Exam Date & Time: 29-May-2023 (02:30 PM - 05:30 PM)



# **MANIPAL ACADEMY OF HIGHER EDUCATION**

## END SEMESTER EXAM MAY-JUNE-2023 THEORY OF MACHINES [AAE 2273]

#### Marks: 50

#### **Duration: 180 mins.**

A

### 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 crank and slotted lever quick return motion mechanism. (5)

A)

- B) Define the Ktutzbach equation for a 2-D special mechanism and discuss the physical significance of the same when DOF is negative, 0 and 1. (3)
- C) Calculate the DOF for the mechanism shown below:



Discuss how a kinematic chain be used to obtain a machine with the example of an IC Engine	
	(2)
With a neat diagram of gear teeth (representing 2 teeth) explain:	
(a) Module	(3)
	Discuss how a kinematic chain be used to obtain a machine with the example of an IC Engine With a neat diagram of gear teeth (representing 2 teeth) explain: (a) Module

(b) Pressure angle.

AAE 2273

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	C)	With the help of a neat sketch deduce the equation of path of contact for the involute profiled teeth.	(5)
3)	A)	Find the minimum number of teeth to avoid undercutting when the addendum for teeth is 0.84 module. The gear ratio is 3:1. Also, find the length of the arc of the contact in terms of the module. Given pressure angle = $20^{\circ}$ .	(4)
	B)	Explain the Ackermann steering gear mechanism.	(3)
	C)	In the cam and follower mechanism draw the representative diagram for displacement, velocity, and acceleration if the follower moves in cycloidal motion.	(3)
4)		A cam is to be designed for a knife-edge follower with the following data:	
		1.Cam lift = 40 mm during $90^{\circ}$ of cam rotation with simple harmonic motion.	
	A)	2. Dwell for the next $30^{\circ}$ .	
		3. During the next 60° of cam rotation, the follower returns to its original position with	
		Uniform velocity.	(2)
		4. Dwell during the remaining 180°.	
		If the radius of the base circle of the cam is 40 mm. Determine the maximum velocity and	
		acceleration of the follower during its ascent and descent, if the cam rotates at 240 r.p.m.	
	B)	For question 4A, draw the displacement, velocity, and acceleration diagram	(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)	An epicyclic gear train is constructed as shown in <b>Fig 1.</b> A fixed annular wheel A and a smaller concentric wheel B are connected by a compound wheel $A_1$ - $B_1$ . $A_1$ gearing with A. $B_1$ gearing with B. The compound wheel revolves on the stud which is carried around an arm that revolves about axis A and B. A has 130 teeth, B has 20 teeth, and $B_1$ has 80 teeth, pitch of A and $A_1$ being twice the pitch of B and $B_1$ . How many revolutions B will make for one revolution of the arm?	

(4)



B) A shaft carries four masses A, B, C, and D of magnitude 200 kg, 300 kg, 400 kg, and 200 kg respectively, and revolving at radii 80 mm, 70 mm, 60 mm, and 80 mm in planes measured from A at 300 mm, 400 mm, and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70°, and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm, and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions. (use of proper scales should be shown clearly in the graph sheet if the graphical method is used).

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