

Fourth Semester B.E. Degree Examination, June/July 2019 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 the principle of working of Whitworth quick return mechanism. (08 Marks)
- b. Explain with sketches, how different inversions of a four bar chain are obtained. Name the inversions. (08 Marks)
- c. For the mechanism show in Fig.Q1(c), determine the degrees of freedom. (04 Marks)

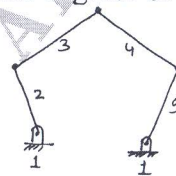


Fig.Q1(c)

OR

- 2 a. Show that the peaucellier mechanism is an exact straight line generating mechanism. (08 Marks)
- b. Explain with a neat sketch, how Ackerman steering gear mechanism is used to steer the vehicle. (08 Marks)
- c. With the help of a neat sketch, explain any one type of intermittent motion mechanism. (04 Marks)

Module-2

- 3 a. In a four link mechanism, the dimensions of the links are as under. $AB = 50\text{mm}$, $BC = 66\text{mm}$, $CD = 56\text{mm}$ and $AD = 100\text{mm}$. At the instant when $\angle DAB = 60^\circ$, the link AB has an angular velocity of 10.5 rad/sec in the counter clockwise direction. Determine : i) Velocity of point C ii) Angular velocities of links BC and CD iii) Velocity of rubbing at point A. Use relative velocity method. (10 Marks)

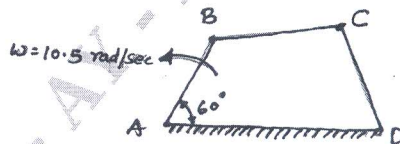


Fig.Q3(a)

- b. In a slider crank mechanism, the crank is 480mm long and rotates at 20 rad/sec in the counter clockwise direction. The length of the connecting rod is 1600mm when the crank turns 60° from inner dead centre, determine : i) Velocity of slider ii) Velocity of point E located at a distance of 450mm on the connecting rod extended. Use relative velocity method. [Refer Fig.Q3(b)] (10 Marks)

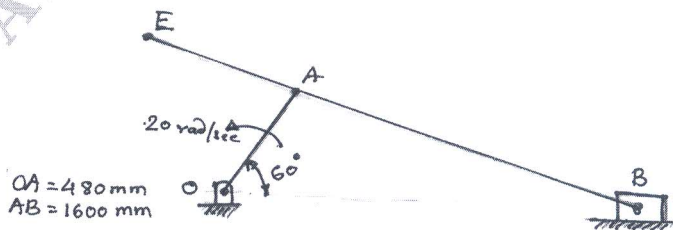


Fig.Q3(b)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, $42+8=50$, will be treated as malpractice.

OR

- 4 a. In the toggle mechanism shown in Fig.Q4(a), the crank OA rotates at 210 rpm in anticlockwise direction. For the given configuration, determine, i) Acceleration of slider D
ii) Angular accelerations of links BD and QB. Use relative acceleration method. (12 Marks)

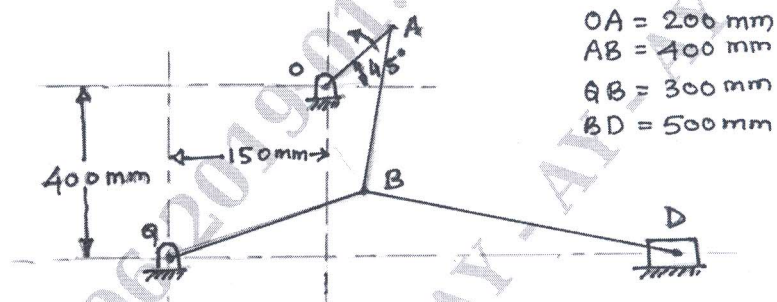


Fig.Q4(a)

- b. A four bar mechanism is shown in Fig.Q4(b). The dimensions of links are :
PQ = O₄Q = 142mm, Q₂P = O₂O₄ = 100mm. At the instant when ∠O₄O₂P = 180° determine the angular velocity of link PQ using instantaneous center method. Locate all the instantaneous centers. Link O₂P is rotating at an angular velocity of 2 rad/sec in the anticlockwise direction. (08 Marks)

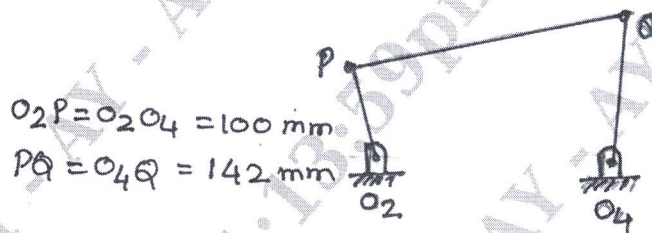


Fig.Q4(b)

Module-3

- 5 a. A four bar mechanism ABCD is as shown in Fig.Q5(a). Find the angular velocities of links BC and CD by vector algebra method if $\omega_{AB} = 45$ rad/sec in counter clockwise direction. (10 Marks)

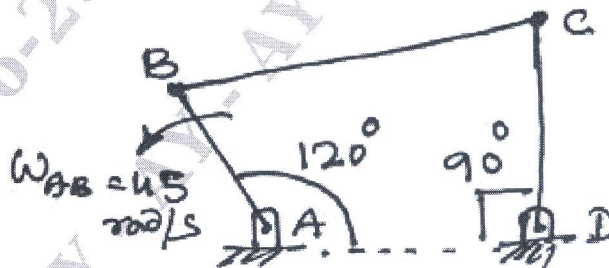


Fig.Q5(a)

- b. The crank and connecting rod of single slider crank mechanism are 200mm and 700mm respectively. the crank is rotating in clockwise direction at 120 rad/sec. Use Klein's construction to determine :
i) Velocity and acceleration of piston ii) angular velocity and angular acceleration of the connecting rod at the instant when the crank is at 30° to inner dead center. (10 Marks)

OR

- 6 a. In a slider crank mechanism, obliquity ratio is 3. The length of connecting rod is 90mm. Crank rotates at uniform speed of 200 rpm. Crank makes an angle of 30° with inner dead center. Calculate velocity of slider, angular velocity of connecting rod, angular acceleration of connecting rod and acceleration of slider. Use analytical method. (12 Marks)
- b. For the slider crank mechanism shown in Fig.Q6(b), determine angular velocity of connecting rod and angular acceleration of connecting rod when the crank rotates at 1.6 rad/sec. Use complex algebra method. (08 Marks)

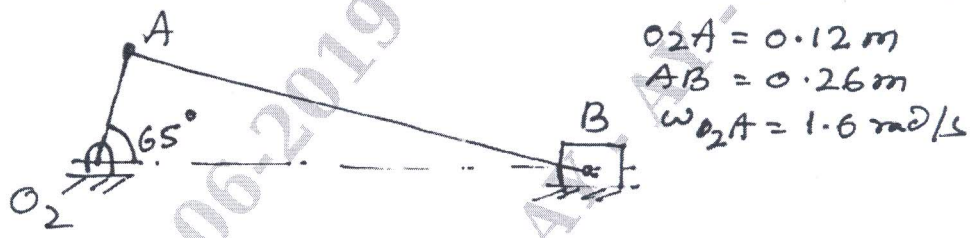


Fig.Q6(b)

Module-4

- 7 a. Sketch and explain the fundamental law of gearing. (08 Marks)
- b. Compare involutes and cycloidal gear tooth profiles. (06 Marks)
- c. What is interference in gears? State/explain the methods by which interference can be avoided. (06 Marks)

OR

- 8 a. In an epicyclic gear train shown in Fig.Q8(a), the arm A carries two gears B and C and a compound gear D – E. The gear B meshes with gear E and gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed and arm A makes 100 rpm in clockwise. (12 Marks)

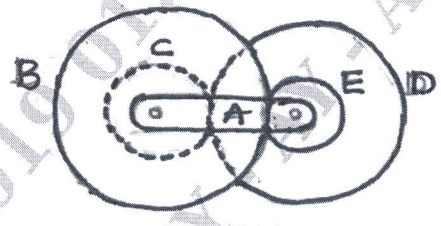


Fig.Q8(a)

- b. In an epicyclic gear train shown in Fig.8(b) an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in counter clockwise direction about the center of gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 rpm in the clockwise direction, what will be the speed of gear B? Use algebraic method. (08 Marks)

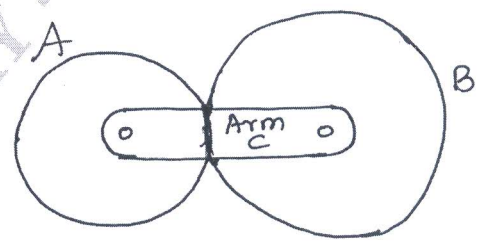


Fig.Q8(b)
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Module-5

- 9 a. Sketch the following types of cam and follower arrangement :
- Wedge cam with knife edge follower
 - DISC cam with roller follower
 - DISC cam with mushroom follower.
- (06 Marks)
- b. Draw the profile of a cam operating a knife-edge follower having a lift of 30mm. The cam raises the follower with simple harmonic motion for 150° of the rotation followed by period of dwell for 60° . The follower descends for the next 100° rotation of cam with uniform velocity, again followed by a dwell period. The cam rotates at a uniform velocity of 120 rpm and has a least radius of 20mm. What will be the maximum velocity and acceleration of the follower during the lift and descend.
- (14 Marks)

OR

- 10 a. With the help of a neat sketch of a disc cam and roller follower define the following :
- Base circle
 - Pitch curve
 - Prime circle.
- (06 Marks)
- b. Draw the profile of cam operating a roller reciprocating follower and having the following data: minimum radius of cam = 25mm, Lift = 30mm, Roller diameter = 15 mm. The cam lifts the follower for 120° with simple harmonic motion followed by a dwell period of 30° . Then the follower lowers down during 150° of cam rotation with uniform acceleration and deceleration followed by a dwell period. If the cam rotates at a uniform speed of 150 rpm, calculate the maximum velocity and acceleration of the follower during descent period.
- (14 Marks)

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