Reg. No.												

Question Paper Code	12485

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2023

Fourth Semester

Mechanical and Automation Engineering

20MUPC402– THEORY OF MACHINES

(Regulations 2020)

(Use of A3 sheet is permitted)

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level, CO
1.	Differentiate a machine and a structure.	*2,K2,CO1*
2.	What is an inversion of Mechanism?	*2 K1,CO1*
3.	List any three advantages of gear drive.	*2 K1,CO2*
4.	What is reverted gear train?	*2 K1,CO2*
5.	Define the function of a governor.	*2 K1,CO4*
6.	Why rolling motion of a ship has no gyroscopic effect?	*2 K1,CO4*
7.	State the importance of Balancing.	*2 K1,CO5*
8.	What is an Inline engine?	*2 K1,CO5*
9.	Define Time period of vibration.	*2 K1,CO6*
10.	What do you mean by whirling speed?	*2 K1,CO6*

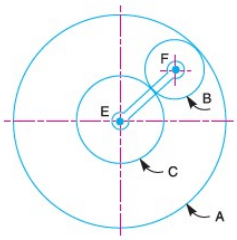
PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	Discuss the classification of kinematic pairs.	*13,K2,CO1*
		OR	
	b)	ABCD is a four bar chain with link AD fixed and is 150 mm. The crank AB is 40 mm long and rotates at 120 rpm clockwise. The link CD oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD, when angle BAD = 60°.	*13,K3,CO1*
12.	a)	Two involute gears of 20° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module, Find :1. The angle turned through by pinion when one pair of teeth is in mesh; and 2. The maximum velocity of sliding.	*13,K3,CO2*

OR

b) An epicyclic gear consists of three gears A, B and C as shown in Fig. The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 r.p.m.. If the gear A is fixed, determine the speed of gears B and C. *13,K3,CO2*



13. a) A Porter governor has equal arms each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 15 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the minimum and maximum speeds and range of speed of the governor. *13,K3,CO4*

OR

b) A ship propelled by a turbine rotor which has a mass of 5 tonnes and a speed of 2100 r.p.m. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions:1. The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius. 2. The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds. 3. The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern. Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case. *13,K3,CO4*

14. a) Four masses m_1, m_2, $m_3$and m_4 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 respectively and the angles between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m. *13,K3,CO5*

OR

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 *13,K3,CO5*

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 400mm 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.

15. a) A shaft 50 mm diameter and 3 m long is simply supported at the ends and carries three isolated loads 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m respectively from the left support. Find the frequency of the vibrations considering the mass of the shaft. Take E = 200 GN/m^2. *13,K3,CO6*

OR

b) The following data are given for a vibratory system with viscous damping: *13,K3,CO6*

Mass = 2.5 kg; spring constant = 3 N/mm and the amplitude decreases to 0.25 of the initial value after five consecutive cycles. Determine the damping coefficient of the damper in the system.

PART - C (1 × 15 = 15 Marks)

16. a) A cam is to be designed for a knife edge follower with the following data : *15,K3,CO3*

1. Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion.
2. Dwell for the next 30°.
3. During the next 60° 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 20 mm from the axis of the cam shaft. The radius of the base circle of the cam is 40 mm.

OR

b) Design a cam for operating the exhaust valve of an oil engine. It is required to give equal uniform acceleration and retardation during opening and closing of the valve each of which corresponds to 60° of cam rotation. The valve must remain in the fully open position for 20° of cam rotation. The lift of the valve is 37.5 mm and the least radius of the cam is 40 mm. The follower is provided with a roller of radius 20 mm and its line of stroke passes through the axis of the cam. *15,K3,CO3*