

4E2053

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B.Tech. (Sem.IV) (Main/Back) Examination, June -2013  
Mechanical Engineering  
Kinematics of Machines

[Time : 3 Hours]

[Total Marks : 80]

[Min. Passing Marks : 24]

Instructions to Candidates :

Attempt any five questions, selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/ calculated must be stated clearly.

Unit - I

1. (a) What do you mean by inversion of mechanism? Describe with the help of suitable sketches the inversion of a slider crank chain. [6]
- (b) The link AB of a four bar mechanism, as shown in fig., revolves uniformly at 120 rpm in clockwise direction. Find the angular acceleration of link BC and CD. The dimensions of various links are as given below:  
AB = 50 mm; BC = 100 mm; CD = 90 mm; AD = 65 mm and  $\angle DAB = 60^\circ$

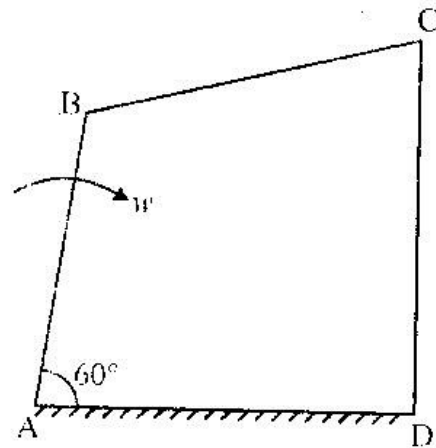
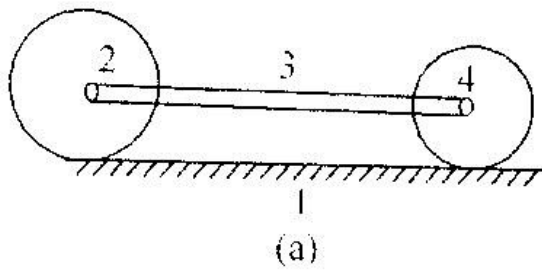


Fig.

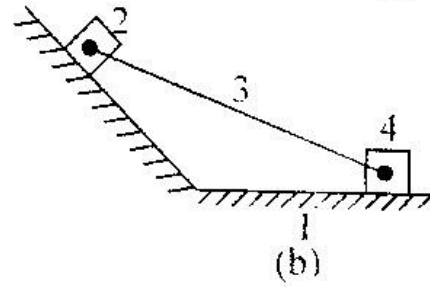
[10]

OR

- (a) State and prove the Arnold Kennedy theorem. Locate the instantaneous centres of following mechanisms.



(a)



(b)

Fig.

[4+4]

- (b) What are straight line mechanisms? With neat sketch, explain the working principles of Scott-Russel mechanism. [8]

[8]

Unit-II

- (a) Sketch and describe the Ackermann steering mechanism. Discuss its advantages with respect to Davis mechanism. [8]
- (b) Describe the working of Hooke's joint. Also show for a Hooke's joint that  
 $\tan \theta = \tan \phi \cos \alpha$   
Where the angle  $\theta$ ,  $\phi$  and  $\alpha$  have their usual meanings. [8]

[8]

OR

- (a) An open belt running over two pulleys of diameter 200mm and 600 mm connects two parallel shafts placed at a

distance of 3m. The smaller pulley rotates at 360 rpm and transmits 8 kW. The coefficient of friction between the belt and pulley is 0.3.

Determine :

(i) Length of belt

(ii) Initial tension

(iii) Minimum width of belt if the safe working tension is 15N/mm width.

[8]

(b) Discuss with justification, the effect of the following conditions on the power transmission capacity of the belt:

(i) Increase the initial tension by 15%

(ii) Increase the coefficient of friction by 15%

(iii) Increase the angle of contact by 15%.

[8]

### Unit-III

3. (a) Define the following terms :

(i) Coefficient of friction

(ii) Limiting friction

(iii) Angle of friction

(iv) Angle of Repose.

[4]

(b) Neglecting collar friction, prove that for maximum efficiency of square threaded screw jack, the helix angle  $\alpha$  is

given by 
$$\alpha = \frac{\pi}{4} - \frac{\phi}{2}$$

[4]

(c) In a flat collar thrust bearing the inner and outer radii are 120mm and 80mm respectively. The total axial thrust is 50kN and intensity of pressure is 0.3 MPa. If the coefficient of friction is 0.05 and shaft rotates at 500 rpm, determine the power lost in over coming the friction. Also determine the number of collars required to withstand the axial thrust.

[8]

OR

3. (a) What do you mean by friction axis of a link. For a link having pin joints at its ends, there are four axis. Explain, how the right friction axis out of four can be determined.

[6]

(b) A cone clutch with semi-cone angle  $12.5^\circ$  transmits 15 kW at 500 rpm. The width of the cone friction surface is 40 percent of mean diameter. If the normal pressure between the surfaces in contact is not to exceed  $120\text{kN/m}^2$ . Determine :

(i) The outer and inner radii of the cone

(ii) The axial force required to engage the clutch.

[10]

### Unit-IV

4. (a) For a block brake as shown in fig., the diameter of brake drum is 500 mm and angle of contact is  $35^\circ$ . The effort applied at the free end of lever is 3kN and coefficient of friction is 0.25. Determine the maximum braking torque for the following cases :

(i) When drum rotates in clockwise direction.

(ii) When drum rotates in counter clockwise direction. Also determine the dimension C for self locking conditions.

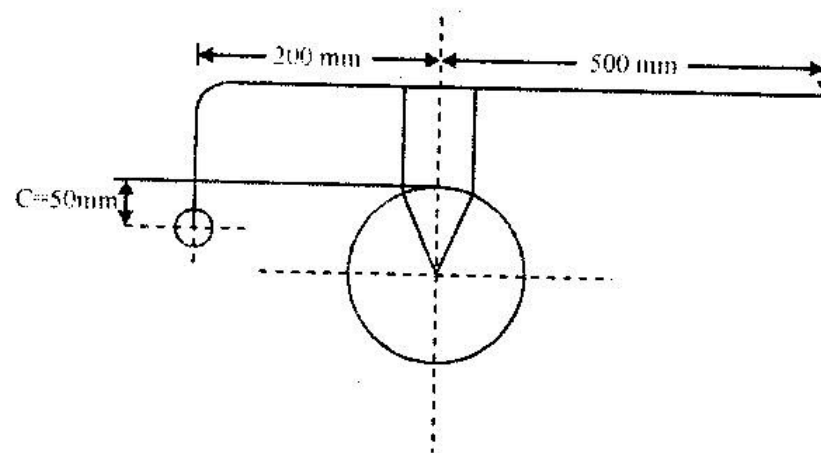


Fig.

(b) (i) What do you mean by a self-energizing brake and self-locking brake? Explain.

[8]

(ii) What is difference between simple band brake and differential band brake? Which is more suitable for large torque capacity?

[4+4]

**OR**

4. (a) Derive the expression (s) of retardation when brakes are applied to the front wheel of an automobile and  
(i) Vehicle moves up on inclined plane  
(ii) Vehicle moves on level road. [8]
- (b) What do you mean by dynamometer. How are dynamometers classified. Explain with neat sketch the working principle of Belt transmission dynamometer. [8]

**Unit-V**

5. A cam with 30 mm minimum radius is rotating clockwise at 1200 rpm to give the follower motion to a roller follower of 20 mm diameter.  
(i) Lift = 25 mm (ii) Follower offset = 10 mm  
(iii) Follower rise during 120° cam rotation with SHM (iv) Follower to dwell for next 60° cam rotation  
(v) Follower to return during 120° cam rotation with uniform velocity.  
(vi) Follower to dwell for remaining period.  
Draw the profile of the cam for above conditions. [16]

**OR**

5. In a symmetrical tangent cam operating a roller follower, the least radius of the cam is 30 mm and roller radius is 15 mm. the angle of ascent is 75° and total lift is 20mm. The speed of the cam is 600 rpm. Calculate :  
(i) Principal dimensions of the cam  
(ii) The acceleration of the follower at beginning of lift where straight flank merges into the circular nose and at the apex of the nose. [16]