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L 1479

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Third Semester

Mechanical Engineering

ME 232 — KINEMATICS OF MACHINES

(Common to Mechatronics Engineering)

Time : Three hours

Maximum : 100 marks

A3-size drawing sheet is to be provided.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is Kutzbach criterion for planar mechanism?
2. Sketch an exact straight line mechanism, with link proportions.
3. Illustrate the instantaneous centers of a typical four bar mechanism.
4. State the condition for a link to experience coriolis acceleration.
5. What are the advantages of roller follower than knife-edge follower?
6. Sketch the displacement, velocity and acceleration diagram when a follower moves with uniform velocity.
7. Prove or disprove that pure rolling is possible at one point only, on the line of action, between two meshing gear teeth profiles.
8. Distinguish, with suitable free hand sketches, a non-reverted gear train and a reverted gear train.
9. Prove or disprove that the efficiency of a screw jack is independent of the load raised.
10. State the condition and the equation for the velocity of the belt for the transmission of power in a flat belt drive.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain the inversions of four bar chain, with neat sketches. (8)
- (ii) Explain with neat sketches the following : (8)
- (1) Offset slider mechanism.
- (2) An indexing mechanism.

Or

- (b) (i) Explain the inversions of single slider crank chains, with neat sketches. (10)
- (ii) Explain mechanical advantage and transmission angle related to Four- bar mechanisms. (6)
12. (a) In the mechanism shown in Fig. 12(a) the crank OA rotates at a constant speed equal to 20 rpm anticlockwise and gives motion to the sliding blocks B and D. The dimensions of various links are OA = 300 mm; AB = 1200 mm; BC = 450 mm and CD = 450 mm.

For the given configuration, determine :

- (i) Velocities of sliders B and D
- (ii) Angular velocity of link CD
- (iii) Linear acceleration of D and
- (iv) Angular acceleration of CD

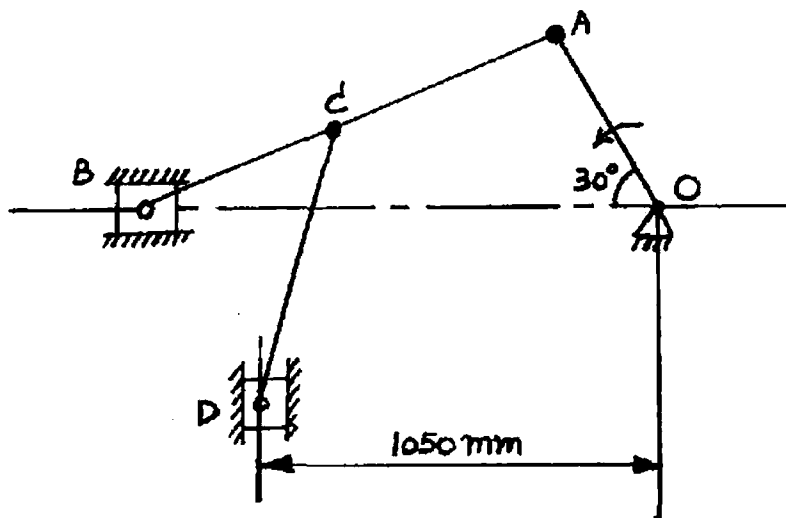


Fig. 12(a)

Or

- (b) For the Four-bar linkage shown in Fig. 12(b) find the acceleration of A and B and the angular acceleration of links 3 and 4, Crank 2 has a constant angular velocity, $\omega_2 = 200$ rad/s counter clockwise direction.

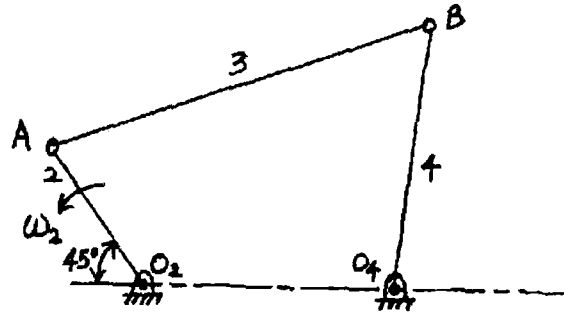


Fig. 12(b)

The linkage $AO_2 = 150$ mm; $BA = 450$ mm, $BO_4 = 300$ mm, $O_4O_2 = 200$ mm.

13. (a) The following data are for a disc cam mechanism with roller follower :

Minimum radius of the cam = 35 mm, lift of the follower = 40 mm

Offset of the follower = 10 mm right, Roller diameter = 15 mm

Cam rotation angles are as mentioned below :

During ascent = 120° , Dwell = 80°

During descent = 80° , Dwell = 80°

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.
- (ii) Draw the cam profile and indicate the relevant data.

Or

- (b) Draw the profile of the cam when the roller follower moves with cycloidal motion as given below :

- (i) Outstroke with maximum displacement of 44 mm during 180° of cam rotation
- (ii) Return stroke for the next 150° of cam rotation.
- (iii) Dwell for the remaining 30° of cam rotation.

The minimum radius of the cam is 20 mm and the diameter of the roller is 10 mm. The axis of the roller follower passes through the cam shaft axis.

14. (a) (i) State the advantages of spur gear over helical gear. (3)
- (ii) Which type of gear pair is to be used to get very large speed reduction in a single stage? State the reason. (3)
- (iii) State and prove the fundamental law of gearing. (7)
- (iv) Determine the minimum number of teeth to avoid interference in worst case of meshing with $14\frac{1}{2}^\circ$ pressure angle. (3)

Or

- (b) Two mating gears have 20 and 40 involute teeth of module 10 mm and 20° 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 the maximum possible length. Determine the addendum height for each gear wheel, length of the path of contact, arc of contact and contact ratio.
15. (a) A screw-jack has a square thread of mean diameter 60 mm and pitch 8 mm. The co-efficient of friction at the screw thread is 0.09. A load of 3 kN is to be lifted through 120 mm. Determine the torque required and the work done in lifting the load through 120 mm. Find the efficiency of the jack also.

Or

- (b) (i) Prove or disprove the following statement : "AV-belt drive with same Co-efficient of friction and angle of wrap as a flat-belt drive will transmit less power than flat-belt drive". (6)
- (ii) Two pulleys, one 450 mm diameter and the other 200 mm diameter are on Parallel shafts 2.1 m 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. (10)