Question Paper

Exam Date & Time: 30-Dec-2022 (09:30 AM - 12:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES END SEMESTER THEORY EXAMINATION - DECEMBER 2022 I SEMESTER B.Sc.(Applied Sciences) in Engg.

KINEMETICS OF MACHINES [IMET 232 - S2]

Marks: 50

Duration: 180 mins.

Answer all the questions.

Missing data may be suitably assumed and justified.

- Define Grashof's law. Discuss the necessary condition for the class-I, class-II and class-III chains.
 B) Explain Devis steering gear. Derive the expression of wheel base, ⁽⁵⁾
 - distance between the pivots of front axles and angle (α)

$$tan\alpha = \frac{w}{2l}$$

2)

A)

Calculate the maximum and minimum transmission angles for the ⁽⁵⁾ mechanisms shown in **Fig Q2A**. The figures indicate the dimensions in standard unit. Identify the type of mechanism whether crank-rocker or rocker-rocker or crank-crank.





B)

PQRS is a four bar chain with link PS fixed is shown in Fig. Q2B. The $^{(5)}$ lengths of the links are PQ = 62.5 mm; QR = 175 mm; RS = 112.5 mm; and PS = 200 mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity diagram when angle QPS = 60° and Q and R lie on the same side of PS. Calculate the angular velocity of links QR and RS.



Fig. Q2B

3) (5) In the above question Q2B, draw the acceleration diagram. Determine the angular acceleration of links QR and RS. A)

B) (5) Determine the lengths of the links of a four-bar linkage to generate the function $y = \log_{10}(x)$ in the interval $1 \le x \le 10$. The crank rotates from an angle of 45° to 105°, where the follower rotates from an angle of 135° to 225°. Given that the length of the smallest link is 5 cm. Use three-point Chebyshev spacing.

- 4) (5) Synthesize the four-bar mechanism by method of Inversion. Assume following data: (1) Length of fixed links 10 cm. (2) Two positions input link A) from initial positions are 30° and 60°. (3) S_{12} and S_{13} are 40 mm and 96 mm respectively and eccentricity is 20 mm.
 - B) (5) A cam is to give the following motion to a knife-edged follower : 1. Outstroke during 60° of cam rotation ; 2. Dwell for the next 30° of cam rotation; 3. Return stroke during next 60° of cam rotation, and 4. Dwell for the remaining 210° of cam rotation. The stroke of the follower is 40 mm and the minimum radius of the cam is 50 mm. The follower moves with uniform velocity during both the outstroke and return strokes. Draw the profile of the cam when the axis of the follower is offset by 20 mm from the axis of the cam shaft.
- (5) 5) A reverted gear train shown in Fig. Q5A. is used to provide a speed ratio of 10. The module of gears 1 and 2 is 3.2 mm and of gears 3 and 4 is 2 A) mm. Determine suitable number of teeth for each gear. No gear is to have less than 20 teeth. The centre distance between shafts is 160 mm.



Fig. Q5A

B)

In a reverted epicyclic gear train, arm A carries two gears B and C, and a (5) compound gear D-E (Fig. Q5B). 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. Determine the speed and direction of gear C when

gear B is fixed and the arm A makes 100 rpm. clockwise.



Fig. Q5B

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