Reg. No.												

Question Paper Code	11930

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

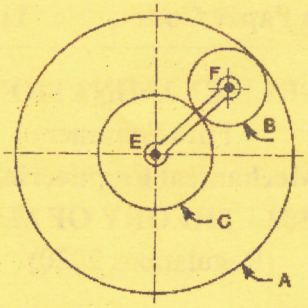
		Marks, K-Level, CO
1.	What is a kinematic link?	*2,K1,CO1*
2.	What is an inversion of Mechanism?	*2,K1,CO1*
3.	Mention the advantages of gear drive.	*2,K1,CO3*
4.	What are mitre gears?	*2,K1,CO3*
5.	State D-Alembert's principle.	*2,K1,CO4*
6.	What are the conditions to be satisfied for a system to be completely balanced?	*2,K2,CO4*
7.	Define Time period of vibration.	*2,K1,CO5*
8.	Define Damping factor.	*2,K2,CO5*
9.	What are the most commonly used belt materials?	*2,K1,CO6*
10.	Define the Height of the Governor.	*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)	Explain the Inversions of Four bar chain Mechanism with neat sketches.	*13,K2,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,CO3*
		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	*13,K3,CO3*

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. 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,CO4*

OR

b) The crank-pin circle radius of a horizontal engine is 300 mm. The mass of the reciprocating parts is 250 kg. When the crank has travelled 60° from I.D.C., the difference between the driving and the back pressures is 0.35 N/mm^2. The connecting rod length between centres is 1.2 m and the cylinder bore is 0.5 m. If the engine runs at 250 r.p.m. and if the effect of piston rod diameter is neglected, calculate: 1. pressure on slide bars, 2. thrust in the connecting rod, 3. tangential force on the crank-pin, and 4. turning moment on the crank shaft. *13,K3,CO4*

14. 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,CO5*

OR

b) The following data are given for a vibratory system with viscous damping: 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. *13,K3,CO5*

15. a) Two pulleys, one 450 mm diameter and the other 200 mm diameter are on parallel shafts 1.95 m apart and are connected by a crossed belt. Find the length of the belt required and the angle of contact between the belt and each pulley. What power can be transmitted by the belt when the larger pulley rotates at 200 rev/min, if the maximum permissible tension in the belt is 1 kN, and the coefficient of friction between the belt and pulley is 0.25? *13,K3,CO6*

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,CO6*

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,CO2*

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. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240 r.p.m.

OR

b) 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 : *15,K3,CO2*

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 the line of stroke of the valve rod passes through 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.