

- Note:** This question paper contains two parts A and B.  
 Part A is compulsory which carries 25 marks. Answer all questions in Part A.  
 Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub-questions.  
 Illustrate your answers with NEAT sketches wherever necessary.

## PART-A

(25 Marks)

- 1.a) What is the difference between Mechanism and Structure? [2M]  
 b) Why is the Whitworth mechanism termed as quick-return mechanism? Explain. [3M]  
 c) A single slider crank chain mechanism with additional construction is shown in Figure 1. If  $\omega$  is the angular speed of the crank OC, write the velocities of the crank in terms of  $\omega$ . [2M]

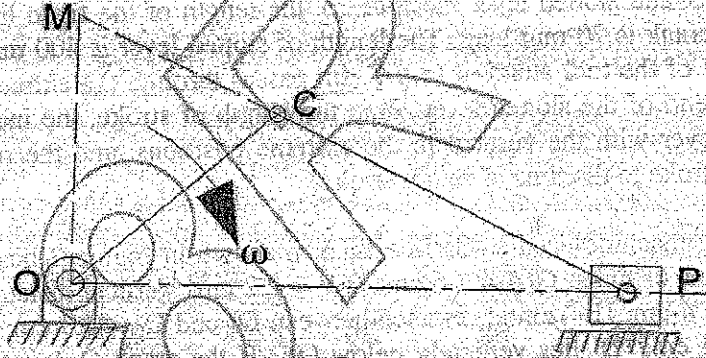


Figure: 1

- d) Explain the concept of *instantaneous centre of rotation* of a body. [3M]  
 e) Compare and contrast the merits and limitations of Peaucillier and Hart mechanisms. [2M]  
 f) Even though the Ackerman's steering gear does not satisfy the condition for correct steering for all the positions, it is preferred to Davis steering gear. How? [3M]  
 g) For a given rotational speed of a cam, how do you calculate the maximum velocity and maximum acceleration of the follower during outward stroke for SHM of the follower? [2M]  
 h) What are the different types of cams? Explain any three with relevant sketches. [3M]  
 i) What is 'Interference' in involute gears? Why is it to be avoided? [2M]  
 j) What is a 'Differential gear', where is it used in automobiles, and why? [3M]

PART-B

(50 Marks)

2.a) Determine the degrees of freedom of the mechanisms shown in Figure.2.

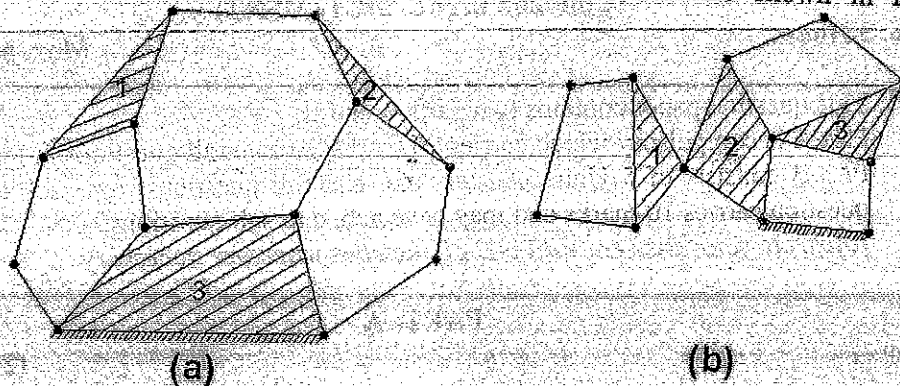


Figure: 2

b) Sketch and explain the inversions of Crank-Rocker mechanism and Double-Rocker mechanism. [5+5]

OR

3.a) Distinguish between rigid link, flexible link, and fluid link. Give one example for each.

b) In a crank and slotted lever mechanism, the length of the fixed link is 225 mm, and the crank is 70 mm long. The length of slotted lever is 400 mm, and the line of stroke of the tool attached to the ram passes through the extreme positions of the free end of the slotted lever. Find the length of stroke, the inclination of the cutting stroke to the vertical in the extreme positions, and the ratio of time of cutting stroke to the time of return stroke. [4+6]

4. A sewing machine needle-bar mechanism shown in Figure 3 has the following dimensions of links:  $O_1A = 1.6$  cm;  $O_2B = 2.2$  cm; Vertical distance between  $O_1$  and  $O_2 = 4$  cm; Horizontal distance between  $O_1$  and  $O_2 = 1.3$  cm;  $AB = 3.5$  cm;  $BC = 1.6$  cm; 'D' lies vertically below  $O_1$ . If the crank  $O_1A$  rotates clockwise uniformly at 150 rpm, find the velocity of the needle at the point 'D'. Use the Instantaneous Centre method. [10]

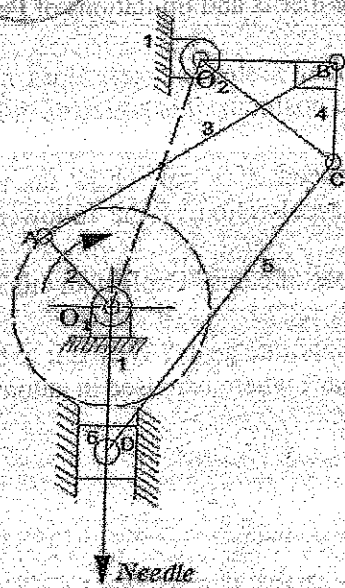


Figure: 3  
OR

5. The oscillating link OAB of a mechanism shown in Figure 4 is pivoted at O, and is rotating at 90 rpm ccw. OA = 15 cm; AB = 7.5 cm; AC = 25 cm; OQ = 20 cm. Find the velocity and acceleration of the slider C. [10]

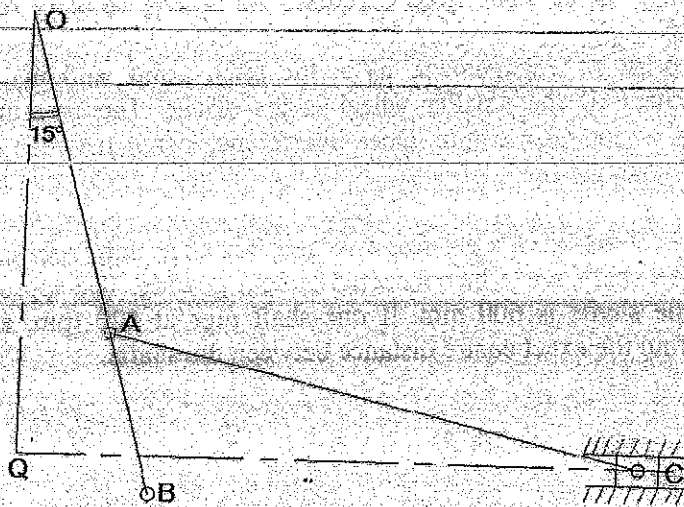


Figure: 4

- 6.a) With the help of a neat sketch, show how the Peaucellier mechanism can be used to generate exact straight line motion.  
 b) Explain why two Hooke's joints are used to transmit motion from the engine to the differential of an automobile. [6+4]
- OR
- 7.a) Derive the condition for correct steering. Further, compare the merits and limitations of the Davis steering gear and Ackermann steering gear.  
 b) Sketch and explain how the location of the tracing point in Grass-hopper mechanism (which generates an approximate straight line motion) can be determined. [5+5]
8. The following particulars relate to asymmetrical tangent cam operating a roller follower: Least radius of cam = 30 mm; Nose radius = 24 mm; Roller radius = 17.5 mm; Distance between the cam shaft centre and nose centre = 23.5 mm; Angle of action of cam =  $150^\circ$ ; Cam shaft speed = 600 rpm. Assuming that there is no dwell between ascent and descent of the follower, determine the lift of the valve and the velocity of the follower at a point where the straight flank merges into the circular nose. [10]
- OR
- 9.a) Cams are manufactured *either* with a particular profile to suit the motion of follower *or* with certain special (standard) profile. Compare the advantages and disadvantages in both the methods.  
 b) A follower moves up 4 cm with SHM corresponding to  $150^\circ$  of cam rotation angle during the outward stroke, dwells for the next  $30^\circ$  of cam rotation angle, and returns to the original position during the next  $120^\circ$  of cam rotation angle with uniform acceleration and retardation, and dwells for the remaining period of cam rotation. However, the uniform acceleration and retardation during the return stroke are not equal, the acceleration being twice the retardation. Draw the displacement vs cam angle rotation diagram for the total follower movement, and find the maximum velocity and maximum acceleration of the follower, if the cam rotates at a uniform speed of 300 rpm. [4+6]

- 10.a) Explain the following *w.r.t.* gears: Interference, Undercutting, Pressure angle.
- b) A pair of involute spur gears having 20 and 40 teeth are in mesh, the speed of smaller wheel being 2000 rpm. Calculate the sliding velocity between the gear teeth faces:
- i) at the point of engagement, ii) at the pitch point, and iii) at the point of disengagement, if the smaller wheel is the driver. The pressure angle =  $20^\circ$ , addendum = module = 5 mm. Does interference occur between the gears? Give reason for your answer. [5+5]

OR

- 11.a) Describe the function of a pre-selective gear box of an automobile.
- b) Two parallel shafts are to be connected by spur gearing. The approximate distance between the shafts is 600 mm. If one shaft runs at 120 rpm, and the other at 360 rpm, find the exact centre distance between the shafts. [6+4]

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