Reg. No. :

Question Paper Code : 91838

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Third/Fourth Semester

Mechanical Engineering

ME 6401 – KINEMATICS OF MACHINERY

(Common to Mechanical Engineering (Sandwich)/Mechatronics Engineering)

(Regulations 2013)

(Also Common to PTME 6401 – Kinematics of Machinery for B.E. (Part-Time)
– Third Semester – Mechanical Engineering (Regulations 2014)

Time : Three Hours   Maximum : 100 Marks

Answer ALL questions.

PART – A   (10×2=20 Marks)

1. State Grubler's criteria for a mechanism.

2. Name any two inversions of the single slider-crank mechanism.

3. Write the relation between the number of instantaneous centres and the number of links in a mechanism.

4. Depict all the possible directions of Coriolis component of acceleration that arise in a quick return motion mechanism.

5. Define trace point of a cam.

6. What is Undercutting in cams ?

7. State Law of Gearing.

8. What type of gear arrangement is used to traverse the carriage in lathe machine ?

9. Differentiate Self-energizing and self-locking brakes.

10. State the limitations of V-belt drive over flat belt drive.

PART – B   (5×13=65 Marks)

11. a) What do you understand by the terminology inversion of a kinematic chain ? Describe the mechanisms obtained by inversion of the four-bar chain.

(OR)

    b) Sketch and describe the working of two different types of quick return mechanisms. Give examples of their applications. Derive an expression for the ratio of times taken in forward and return stroke for one of these mechanisms.

12. a) The diagram shows part of a quick return mechanism. The pin A slides in the slot when the disc is rotated. Calculate the angular velocity and acceleration of link BC when θ = 60° and ω = 100 rad/s.
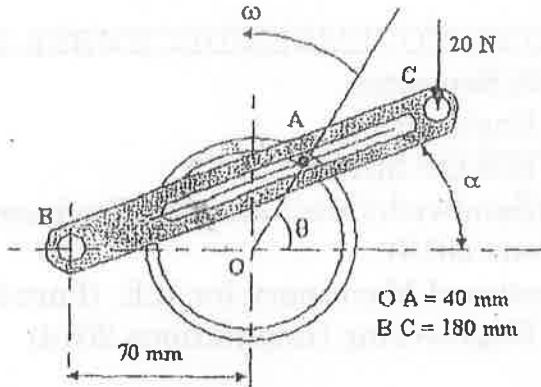

O A = 40 mm
B C = 180 mm
70 mm

Fig. 12 (a)

(OR)

b) Derive the expression for Coriolis component of acceleration with neat sketch and give its direction for various conditions.

13. a) Draw the profile of a cam operating a knife-edge follower when the axis of the follower passes through the axis of cam shaft from the following data :

   i) Follower to move outwards through 40 mm during 60° of cam rotation.

   ii) Follower to dwell for the next 45°.

   iii) Follower to return to its original position during next 90°.

   iv) Follower to dwell for the rest of the 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 cam is 50 mm.

(OR)

b) Draw the profile of a cam operating a knife-edge follower (when the axis of the follower passes through the axis of cam shaft) from the following data :

   i) Follower to move outward through 30 mm with Simple Harmonic motion during 120° of cam rotation.

   ii) Follower to dwell for the next 60°.

   iii) Follower to return to its original position with uniform velocity during 90° of cam rotation.

   iv) Follower to dwell for the rest of the cam rotation. The least radius of cam is 20 mm and the cam rotates at 240 rpm.

14. a) The following data relate to a pair of 20° involute gears in mesh :
    Module = 6 mm, Number of teeth on pinion = 17, Number of teeth on gear = 49; Addenda on pinion and gear wheel = 1 module.
    Find : (i) The number of pairs of teeth in contact (ii) The angle turned through by the pinion and the gear wheel when one pair of teeth is in contact and (iii) The ratio of sliding to rolling motion when the tip of a tooth on the larger wheel (1) is just making contact, (2) is just leaving contact with its mating tooth and (3) is at the pitch point.

    (OR)

   b) An epicyclic gear consists of three gears A, B and C as shown in Fig. 14 (b). The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 rpm. If the gear A is fixed, determine the speed of gears B and C.
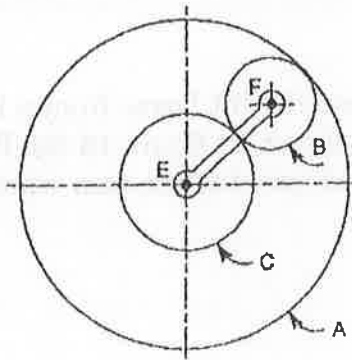

Fig. 14 (b)

15. a) 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 the screw. The external and internal diameters of the bearing surface of the loose head are 60 mm and 10 mm respectively. The coefficient of friction for the screw as well as the bearing surface may be taken as 0.08.

    (OR)

   b) A leather faced conical clutch has a cone angle of 30°. If the intensity of pressure between the contact surfaces is limited to 0.35 N/mm^2 and the breadth of the conical surface is not to exceed of one-third of the mean radius. Determine the dimensions of the contact surfaces to transmit 22.5 kW at 2000 rpm. Assume uniform wear rate and take coefficient of friction as 0.15.

PART – C   (1×15=15 Marks)

16. a) Figure 16 (a) shows a mechanical press used to exert large forces to insert a small part into a larger one. Draw a kinematic diagram, using the end of the handle as a point of interest. Also compute the degrees of freedom.
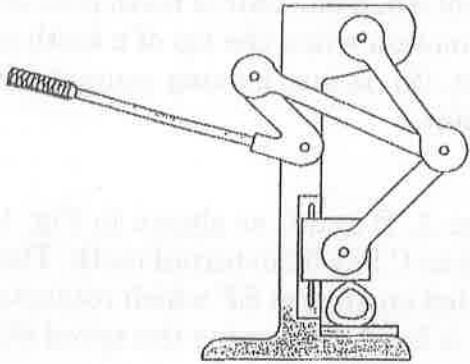

Fig. 16 (a)

(OR)

b) A cam is to be used for a platform that will repeatedly lift boxes from a lower conveyor to an upper conveyor. This machine is shown in figure 16 (b). Plot a displacement diagram and determine the required speed of the cam when the follower motion sequence is as follows :

   i) Rise 40 mm in 1.2 s.
   ii) Dwell for 0.3 s.
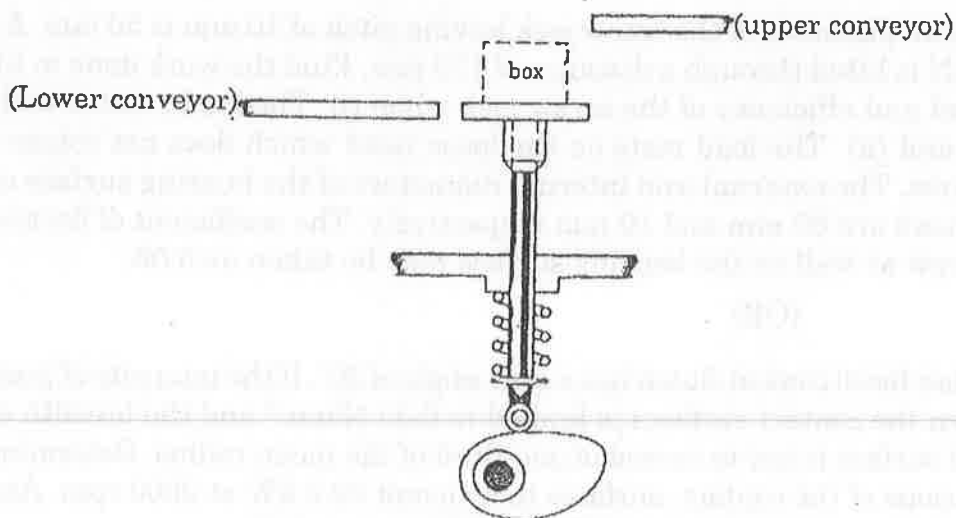   iii) Fall 20 mm in 0.9 s.
   iv) Dwell 0.6 s.
   v) Fall 20 mm in 0.9 s.

Fig. 16 (b)