Reg. No.												

Question Paper Code	12041

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2023

Fourth Semester

Mechanical and Automation Engineering

20MUPC402 - THEORY OF MACHINES

(Regulations 2020)

(A3 Size Drawing Sheets need to be provided)

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level, CO
1.	Differentiate between a machine and a structure.	*2,K2,CO1*
2.	Write Grashof's law.	*2,K1,CO1*
3.	What are the types of gears used if the shafts are parallel and co planar?	*2,K1,CO2*
4.	Define module of a gear.	*2,K1,CO2*
5.	What is meant by 'Height' of the Governor?	*2,K1,CO4*
6.	Why rolling motion of a ship has no gyroscopic effect?	*2,K2,CO4*
7.	What is meant by 'reference Plane', when several masses are rotating in different planes?	*2,K2,CO5*
8.	List down the conditions necessary for the Multi-cylinder engines to be complete balanced.	*2,K2,CO5*
9.	Define whirling speed.	*2,K1,CO6*
10.	What 'Logarithmic decrement' is as applied to damped vibrations?	*2,K2,CO6*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	With neat sketches, Explain the following Inversions of Single slider crank mechanism: (i) Gnome Engine (ii) Oscillating cylinder Engine (iii) Hand pump.	*13,K2,CO1*
		OR	
	b)	Explain the Inversions of Four bar chain Mechanism with neat sketches.	*13,K2,CO1*
12.	a)	A pair of gears, having 40 and 20 teeth respectively, are in meshing, the speed of the smaller being 2000 r.p.m. Determine the velocity of sliding between the gear teeth faces at the point of engagement, at the pitch point, and at the point of disengagement if the smaller gear is the	*13,K3,CO2*

driver. Assume that the gear teeth are 20° involute form, addendum length is 5 mm and the module is 5 mm. Also find the angle through which the pinion turns while any pairs of teeth are in contact.

OR

b) In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear B? *13,K3,CO2*

13. a) In an engine governor of the Porter type, the upper and lower arms are 200 mm and 250 mm respectively and pivoted on the axis of rotation. The mass of the central load is 15 kg, the mass of each ball is 2 kg and friction of the sleeve together with the resistance of the operating gear is equal to a load of 25 N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40°, find, taking friction into account, 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 with 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 *A*, *B*, *C* and *D* are attached to a shaft and revolve in the same plane. The masses are 12 kg, 10 kg, 18 kg and 15 kg respectively and their radii of rotations are 40 mm, 50 mm, 60 mm and 30 mm. The angular position of the masses *B*, *C* and *D* are 60°, 135° and 270° from the mass *A*. Find the magnitude and position of the balancing mass at a radius of 100 mm. *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 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 *13,K3,CO5*

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) Calculate the whirling speed of a shaft of 20 mm diameter and 0.6 m long carrying a mass of 1 kg at its mid-point. The density of the shaft material is 40 Mg/m^3, and Young's modulus is 200 GN/m^2. Assume the shaft to be freely supported. *13,K3,CO6*

OR

b) 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 stiffness 5.4 N/mm. If the vibrating system have 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. *13,K3,CO6*

PART - C (1 × 15 = 15 Marks)

16. a) 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*

OR

b) A cam rotating clockwise at a uniform speed of 200 r.p.m. is required to move an Radial knife edge follower with a Simple harmonic motion on both the outward and return strokes. The angle of ascent, the angle of dwell (between ascent and descent) and the angle of descent is 120°, 60° and 90° respectively. The follower dwells for the rest of cam rotation. The least radius of the cam is 40 mm and the lift of the follower is 40 mm. The line of stroke of the follower passes through the axis of the cam. Draw the cam profile and find the maximum velocity and acceleration of the follower during the outstroke. *15,K3,CO3*