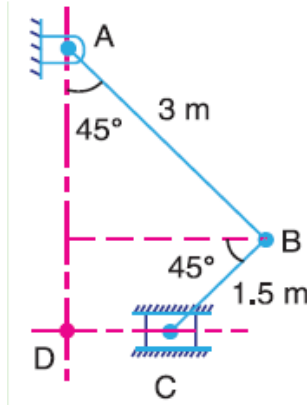
Q-3

Attempt all questions

- (a) Sketch and explain any two inversions of a double slider crank chain. (04)
- (b) In the mechanism shown in Figure, the slider  $C$  is moving to the right with a velocity of 1 m/s and an acceleration of 2.5 m/s. The dimensions of various links are  $AB = 3$  m inclined at  $45^\circ$  with the vertical and  $BC = 1.5$  m inclined at  $45^\circ$  with the horizontal. Determine: 1. The magnitude of vertical and horizontal component of the acceleration (10)



of the point B, and 2. The angular acceleration of the links AB and BC.



**Q-4**

**Attempt all questions**

- (a) Derive an expression for the effort required to raise a load with a screw jack taking friction into consideration. (07)
- (b) Two pulleys, one 450 mm diameter and the other 200 mm diameter are on parallel shafts 1.95 m apart and are connected by a crossed belt. Find the length of the belt required and the angle of contact between the belt and each pulley. What power can be transmitted by the belt when the larger pulley rotates at 200 rev./min, if the maximum permissible tension in the belt is 1 kN, and the coefficient of friction between the belt and pulley is 0.25? (07)

**Q-5**

**Attempt all questions**

- (a) For a flat belt, prove that  $\frac{T_1}{T_2} = e^{\mu\theta}$  (07)  
 Where,  $T_1$  = Tension in the tight side of the belt,  $T_2$  = Tension in the slack side of the belt,  $\mu$  = Coefficient of friction between the belt and the pulley, and  $\theta$  = Angle of contact between the belt and the pulley (in radians.)
- (b) The pitch of 50 mm mean diameter threaded screw of a screw jack is 12.5 mm. The coefficient of friction between the screw and the nut is 0.13. Determine the torque required on the screw to raise a load of 25 kN, assuming the load to rotate with the screw. Determine the ratio of the torque required to raise the load to the torque required to lower the load and also the efficiency of the machine. (07)

**Q-6**

**Attempt all questions**

- (a) Define the following terms as applied to cam with a neat sketch :- (07)  
 (a) Base circle, (b) Pitch circle, (c) Pressure angle, and (d) Stroke of the follower.
- (b) A pinion of 20 involute teeth and 125 mm pitch circle diameter drives a rack. The addendum of both pinion and rack is 6.25 mm. 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. (07)

**Q-7**

**Attempt all questions**

- (a) What do you understand by 'gear train'? Discuss the various types of gear trains. (05)
- (b) A cam, with a minimum radius of 50 mm, rotating clockwise at a uniform speed, is required to give a knife edge follower the motion as described below : (09)  
 1. To move outwards through 40 mm during 100° rotation of the cam  
 2. To dwell for next 80°



3. To return to its starting position during next  $90^\circ$  and

4. To dwell for the rest period of a revolution i.e.  $90^\circ$ .

Draw the profile of the cam when the line of stroke of the follower passes through the centre of the cam shaft. The displacement 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.

**Q-8**

**Attempt all questions**

- (a) What is the condition for correct steering? Sketch and explain Ackermann steering gear mechanism. (07)
- (b) Explain with sketches the different types of cams and followers. (07)

