		Reg. No.									
ANIPAL INSTITUTE OF TECHNOLOGY											
TASAIRED BY LIT	MANIPAL (A constituent unit of MAR	IE, Manipal)									

# DEPARTMENT OF MECHATRONICS V SEMESTER B.TECH. MECHATRONICS

# END SEMESTER EXAMINATION, NOV/DEC 2023

# SUBJECT: THEORY OF MACHINES [MTE 3154]

#### (01/12/2023)

## **Time: 3 Hours**

## MAX. MARKS: 50

## **Instructions to Candidates:**

✤ Answer ALL the questions.

✤ Data not provided may be suitable assumed.

Q.		Μ	CO	РО	LO	BL
1A.	In a four link kinematic chain, link AB=8cm, BC=10cm, CD=12cm	2	1	2	2	
	and DA=3cm. Does it satisfies Grashof's law?? Find all the inversions					
	of this kinematic chain.					L3
1 <b>B</b> .	Evaluate the three types of constrained motion with suitable examples	3	1	1	1	L2
1C.	Analyse the inversion obtained by fixing the slider of the following	5	1	2	2	
	mechanism i) Single slider crank mechanism ii) Double slider crank	_				
	mechanism. Explain each inversion with an application. Draw					L4
24	relevant sketches	2	1	1	1	
2A.	Sketch a Tchebicheff (Chebyshev) Mechanism. Mention the dimensions of links so that it can be used to trace a straight line	2	I	I	1	L2
2B	Design a four link mechanism to coordinate three positions of the	3	5	3	3	
	input and the output links for the following angular displacements by		-	_		Т 4
	inversion methods: - $\theta_{12} = 35^{\circ}$ ; $\theta_{13} = 80^{\circ}$ ; $\emptyset_{12} = 50^{\circ}$ ; $\emptyset_{13} = 80^{\circ}$					L4
2C	In a steam engine mechanism, stroke length is 30cm. Ratio of	5	2	4	3,4	
	connecting rod length to crank radius is four. At a particular instant,					
	angular velocity of crank is 20 rad/sec and is being retarded at the rate of 70 rad/sec <sup>2</sup> . Angle turned by the grank from inner dead centre					
	position is 30 degrees. Find out Acceleration of piston and angular					
	acceleration of connecting rod. (Use Graphical Method, Write Graph					
	sheet No in EPAD, Show all calculation in EPAD, and diagram in					τ.4
	Graph sheet)					L4
<b>3A</b>	A flywheel absorbs 24kJ of energy on increasing its speed of 210 rpm,	2	3	1	1	L4
<b>a</b> D	to 214 rpm. Determine its kinetic energy at 250 rpm	•	•		2	
<b>3</b> B	A flywheel which is rotating at a maximum speed of 250 rpm and is	3	3	3	3	
	The punch is driven by a constant torque electric motor and punches					
	750 holes per hour. Each punching operation requires 14000 Nm of					
	energy and takes 1.8 seconds. If the speed of the flywheel not to fall					
	below 225 rpm find i) power of the motor, ii) mass of flywheel					L4

3C	A shaft running in bearings carries masses 20, 30 and 40kg, in planes	5	3	3	2.3	
	A. B and C with centre of gravity from the axis of the shaft 30mm.				,	
	20mm and 15mm, respectively. The distances of planes B and C from					
	A are 1000mm and 2000mm to the right of A. The relative angular					
	position of the centre of gravity of the unbalanced masses are such that					
	they are in static equilibrium. To obtain complete dynamic balance					
	suitable masses are introduced in planes D and E with centre of gravity					
	100mm from the axis D is 500mm to the left of $\Delta$ and E 500mm to					
	the right of C. Determine the position and magnitude of the balance					
	massas (Use Graphical Method Write Graph sheet No in EPAD					
	Show all calculation in EPAD, and diagram in Graph sheet)					L4
11	Two aqual gapes are in much having prossure angle of 14.5 degree	2	1	2	2	
4A	Addendum $-1$ module. Find the minimum number of teeth required	4	4	4	2	
	to avoid interference.					L3
<b>4B</b>	Show that Paucellier mechanism can be used to trace a straight line.	4	5	2	2	т э
	Sketch the mechanism.					L3
<b>4</b> C	Two mating gears have 30 and 18 involute teeth of module 6mm and	4	4	3	3	
	$20^{\circ}$ pressure angle. The addendum on each wheel is one module.					
	Pinion speed is 400 rpm. What is the sliding velocity when the pinion					L4
5 4	tooth tip touches the gear flank? Also find contact ratio.	2	1	2	2	
ЭА	Is it possible to build a mechanism with only three lower pairs? Justily	2	I	2	2	L4
5B	Determine a suitable train of wheels to satisfy the requirements of a	3	4	3	3	
CD	clock, the minute hand of which is fixed to a spindle and the hour hand	Ũ	•	U	C	
	to a sleeve rotating freely on the same spindle. The pitch is the same					
	for all the wheels and each wheel has at least 14 teeth. The total					T /
	number of teeth should be as small as possible.					L' <del>4</del>
<b>5</b> C	In an Epicyclic gear train, the internal wheels C, D and the compound	5	4	4	4	
	wheels A and B rotate independently about axis O. The wheels E and					
	F rotate on pins fixed to the arm G. E gears with B and D and F gears					
	with A and C. All wheels have the same module and number of teeth					
	are $T_A = 52$ ; $T_B = 56$ ; $T_E = T_F = 36$ .					
	a) Sketch the arrangement					
	b) If arm G makes 200 rpm clockwise and D is fixed, find speed &					
	direction of rotation of C					
	c) If arm G makes 200 rpm clockwise and wheel D makes 20 rpm					T A
	counter clockwise, find the speed of wheel C					174

 $\label{eq:L1-Remembering} L1-Remembering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating, L6-Creating$