

## Fourth Semester B.E. Degree Examination, Dec.2013/Jan.2014

### Kinematics of Machines

Time: 3 hrs.

Max. Marks:100

**Note: Answer FIVE full questions, selecting at least TWO questions from each part.**

#### PART - A

- 1 a. Distinguish between:
  - i) Higher pair and lower pair
  - ii) Open pair and closed pair
  - iii) Machine and mechanism
- b. Define single slider crank chain. Explain briefly the inversions of single slider crank chain.
- c. Sketch the mechanism used to transmit constant angular velocity ratio between two shafts whose axes are separated by a small distance.
- d. Use Grubler's criterion to determine the degrees of freedom of the following mechanism. Refer Fig.Q1(d).

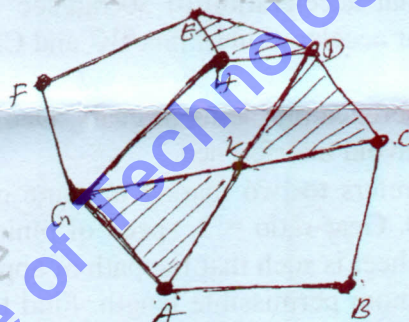


Fig.Q1(d)

- 2 a. Explain with a neat sketch the working principle of crank and slotted lever mechanism.
- b. Explain with a neat sketch the mechanism used to trace exact straight line.
- c. Sketch the mechanism used to overcome a very large resistance with a small amount of driving force.
- 3 Fig.Q3 shows a four bar mechanism. Crank  $O_2A$  rotates at 200 rpm and an angular acceleration of  $150 \text{ rad/sec}^2$  at the instant when the crank makes an angle of  $45^\circ$  to the horizontal. Find the acceleration of points B and C and angular velocities and angular acceleration of links 3 and 4.

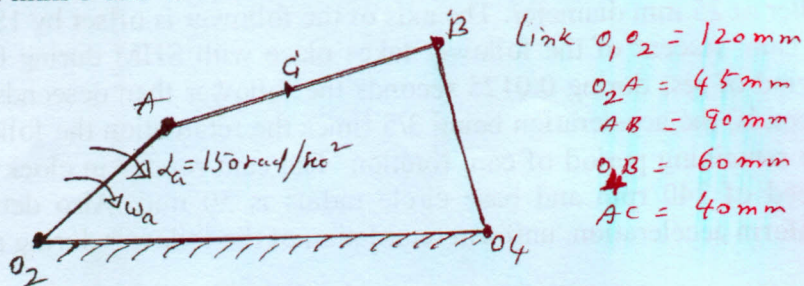


Fig.Q3

- 4 a. In a slider crank mechanism shown in Fig.Q4(a) the crank  $OA = 300$  mm and the connecting rod  $AB = 1200$  mm the crank  $OA$  is turned  $30^\circ$  from the inner dead centre. Locate all the instantaneous centres. If the crank rotates at  $15$  rad/sec clockwise, find:
- Velocity of slider B and
  - Angular velocity of connecting rod AB.

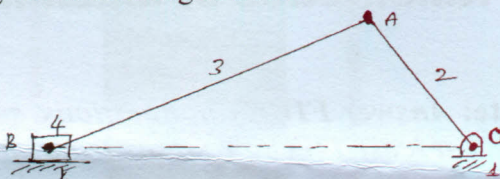


Fig.Q4(a)

- b. Determine the velocity and acceleration of the piston by Kelvin's construction to the following specification:
- Stroke =  $300$  mm
  - Ratio of length of connecting rod to crank radius =  $4$
  - Speed of engine =  $300$  rpm
  - Position of crank =  $45^\circ$  with inner dead centre.

(08 Marks)

**PART - B**

- 5 In a four bar mechanism ABCD, link  $AB = 300$  mm,  $BC = 360$  mm,  $CD = 360$  mm and the fixed link  $AD$  is  $600$  mm. the angle  $BAD = 60^\circ$ . The link  $AB$  has an angular velocity of  $10$  rad/sec and angular acceleration of  $30$  rad/sec<sup>2</sup> both clockwise. Determine the angular velocities and angular acceleration of link  $BC$  and  $CD$  by using complex algebra method. (20 Marks)
- 6 a. Briefly discuss interference problems in gears. Deduce an expression for minimum number of teeth on a gear to avoid interference. (08 Marks)
- b. The following data refers to two mating involute gears of  $20^\circ$  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 reuse on each side are half of the maximum permissible length. Find the maximum velocity of sliding during path of approach and path of recess and the length of arc of contact. (12 Marks)
- 7 a. Deduce an expression for holding torque in epicyclic gear train. (05 Marks)
- b. An epicyclic gear train arrangement consists of three planet wheels of equal size and equispaced ( $120^\circ$  apart) carried by a spider (arm). The three planet wheels mesh externally with a sun wheel and internally with an annular ring, which is stationary. The pitch circle diameter of the ring is approximately  $228$  mm and module is  $4$  mm. The spider makes one revolution for every five revolutions of the spindle carrying the sun wheel. Determine the number of teeth for all the gears and the exact pitch circle diameter of the ring. If a torque of  $30$  N-m is applied to the sun wheel, determine the torque required to hold the ring stationary. (15 Marks)
- 8 Draw to full size the profile of cam which gives a lift of  $38$  mm to a follower carrying a roller of  $25$  mm diameter. The axis of the follower is offset by  $18$  mm to the right of the axis of cam. Ascent of the follower takes place with SHM during  $0.05$  seconds followed by a period of rest during  $0.0125$  seconds the follower then descends with UARM during  $0.125$  seconds, the acceleration being  $3/5$  times the retardation the follower remains at rest during the remaining period of cam rotation. The cam rotates in clockwise direction at a constant speed of  $240$  rpm and base circle radius is  $50$  mm. Also determine maximum velocity, uniform acceleration, uniform retardation of the follower during return stroke. (20 Marks)

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