Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. (Full Time) –REGULAR/ARREAR END SEMESTER EXAMINATIONS, APR / MAY 2024

B.E Industrial Engineering/ Mechanical Engineering/ Manufacturing Engineering
Semester IV
ME5452 & Mechanics of Machines
(Regulation2019)

Time:3hrs Max.Marks: 100

CO1	**Design the linkages and the cam mechanisms for specified output motions.**
CO2	**Determine the gear parameters of toothed gearing and speeds of gear trains in various applications.**
CO3	**Evaluate the frictional torque in screw threads, clutches, brakes, and belt drives.**
CO4	**Determine the forces on members of mechanisms during static and dynamic equilibrium conditions**
CO5	**Determine the balancing masses on rotating machinery and the natural frequencies of free and forced vibratory systems.**

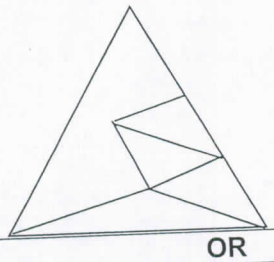
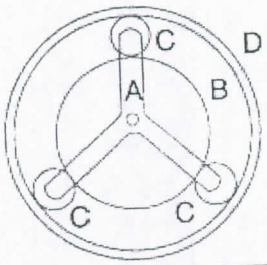
BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

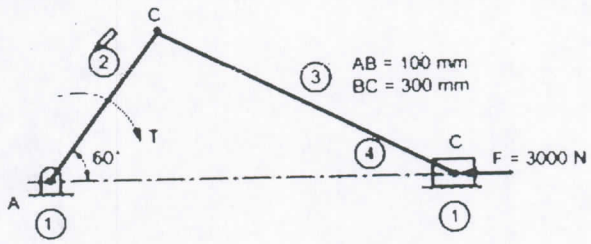
PART- A(10x2=20Marks)
(Answer all Questions)

Q.No.	Questions	Marks	CO	BL
1	State the Grubler's criterion for determining the degrees of freedom (n) of mechanism having plane motion.	2	CO1	L1
2	In a crank and slotted lever quick return mechanism, the distance between the fixed centers is 180 mm and the driving crank is 90 mm long. Determine the ratio of the time taken on the cutting and return strokes.	2	CO1	L2
3	Write the formula for speed ratio in the design of spur gears.	2	CO2	L2
4	Define the following with respect gears (i) Arc of approach (ii) Arc of contact.	2	CO2	L1
5	What is meant by the efficiency of the screw?	2	CO3	L1
6	150 mm diameter valve, against which a steam pressure of 2 MN/m2 is acting, is closed using a square threaded screw 50 mm in external diameter with 6 mm pitch. If the coefficient of friction is 0.12; find the load (W) required to turn the handle.	2	CO3	L2
7	Write about the principle of superposition.	2	CO4	L1
8	Describe the conditions of static equilibrium for a rigid body	2	CO4	L1
9	Define the Damping Factor.	2	CO5	L1
10	Four masses m1, m2, m3, and m4 are 200 kg, 300 kg, 240 kg, and 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m. Find the magnitude.	2	CO5	L2

PART- B(5x 13=65Marks)
(Restrict to a maximum of 2 subdivisions)

Q.No.	Questions	Marks	CO	BL
11 (a)	**i)** The distance between the fixed centers in a crank and the slotted lever quick return motion mechanism is 580 mm, and the length of the driving crank is 240 mm. Calculate the slotted bar's inclination with the vertical in the extreme position and the time ratio of the cutting stroke to the return stroke. Find the length of	9	CO1	L4

	the stroke if the line of stroke traverses through the extreme positions of the free end of the lever if the slotted bar is 500 mm long. **ii)** Determine the number of Binary joints for the given figure below and find out the chain type. 	**4**		
	OR			
11 (b)	Analyze the different mechanisms obtained by the inversions of a single slider crank chain. Illustrate each mechanism with a neat sketch, and describe the function and application of each inversion	**13**	CO1	L3
12 (a)	Write the various terminologies used in gears, and illustrate these concepts with a detailed and accurate sketch. Ensure to explain the function and significance of each term in the context of gear mechanisms.	**13**	CO2	L3
	OR			
12 (b)	In an epicyclic gear of the 'sun and planet' type shown in Figure below, the pitch circle diameter of the internally toothed ring is to be 224 mm and the module 4 mm. When ring D is stationary, the spider A, which carries three planet wheels C of equal size, is to make one revolution in the same sense as the sunwheel B for every five revolutions of the driving spindle carrying the sunwheel B. Determine suitable numbers of teeth for all the wheels. 	**13**	CO2	L4
13(a)	**i)**The mean diameter of the screw jack having a pitch of 10 mm is 50 mm. A load of 20 kN is lifted through a distance of 170 mm. Find the work done in lifting the load and efficiency of the screw jack when 1. the load rotates with the screw, and 2. the load rests on the loose head which does not rotate with the screw. The external and internal diameters of the bearing surface of the loose head are 60 mm and 10 mm respectively. The coefficient of friction for the screw as well as the bearing surface may be taken as 0.08. **ii)** Write the derivation for the torque required to lower the load by a screw jack.	**8** **5**	CO3	L4

13 (b)	**i)**Determine the maximum, minimum, and average pressure in plate clutch when the axial force is 4 kN. The inside radius of the contact surface is 50 mm and the outside radius is 100 mm. Assume uniform wear. **ii)**Define Friction clutches. Write about single disc clutch.	**8** **5**	CO3	L4
14 (a)	Explain D' Alembert's principle and illustrate its applications with two distinct examples.	**13**	CO4	L3
	OR			
14 (b)	For the slider-crank mechanism position shown below, an external load F = 3000 N acts horizontally on slider 4 at point C. The linkage dimensions are: AB = 100 mm; BC = 300 mm; ∠BAC = 60°. Determine the forces acting on various links and also the driving torque T, so that the mechanism is in static equilibrium.  	**13**	CO4	L4
15 (a)	Four masses A, B, C, and D as shown below are to be completely balanced. A B C D Mass (kg) — 30 50 40 Radius (mm) 180 240 120 150 The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90°. B and C make angles of 210° and 120° respectively with D in the same sense. Find: **1.** The magnitude and the angular position of mass A **2.** The position of planes A and D. Take B as R.P	**13**	CO5	L4
	OR			
15 (b)	**i)**The measurements on a mechanical vibrating system show that it has amass of 8 kg and that the springs can be combined to give an equivalent spring of stiffness5.4 N/mm. If the vibrating system has a dashpot attached which exerts a force of 40 N when the mass has a velocity of 1 m/s, find : **1.** critical damping coefficient, **2.** damping factor, **3.** Logarithmic decrement, and **4.** ratio of two consecutive amplitudes. **ii) A** cantilever shaft 60 mm in diameter and 300 mm long has a disc of mass100 kg at its free end. The Young's modulus for the shaft material is 200 GN/m2. Determine the frequency of longitudinal and transverse vibrations of the shaft.	**8** **5**	CO5 CO5	L4 L4

PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

Q.No.	Questions	Marks	CO	BL
16.	A cam is to be designed for a knife-edge follower with the following data: 1. Cam lift = 30 mm during 90° of cam rotation with simple harmonic motion. 2. Dwell for the next 20°. 3. During the next 70° of cam rotation, the follower returns to its original position with simple harmonic motion. 4. Dwell during the remaining 180°. Draw the profile of the cam when the line of stroke is offset 15 mm from the axis of the camshaft. The radius of the base circle of the cam is 30 mm. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 120 r.p.m. **Impact Analysis:** Explain how cam profiles can affect the motion characteristics and performance of the mechanism.	**12** **3**	CO1	L5 L6