

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023 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. Define kinematic chain, kinematic pair, mechanism inversion, structure, machine. (06 Marks)
- b. With neat sketch, explain crank and slotted lever mechanism. (07 Marks)
- c. With neat sketch explain Whitworth quick return motion mechanism. (07 Marks)

OR

- 2 a. With neat sketch, explain Peaucellier Mechanism. (06 Marks)
- b. With neat sketch, explain Geneva mechanism. (06 Marks)
- c. With neat sketch, explain Ackerman steering gear mechanism. (08 Marks)

Module-2

- 3 a. Define the following:
 - (i) Linear and Angular Velocity
 - (ii) Linear and Angular Acceleration
 (06 Marks)
- b. 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.Q3(b), find:
 - (i) Velocity of piston C and angular velocity of connecting rod BC.
 - (ii) Acceleration of piston 'S' and angular acceleration of connecting rod BC.

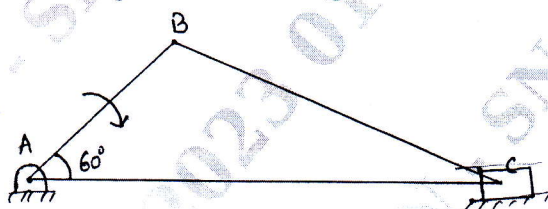


Fig.Q3(b)

(14 Marks)

OR

- 4 a. State and prove Kennedy's theorem. (08 Marks)
- b. Locate all the instantaneous centres for the toggle mechanism shown in Fig.Q4(b).
 $O_2A = 180$ mm $AB = 360$ mm $CB = 240$ mm $BD = 540$ mm

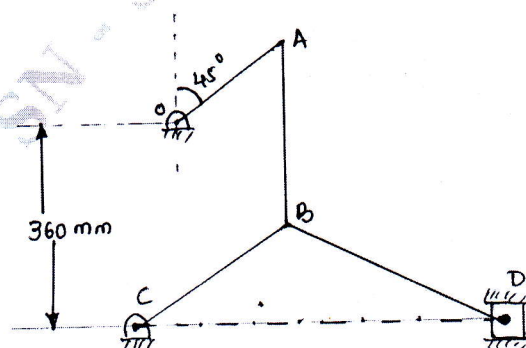


Fig.Q4(b)

(12 Marks)

Module-3

- 5 a. Explain Klein's construction for slider crank mechanism. (10 Marks)
 b. In a reciprocating engine the length of crank is 250 mm and length of connecting rod is 1000 mm. The crank rotates at a uniform speed of 300 rpm in clockwise direction and the crank is inclined at 30° with inner dead centre. The centre of gravity of the connecting rod is 400 mm away from the crank end. By Klein's construction, determine: (i) Velocity and acceleration of piston (ii) Angular velocity and angular acceleration of connecting rod (iii) Velocity and acceleration at the centre of gravity of the connecting rod. (10 Marks)

OR

- 6 Using complex algebra, derive expression for velocity and acceleration of the piston, angular acceleration of connecting rod of a reciprocating engine mechanism. With these expressions, determine the above quantities, if the crank length is 50 mm, connecting rod 200 mm, crank speed is constant at 3000 rpm and angle is 30° . (20 Marks)

Module-4

- 7 a. Derive an expression to determine length of arc of contact for a pair of mating gears. (10 Marks)
 b. The following data refers to two mating involute gear of 20° pressure angle. Number of teeth on pinion is 20. Gear ratio = 2, speed of pinion is 250 rpm. Module = 12 mm. If the addendum on each wheel is such that the path of approach and the path of recess on each side are half of the maximum permissible length. Find:
 (i) The addendum of pinion and gear
 (ii) The length of arc of contact
 (iii) The maximum velocity of sliding during approach and recess. (10 Marks)

OR

- 8 a. Sketch and explain: (i) Simple gear train (ii) Compound gear train (08 Marks)
 b. In an epicyclic gear train, the internal wheels A, B and the compound wheels C and D rotates independently about axis 'O'. The wheels E and F rotates on a pin fixed to arm G. E gears with A and C, and F gears with B and D. All the wheels have same pitch and number of teeth on E and F are 18, C = 28, D = 26.
 (i) Sketch the arrangement
 (ii) Find the number of teeth on A and B
 (iii) If the arm G makes 150 rpm CW and A is fixed, find speed of B
 (iv) If the arm G make 150 rpm CW and wheel A makes 15 rpm CCW, find the speed B. (12 Marks)

Module-5

- 9 A cam rotating clockwise at uniform speed of 300 rpm operates a reciprocating follower through a roller 1.5 cm diameter. The follower motion is defined as below:
 (i) Outward during 150° with UARM. (ii) Dwell for next 30°
 (iii) Return during next 120° with SHM (iv) Dwell for the remaining period.
 Stroke of the follower is 3 cm, minimum radius of the cam 3 cm. Draw the cam profile:
 (a) Follower axis passes through cam axis (b) Follower axis offset to the right by 1 cm
 Also find the maximum velocity and acceleration during outward and inward stroke. (20 Marks)

OR

- 10 Draw to full size the profile of cam which will give a lift of 38 mm to a follower carrying a roller of 25 mm diameter. The axis of the follower is off-set by 18 mm to the right of the axis of cam. Ascent of the follower takes place with SHM in 0.05 second followed by a period of rest 0.0125 second. The follower then descends with UARM during 0.125 second the acceleration being $\frac{3}{5}$ times retardation. The cam rotates in clockwise direction at a constant speed of 240 rpm and the base circle radius is 50 mm. (20 Marks)