Reg. No.												

Question Paper Code	12402

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

Fifth Semester

Mechanical Engineering

20MEPC503 - THEORY OF MACHINES

(Regulations 2020)

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

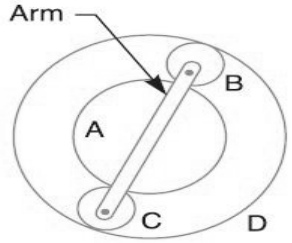
		Marks, K-Level, CO
1.	Give some examples for kinematics pairs.	*2,K1,CO1*
2.	Write the equation of kutzbach criterion.	*2,K1,CO1*
3.	State law of gearing.	*2,K2,CO2*
4.	What are the applications of reverted gear train?	*2,K1,CO2*
5.	Define maximum fluctuation of speed.	*2,K1,CO4*
6.	Write the condition for complete balancing.	*2,K1,CO4*
7.	What are the causes of vibration?	*2,K1,CO5*
8.	Compare free vibration and forced vibrations.	*2,K2,CO5*
9.	Define power of a governor.	*2,K1,CO6*
10.	Give the application of gyroscopic principle.	*2,K1,CO6*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	Explain the Inversions of Four bar chain Mechanism with neat sketches.	*13,K2,CO1*
		OR	
	b)	PQRS is a four bar chain with link PS fixed. The lengths of the links are PQ = 62.5 mm ; QR = 175 mm ; RS = 112.5 mm ; and PS = 200 mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagram when angle QPS = 60° and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of links QR and RS.	*13,K3,CO1*
12.	a)	A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio.	*13,K3,CO2*
		OR	

b) An epicyclic train of gears is arranged as shown in Figure. How many revolutions does the arm, to which the pinions B and C are attached, make: 1. when A makes one revolution clockwise and D makes half a revolution anticlockwise? and 2. When A makes one revolution clockwise and D is stationary? The number of teeth on the gears A and D are 40 and 90 respectively. *13,K3,CO2*



13. a) A vertical double acting steam engine has a cylinder 300 mm diameter and 450 mm stroke and runs at 200 r.p.m. The reciprocating parts has a mass of 225 kg and the piston rod is 50 mm diameter. The connecting rod is 1.2 m long. When the crank has turned through 125° from the top dead centre, the steam pressure above the piston is 30 kN/m^2 and below the piston is 1.5 kN/m^2. Calculate the effective turning moment on the crank shaft. *13,K3,CO4*

OR

b) A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. *13,K3,CO4*

14. a) Calculate the critical speed of a shaft 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/m2. Assume the shaft to be freely supported. *13,K3,CO5*

OR

b) A mass of 50kg is suspended by an elastic structure of total stiffness 20kN/m. The damping ratio of the system is 0.2. A simple harmonic disturbing force acts on the mass and at any time t seconds, the force is 60sin10t new tons. Find the amplitude of the vibrations and the phase angle caused by the damping. *13,K3,CO5*

15. a) In a porter governor, each of the four arms is 400 mm long. The upper arms are pivoted on the axis of the sleeve; where as the lower arms are attached to the sleeve at a distance of 45 mm from the axis of rotation. Each ball has a mass of 5 kg and the load on the sleeve is 60 kg. What will be the equilibrium speeds of the two extreme radii of 250 mm and 300 mm of rotation of the governor balls? *13,K3,CO6*

OR

b) The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: *13,K3,CO6*

1. When the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h?
2. When the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity? The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees.

PART - C (1 × 15 = 15 Marks)

16. a) A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below : 1. To raise the valve through 50 mm during 120° rotation of the cam ; 2. To keep the valve fully raised through next 30°; 3. To lower the valve during next 60°; and 4. To keep the valve closed during rest of the revolution i.e. 150°; The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when (a) the line of stroke of the valve rod passes through the axis of the cam shaft, and (b) the line of the stroke is offset 15 mm from the axis of the cam shaft. The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion. Determine the maximum acceleration of the valve rod when the cam shaft rotates at 100 r.p.m. Draw the displacement, the velocity and the acceleration diagrams for one complete revolution of the cam. *15,K3,CO3*

OR

b) A cam, with a minimum radius of 50 mm, rotating clockwise at a uniform speed is required to give a knife edge follower, the, motion described below : *15,K3,CO3*

1. To move outwards through 40 mm during 100° rotation of the cam
2. To dwell for the next 80°
3. To return to its starting position during next 90° and 4. To dwell during rest of the revolution i.e. 90°

Draw the profile of the cam when the line of stroke of the valve rod passes through the axis of the cam shaft. The displacement of the follower is to take place with Uniform acceleration and uniform retardation.