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## Fourth Semester B.E. Degree Examination, July/August 2021 Kinematics of Machines

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions.

- 1 a. Define the following terms with example:
 

i) Kinematic pair	ii) Kinematic chain	iii) Mechanism
iv) Degree of freedom	v) Structure	

(08 Marks)
- b. Explain with a neat sketch any two inversions of double slider crank chain mechanism. (08 Marks)
- 2 Sketch and explain the following mechanism:
  - a. Crank and slotted lever quick return mechanism (06 Marks)
  - b. Peaucellier's mechanism (04 Marks)
  - c. Ackermann steering gear mechanism (06 Marks)
- 3 a. What is Coriolis component of acceleration? Derive the expression for the same. (06 Marks)
- b. In the mechanism shown in Fig.Q3(b), the slider C is moving to the right with a velocity of 1 m/s and an acceleration of  $2.5 \text{ m/s}^2$ . The dimensions of various links are  $AB = 3 \text{ m}$  inclined at  $45^\circ$  with the vertical and  $BC = 1.5 \text{ m}$  inclined at  $45^\circ$  with the horizontal. Determine: i) The magnitude of vertical and horizontal component of acceleration of the point B and (ii) The angular acceleration of the links AB and BC.

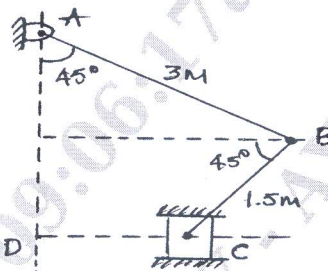


Fig.Q3(b)

(10 Marks)

- 4 A pin jointed four bar mechanism ABCD is shown in Fig.Q4. Link  $AB = 150 \text{ mm}$ ,  $BC = 180 \text{ mm}$ ,  $CD = 180 \text{ mm}$  and the fixed link  $AD = 300 \text{ mm}$ . Link AB makes  $60^\circ$  with the link AD, and rotates uniformly at 100 rpm. Locate all the instantaneous centres and find the angular velocity of link BC and the linear velocity of link CD.

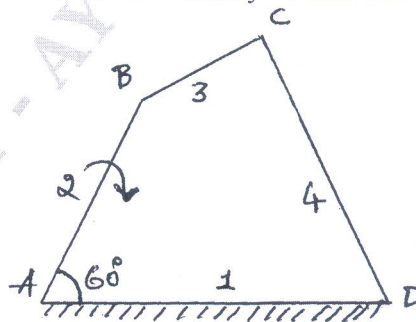


Fig Q4

(16 Marks)

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.

- 5 In a four bar mechanism ABCD (Fig.Q5) link AB = 300mm, BC = 360mm, CD = 360mm, and fixed link AD = 600mm. The link AB makes  $60^\circ$  with fixed link AD. The link AB has an angular velocity of 10 rad/sec and angular acceleration  $30 \text{ rad/sec}^2$  both clockwise. Determine the angular velocity and angular acceleration of link BC and CD.

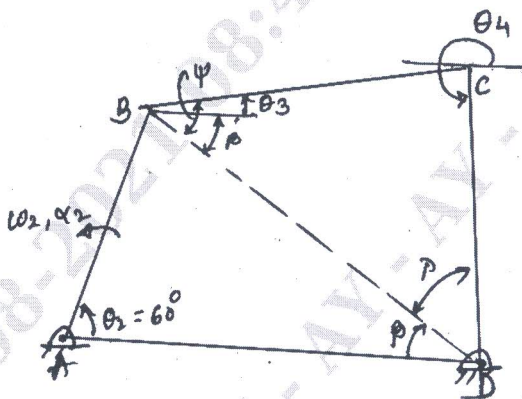


Fig.Q5

(16 Marks)

- 6 a. The crank of an engine is 200mm long and ratio of length of connecting rod to crank radius is 4. Determine acceleration of piston when crank turns through  $45^\circ$  from inner dead centre position and moving towards centre at 240 rpm by complex algebra method. (08 Marks)
- b. The crank and connecting rod of reciprocating engine are 200mm and 700mm respectively. the crank is rotating in clockwise direction at 120rad/sec. Using Klein's construction find :  
 i) Velocity and acceleration of piston  
 ii) Velocity and acceleration of the midpoint of the connecting rod  
 iii) Angular velocity and angular acceleration of connecting rod at instant when crank is at  $30^\circ$  from inner dead centre. (08 Marks)
- 7 a. State and prove law of gearing or condition for correct steering. (06 Marks)
- b. Two  $20^\circ$  involute spur gears mesh externally and give a velocity of ratio 3. Module is 3 mm and the addendum is equal to 1.1 module. If the pinion rotates at 120 rpm, determine:  
 i) Minimum number of teeth on each wheel to avoid interference.  
 ii) Number of pairs of teeth in contact. (10 Marks)
- 8 a. Explain different types of gear trains with neat sketches. (08 Marks)
- b. An epicyclic gear train consists of a sun wheel S, a stationary internal gear E and three identical planet gears P carried on a carrier C. The size of different toothed wheels are such that planet carrier C rotates at  $\frac{1}{5}$  speed of sun wheel S. Minimum number of teeth on any sun wheel is 16. The driving torque on sun wheel is 100N-m. Determine :  
 i) Number of teeth on different wheels of gear train  
 ii) Torque necessary to keep the internal gear stationary. (08 Marks)
- 9 a. Define following with respect to cams :  
 i) Prime circle    ii) Pressure angle    iii) Pitch point    iv) Trace point. (04 Marks)



- b. A cam rotating clockwise at uniform speed of 300 rpm operates a reciprocating follower having roller of 10mm diameter. The following motions defined below :
- Moves outward during  $120^\circ$  of cam rotation with UARM
  - Dwell in lifted position for next  $30^\circ$  of cam rotation
- returns with SHM for next  $120^\circ$  of cam rotation stroke of the follower is 30mm. The minimum radius of cam is 20mm. Draw profile of cam when line stroke of follower passes through centre of cam shaft. Also calculate maximum velocity and acceleration of follower during out stroke. (12 Marks)

- 10 A cam with 25 mm as minimum radius is rotating clockwise at a uniform speed of 1000 rpm, and has to give the motion to the knife-edge follower as defined below:
- Follower to move outwards through 25 mm during  $120^\circ$  cam rotation.
  - Follower to dwell for the next  $60^\circ$  of cam rotation.
  - Follower to return to its starting position during next  $90^\circ$  of cam rotation.
  - Follower to dwell for the rest of the cam rotation.
- The displacement of the follower takes place with uniform acceleration and retardation on both the outward and return strokes, draw the cam profile when follower axis is offset to right by 10 mm from the axis of cam. Determine the maximum velocity and acceleration during outstroke and return stroke. (16 Marks)

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