Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS

IV SEMESTER B.TECH. MECHATRONICS

END SEMESTER MAKE-UP EXAMINATION, JUNE 2024

SUBJECT: THEORY OF MACHINES [MTE 2221]

(19/06/2024)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitable assumed.

Q. No		M	CO	PO	LO	BL
1A.	Classify the kinematic pairs according to type of the contact between the elements	2	1	1	1	L2
1B.	A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20-degree pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio.	4	4	2	2	L4
1C.	One of the inversions of double slider crank chain is used to connect two parallel shafts whose axes are at small distance apart. Explain the mechanism with relevant sketch	4	1	2	2	L3
2A.	In a spur gear, explain the terms, i) Module, ii) Dedendum, iii) Diametral Pitch	3	4	1	1	L4
2B	A four-bar mechanism is to be designed, by using three precision points to generate the function $y = x^2$ for the range $2 \leq x \leq 7$. Assume 30 degree starting position and 120 degree finishing position for the input link and 60 degree starting position and 180 degree finishing position for the output link, find the values of x, θ and ø corresponding to the three precision points using chebychev spacing.	4	2	2	3	L4
2C	The crank and connecting rod of a steam engine are 50 cm and 200 cm long respectively. The crank makes 180 rpm in the clockwise direction. When it has turned 45 degrees from the inner dead centre position, determine i) velocity of the piston, ii) velocity of connecting rod and iii) velocity of point E on the connecting rod 150 cm from the gudgeon pin. (Use Graphical Method, Write Graph sheet No in EPAD, Show all calculation in EPAD, and diagram in Graph sheet)	3	2	3	3,4	L4
3A	Two parallel shafts about 600 mm apart are to be connected by spur gears. One shaft is to run at 360 rpm and the other at 120 rpm. Determine,	3	4	2	2	L3

	number of teeth and diameter of gears and exact centre distance between them					
3B	Elaborate the significance of flywheel in i) an IC engine, ii) a power press	2	3	1	1	L2
3C	A shaft carries four masses *A, B, C* and *D* placed in parallel planes perpendicular to the shaft axis and in this order along the shaft. The masses *B* and *C* are 40kg and 28kg and both are at 160mm radius. While the masses in planes *A* and *D* are at 200mm radius. Angle between *B* and *C* is 100°, *B* and *A* is 190°, both angles measured in the same sense. Planes *A* and *B* are 250mm apart, *B* and *C* are 500mm apart. If the shaft is to be in complete balance, determine (i) masses in planes *A* and *D*, (ii) distance between planes *C* and *D* and (iii) angular position of mass *D* (Use Graphical Method, Write Graph sheet No in EPAD, Show all calculation in EPAD, and diagram in Graph sheet)	5	3	3	2,3	L4
4A	In case of Cam, follower can move in 4 different ways during ascent/descent. Explain each one with relevant sketch.	4	5	1	1	L2
4B	Explain the salient features of reverted gear train	2	4	1	1	L3
4C	In a reverted epicyclic gear train, the arm A carries two gears B and C and a compound gear D – E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed, and the arm A makes 100 rpm clockwise.	4	4	3	4	L4
5A	A crank and slotted lever mechanism used in shaper has a centre distance of 300 mm between the centre of oscillation of the slotted lever and the centre of rotation of the crank. The radius of the crank is 120 mm. Find the ratio of the time of cutting to the time of return stroke.	2	1	2	2	L4
5B	A punching press is required to punch 30 mm diameter holes in a plate of 20 mm thickness at the rate of 20 holes per minute. It requires 6 Nm of energy per mm^2 of sheared area. If punching takes place in 1/10 of a second and the rpm of the flywheel varies from 160 to 140, determine the mass of the flywheel having radius of gyration of 1 meter.	3	3	2	3	L4
5C	A Cam with 60 mm as minimum diameter is rotating clockwise at a uniform speed of 900 rpm and must give the motion to the knife edge follower as defined below. Follower to move outward through 25mm during 100 degree of Cam rotation with uniform acceleration and deceleration motion. Dwell for the next 80 degree Follower to return to its starting position during the next 120 degree with SHM Dwell for the remaining period. Draw the Cam profile.	5	5	3	4	L4

L1 – Remembering, L2 – Understanding, L3 - Applying, L4 – Analyzing, L5 – Evaluating, L6 - Creating