

# C.U.SHAH UNIVERSITY

## Winter Examination-2015

Subject Name : Kinematics of Machines

Subject Code : 4TE03KOM1

Branch :B.Tech (Mechanical)

Semester :3

Date :05/12/2015

Time :2:30 To 5:30

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.
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Q-1

Attempt the following questions:

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- a) The purpose of a link is to
  - (a) Transmit motion
  - (b) Guide other links
  - (c) Act as a support
  - (d) All of the above
- b) The example of spherical pair is
  - (a) Bolt and nut
  - (b) Lead screw of a lathe
  - (c) Ball and socket joint
  - (d) Ball bearing and roller bearing
- 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 total number of instantaneous centres for a mechanism consisting of n links are
  - (a)  $n/2$
  - (b) n
  - (c)  $(n-1) / 2$
  - (d)  $n(n-1) / 2$
- e) The direction of linear velocity of any point on a link with respect to another point on the same link is
  - (a) parallel to the link joining the points
  - (b) at  $45^\circ$  to the link joining the points
  - (c) perpendicular to the link joining the points
  - (d) none of these
- 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) When two pulleys of different diameters are connected by means of an open belt drive, then the angle of contact taken into consideration should be of the
  - (a) larger pulley
  - (b) smaller pulley
  - (c) average of two pulleys
- h) The centrifugal tension in belts
  - (a) Have no effect on the power transmitted
  - (b) Decreases power transmitted
  - (c) Increases power transmitted
  - (d) Increases power transmitted upto a certain speed and then decreases
- i) The two parallel and coplanar shafts are connected by gears having teeth parallel to the axis of the shaft. This arrangement is called
  - (a) Spur gearing
  - (b) Helical gearing
  - (c) Bevel gearing
  - (d) Spiral gearing
- j) The size of a gear is usually specified by
  - (a) Pressure angle
  - (b) Circular pitch
  - (c) Diametral pitch
  - (d) Pitch circle diameter



- k) Static friction is always \_\_\_\_\_ dynamic friction.  
 (a) equal to (b) less than (c) greater than
- l) 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.
- m) In a radial cam, the follower moves  
 (a) in a direction perpendicular to the cam axis  
 (b) in a direction parallel to the cam axis  
 (c) in any direction irrespective of the cam axis  
 (d) along the cam axis
- n) Pitch point on a cam is  
 (a) any point on pitch curve  
 (b) the point on cam pitch curve having the maximum pressure angle  
 (c) any point on pitch circle  
 (d) the point on cam pitch curve having the minimum pressure angle

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

**Q-2**

**Attempt all questions**

- a) Explain the phenomenon of slip and creep in a belt drive. **04**
- b) What is the condition for correct steering? Sketch and explain Ackermann steering gear mechanism **05**
- c) Draw sketches of any two inversions of double slider crank mechanism and State their applications. **05**

**Q-3**

**Attempt all questions**

- a) Define the following terms. **04**  
 (1) Kinematic Pair (2) Kinematic Chain (3) Lower Pair (4) Higher Pair.
- b) The crank of a slider crank mechanism rotates clockwise at a constant speed of 300r.p.m. The crank is 150 mm and the connecting rod is 600 mm long. **10**  
 Determine:  
 1. Linear velocity and acceleration of the midpoint of the connecting rod,  
 2. Angular velocity and angular acceleration of the connecting rod, at a crank angle of  $45^\circ$  from inner dead centre position.

**Q-4**

**Attempt all questions**

- a) The crank of a reciprocating engine is 15 cm long and length of connecting rod length is 40 cm. The velocity of slider is 6 m/s when crank has turned  $120^\circ$  from IDC. Determine Using Klein's construction method. **07**  
 (i) Acceleration of the slider.  
 (ii) Angular velocity and angular acceleration of the connecting rod
- b) Fig. 1 Show a "toggle mechanism", in which the length of various links are as follows:  $OP = 15$  cm,  $PQ = 30$  cm,  $QR = 22.5$  cm and  $QS = 50$  cm. 'S' is a slider which is constrained to move in a horizontal direction. For the given configuration, Find the velocity of slider 'S' and angular velocity of links QR & QS when the crank OP is rotating uniformly with a speed of 240 rpm in counter- clockwise direction by instantaneous centre method. **07**



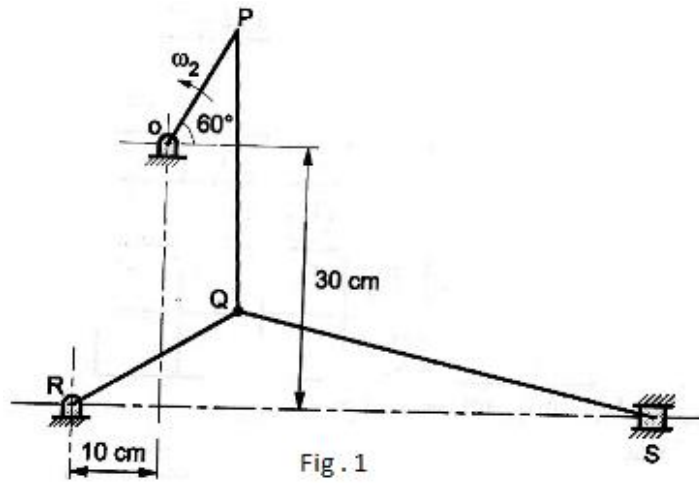


Fig . 1

Q-5

**Attempt all questions**

- Discuss relative merits and demerits of belt drive over chain drive. **04**
- Explain with sketches the different types of cams and followers. **05**
- An open belt drive is used to transmit 2.5 KW power. The belt is running at 2.5 m/sec velocity over the pulleys. The angle of contact being  $165^\circ$  and co-efficient of friction being 0.3 what will be the effect on power transmission if the initial tension in belt is increased by 8%. **05**

Q-6

**Attempt all questions**

- What do you understand by ‘gear train’? Discuss the compound gear trains. **04**
- State the law of correct gearing and give its proof. **05**
- What is the smallest number of teeth theoretically required in order to avoid interference on a pinion having pressure angle  $22^\circ$  and module 1 which is to gear with i) Rack ii) an equal pinion iii) a wheel to give a ratio of 3:1. **05**

Q-7

**Attempt all questions**

- Define the equation of efficiency of inclined plane theory considering motion of body upward. **07**
- Find the force required to be applied at the end of 500 mm long lever of screw jack. The threads are single start square with 12 mm pitch and 65 mm mean diameter. The load does not rotate with screw spindle. The COP for threads is 0.15 and for collar it is 0.12 which is having 40 mm mean radius. Also find the efficiency of the screw jack if the load to be lifted is 8 KN. **07**

Q-8

**Attempt all questions**

- Derive expression for length of belt for Open belt drive **05**
- Determine a cam for operating the exhaust valve of an oil engine. It is required to give simple harmonic motion during opening and closing of the valve each of which corresponds to  $60^\circ$  of cam rotation. The valve must remain in the fully open position for  $30^\circ$  of cam rotation. The lift of the valve is 40 mm and the least radius of the cam is 40 mm. The follower is provided with a roller of radius 15 mm and its line of stroke passes through the axis of cam. Find out the maximum value of velocity and acceleration of follower if the cam rotates at 120 rpm. **09**

