

## Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025 Kinematics of Machines

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. With the help of a neat sketch explain :
  - i) Geneva wheel mechanism and
  - ii) Ratchet and Pawl mechanism

(12 Marks)
- b. Calculate the degrees of freedom for the following [Refer Fig.Q1(b)(i) and Fig.Q1(b)(ii)]:

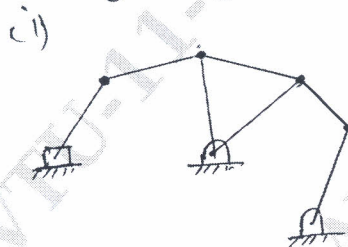


Fig.Q1(b)(i)

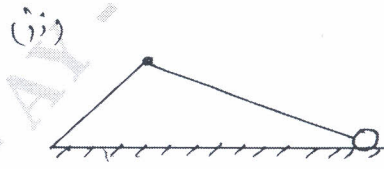


Fig.Q1(b)(ii)

(08 Marks)

OR

- 2 a. With a neat sketch explain :
  - (i) Robert's mechanism
  - (ii) Peaucellier's mechanism

(10 Marks)
- b. Explain with neat sketch the concept of Pantograph and also derive the same. (10 Marks)

### Module-2

- 3 A four bar mechanism ABCD is made up of four links, pin joined at ends. AD is a fixed link which is 180 mm long. The links AB, BC and CD are 90 mm, 120 mm and 120 mm long respectively. At certain instant, the link AB makes an angle of  $60^\circ$  with the link AD, if the link AB rotates at uniform speed of 100 rpm clockwise. Determine
  - (i) Angular velocity of the links BC and CD and
  - (ii) Angular acceleration of the link CD and CB.

(20 Marks)

OR

- 4 In a slider crank mechanism, the crank OB = 30 mm and the connecting rod BC = 120 mm. The crank rotates at a uniform speed of 300 rpm clockwise. For the crank position shown in Fig.Q4, in which the crank is turned  $60^\circ$ , find (i) velocity of piston C and angular velocity of connecting rod BC (ii) Acceleration of piston C and angular acceleration of connecting rod BC.

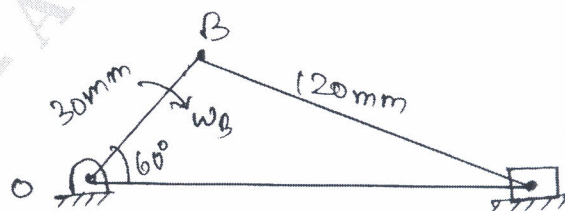


Fig.Q4

(20 Marks)

**Module-3**

- 5 a. Derive an expression for slider crank mechanism using Klein's construction. (10 Marks)  
 b. Describe with a neat sketch Kennedy's theorem. (10 Marks)

**OR**

- 6 In a reciprocating engine the length of crank is 25 cm and length of connected rod is 100 cm. The crank rotates at an uniform speed of 300 rpm. By Klein's construction determine  
 (i) Velocity and acceleration of piston (ii) Angular velocity and angular acceleration of connecting rod (iii) Velocity and acceleration of a point on the connecting rod is 40 cm from crank end, when the crank is  $30^\circ$  from inner dead center. (20 Marks)

**Module-4**

- 7 a. Derive an expression for length of arc of contact, length of path of contact and contact ratio. (10 Marks)  
 b. Two equal spur gears of 48 teeth mesh together with pitch radii of 100 mm and the addendums are 4.25 mm. If the pressure angle is  $20^\circ$ . Calculate the length of action and contact ratio. (10 Marks)

**OR**

- 8 In an epicyclic gear train, internal wheel A, F and the compound wheel C, D rotate about the axis 'O'. The wheels B and E rotate on a pin fixed to the arm L. The wheels have same pitch and the number of teeth on B and E are 18, C = 28, D = 26. If the arm L makes 150 rpm clockwise. Find the speed of F when (i) Wheel A is fixed and (ii) Wheel A makes 15 rpm clockwise. (20 Marks)

**Module-5**

- 9 A cam rotating clockwise at uniform speed of 300 rpm operates a reciprocating follower through a roller 2.0 cm in diameter. The follower motion is defined as follows : (i) Outward during  $150^\circ$  with UARM (ii) Dwell for next  $30^\circ$  (iii) Return during next  $120^\circ$  with SHM (iv) Dwell for the remaining period. Stroke of the follower is 3 cm. Minimum radius of the cam is 3 cm. Draw the cam profile  
 (a) Follower axis passes through cam axis  
 (b) Follower axis is offset to the right by 1 cm. (20 Marks)

**OR**

- 10 A cam with 3 cm as minimum radius is rotating clockwise at a uniform speed of 1200 rpm and has to give the motion to the knife edge follower as follows :  
 (i) Follower to move outward through 3 cm during  $120^\circ$  of cam rotation with SHM  
 (ii) Dwell for the next  $60^\circ$ .  
 (iii) Follower to return to its starting position during the next  $90^\circ$  with UARM.  
 (iv) Dwell for the remaining period.  
 Draw the cam profile  
 (a) Follower axis is offset to the left by 1 cm.  
 (b) Follower axis passes through cam axis.  
 Also find the maximum velocity and acceleration during outward and inward or return stroke. (20 Marks)

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