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**Question Paper Code : 80912**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Third / Fourth Semester

Mechanical Engineering

ME 8492 — KINEMATICS OF MACHINERY

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

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Distinguish between machine and mechanism.
2. For the four-bar mechanism shown in Figure 1, check whether it satisfy the Gruebler's criteria or not.

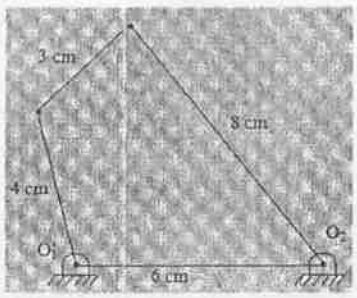


Figure 1

3. Define rubbing velocity associated with a pin joint.
4. For the slider-crank mechanism shown in Figure 2, draw the schematic velocity diagram when $\theta_2 = 90^\circ$.

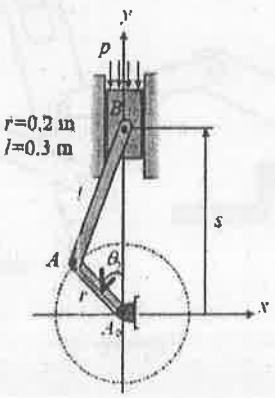


Figure 2

5. State any two practical applications of cam-follower mechanism.

6. Write the situations under which undercutting of a cam-follower mechanism will occur.

7. State the law of gearing.

8. Write the reason for axial thrust associated with the helical gears.

9. Why the belt and rope drives are also called as "friction drives"?

10. Distinguish between a brake and clutch.

PART B — (5 × 13 = 65 marks)

11. (a) Define kinematic inversion of a mechanism. Discuss the inversions of a double slider crank mechanism using practical examples with suitable sketches.

Or

(b) (i) For the four-bar mechanism shown in Figure 3, determine the maximum and minimum transmission angles. (8)

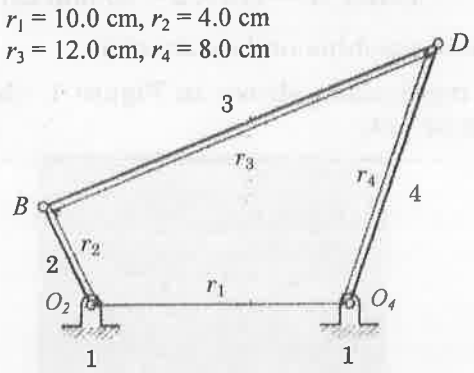


Figure 3

(ii) For the mechanism shown in Figure 4, calculate the degrees of freedom. (5)

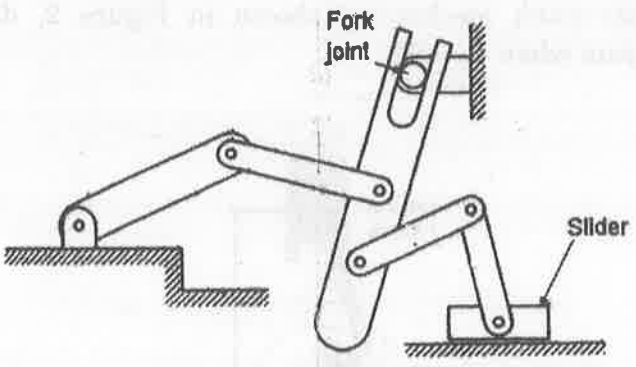


Figure 4

12. (a) For the mechanism shown in Figure 5, OA = 300 mm, AB = 600 mm, AC = BD = 1200 mm. OD is horizontal for the given configuration. If OA rotates at 200 rpm in the clockwise direction, find

(i) linear velocities of C and D (7)

(ii) angular velocities of links AC and BD. (6)

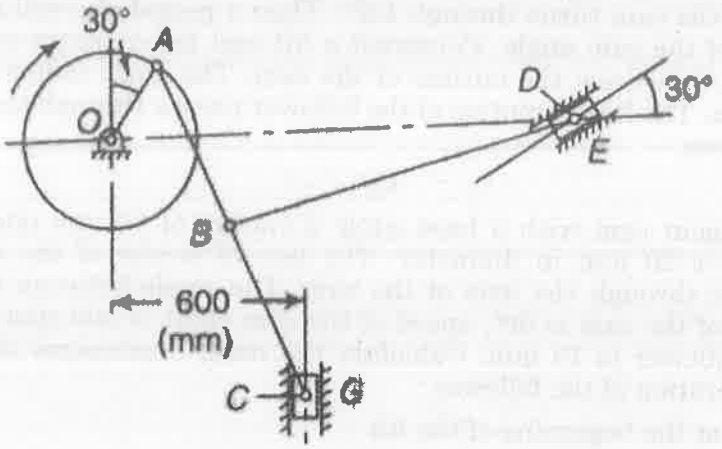


Figure 5

Or

(b) In a four-bar mechanism shown in Figure 6, AB = 5 cm, AD = 4 cm and DC = 2 cm. In the configuration shown, both AB and DC are perpendicular to AD. The bar AB rotates with an angular velocity of 10 rad/sec. Find the linear acceleration of B and C, angular velocities and accelerations of links BC and CD at the given instant.

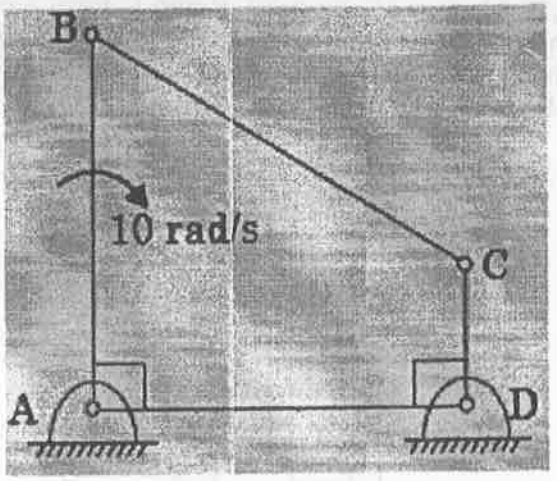


Figure 6

13. (a) A cam is required to give motion to a follower fitted with a roller that is 50 mm in diameter. The lift of the follower is 30 mm and is performed as,

- with uniform acceleration for 12 mm, the cam turns through 45°
- with uniform velocity for 12 mm, the cam turns through the next 30°
- with uniform deceleration for the remainder of the lift, the cam turns through the next 45°

The follower falls through immediately with simple harmonic motion while the cam turns through 120°. Then a period of dwell is followed for 120° of the cam angle. Construct a lift and fall diagram on a cam angle base. Also, draw the outline of the cam. The least radius of the cam is 35 mm. The line of motion of the follower passes through the center of the cam axis.

Or

(b) A tangent cam with a base circle diameter of 50 mm operates a roller follower 20 mm in diameter. The line of stroke of the roller follower passes through the axis of the cam. The angle between the tangential faces of the cam is 60°, speed of the cam shaft is 200 rpm and the lift of the follower is 15 mm. Calculate the main dimensions of the cam and acceleration of the follower :

(i) at the beginning of the lift (5)

(ii) where the roller just touches the nose (4)

(iii) the apex of the circular nose. (4)

14. (a) Two 20° involute spur gears mesh externally and give a velocity ratio of 3. The module is 3 mm and the addendum is equal to 1.1 module. If the pinion rotates at 120 rpm, determine

(i) the minimum number of teeth on each wheel to avoid interference, (7)

(ii) contact ratio. (6)

Or

(b) The number of teeth in the gear shown in Figure 7 are as follows : $T_S = 18$, $T_P = 24$, $T_C = 12$, $T_A = 72$. P and C form a compound gear carried by the arm "a" and the annular gear A is held stationary. Determine the speed of the output at "a". Also find the holding torque required on A if 5 kW is delivered to S at 800 rpm with an efficiency of 94%.

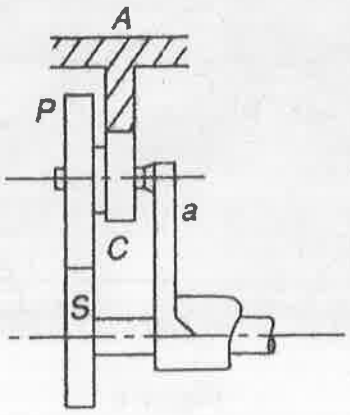


Figure 7

15. (a) The following data relate to a screw jack: Pitch of the threaded screw = 8 mm, diameter of the threaded screw = 40 mm, Co-efficient of friction between the screw and nut = 0.1 and Load = 40 kN. Assuming that the load rotates with the screw, determine the

(i) ratio of torques required to raise and lower the load (6)

(ii) efficiency of the machine. (7)

Or

(b) A single plate clutch is required to transmit 8 kW at 1000 rpm. The axial pressure is limited to 70 kN/m$^2$. The mean radius of the plate is 4.5 times the radial width of the friction surface. If both the sides of the plate are effective and the coefficient of friction is 0.25, find the

(i) inner and outer radii of the plate and the mean radius (8)

(ii) width of the friction lining. (5)

PART C — (1 × 15 = 15 marks)

16. (a) The mechanism shown in Figure 8 has been taken from a feed device for an automated ball bearing assembly machine. An electric motor is attached to link A as shown. Carefully examine the configuration of the components in the mechanism. Then answer the following leading questions to gain insight into the operation of the mechanism.

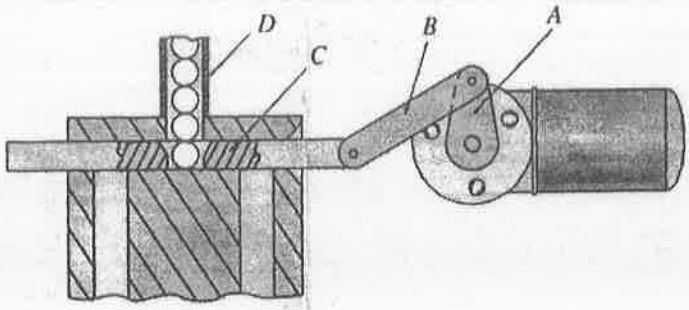


Figure 8

(i) As link A rotates clockwise 90°, what will happen to slide C? (2)

(ii) What happens to the ball trapped in slide C when it is at this position? (3)

(iii) As link A continues another 90° clockwise, what action occurs? (2)

(iv) What is the purpose of this device? (3)

(v) Why are there chamfers at the entry of slide C? (2)

(vi) Why do you suppose there is a need for such a device? (3)

Or

(b) The mechanism shown in Figure 9 is used to pull movie film through a projector. The mechanism is driven by the drive wheel rotating at a constant speed of 560 rpm. At the instant shown, graphically determine the linear velocity of the point of the claw which engages the film and angular velocity of the claw.

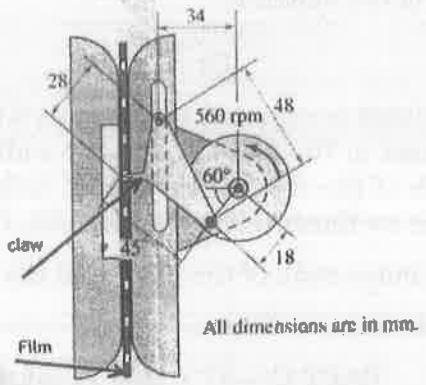


Figure 9