Exam Date & Time: 04-Jul-2023 (02:30 PM - 05:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

THEORY OF MACHINES [AAE 2273]

Duration: 180 mins.

Α

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) With a neat sketch derive an expression for the ratio of times taken in forward and return stroke and length of stroke for Whitworth quick return motion mechanism. (5)

A)

Marks: 50

- B) How can you define degrees of freedom (DOF) with respect to a mechanism? How do think DOF and Grublers Criterion are essential in deciding a 4-bar simple mechanism? (3)
- C) Calculate the DOF for the mechanism shown below:



2) Mathematically substantiate how fixing the slotted plate in the double slider crank mechanism will result in elliptical trammel

(2)

(3)

A)

B) With a neat diagram of gear teeth (representing 2 teeth) explain:

- (a) Circular pitch
- (b) Diametrical Pitch
- C) Deduce the equation for the velocity of sliding ($V_{sliding}$) and discuss what happens to the (5)

		equation when the contact point(Q) coincides with the pitch point(P)	
3)	A)	2 equal spur gears of 20° involute teeth, module pitch 4 mm, and the number of teeth 40 are in mesh. If the length of the arc of contact is 1.75 times the circular pitch, find the length of the addendum.	(4)
	B)	Deduce the condition for correct steering in a motor car.	(3)
	C)	Draw the representative diagram for displacement, velocity, and acceleration if the follower moves in uniform acceleration and retardation.	(3)
4)		A cam, with a minimum radius of 50 mm, rotating clockwise is required to give a knife edge follower the motion as described below:	
	A)	1. To move outwards through 40 mm during 100° rotation of the cam;	
		2. To dwell for the next 80°	
		3. To return to its starting position during the next 90°	
		4. To dwell for the rest period of a revolution i.e. 90°.	(2)
		The displacement of the follower is to take place with uniform acceleration and uniform	
		retardation. Determine the maximum velocity and acceleration of the follower when the camshaft	
		rotates at 900 r.p.m.	
	B)	For question 4A, draw the displacement, velocity, and acceleration diagram for one complete rotation of cam	(4)
	C)	Using the data from 4A and 4 B, Draw the profile of the cam when the line of stroke of the follower passes through the axis of the camshaft.	(4)
5)	A)	The gear train is shown in Fig 1 , where gear A meshes with gear B. In the compound gear B-C, Gear C meshes with gear D, rotating relative to A around the same axis A. If gear A is fixed, Arm F is used as the driving member, determining the speed ratio N_{D}/N_{F} . The number of teeth on wheels A, B, C, and D are 61, 61, 62, and 60, respectively.	

(4)



B) A, B, C, and D are four masses carried by a rotating shaft at radii 100, 125, 200, and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C, and D are 10 kg, 5 kg, and 4 kg respectively.

Find the required mass A and the relative angular settings of the four masses so that the (6) shaft shall be in complete balance. (use of proper scales should be shown clearly in the graph sheet)

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