Reg. No.															

Question Paper Code	14025

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Fifth Semester

Mechanical Engineering

20MEPC503 – THEORY OF MACHINES

Regulations - 2020

(A3 Size Drawing sheet need to be issued)

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	The Gruebler's criterion for determining the degrees of freedom (n) of a mechanism having plane motion is: (a) n = (l – 1) – j (b) n = 2 (l – 1) – 2j (c) n = 3 (l – 1) – 2j (d) n = 4 (l – 1) – 3j	1	K1	CO1
2.	In a 4-bar linkage, if the lengths of shortest, longest, and the other two links are denoted by s, l, p, and q, then it would result in Grashof's linkage provided that: (a) l + p < s + q (b) l + s < p + q (c) l + p = s + q (d) none of these	1	K1	CO1
3.	The type of gears used to connect two non-parallel non-intersecting shafts are (a) spur gears (b) helical gears (c) spiral gears (d) none of these	1	K2	CO2
4.	If the module of a gear be m, the number of teeth T and pitch circle diameter D, then (a) m = D/T (b) D = T/m (c) m = D/2T (d) none of these	1	K1	CO2
5.	The angle between the direction of the follower motion and a normal to the pitch curve is called (a) pitch angle (b) prime angle (c) base angle (d) pressure angle	1	K1	CO3
6.	The cam follower extensively used in air-craft engines is (a) knife edge follower (b) flat faced follower (c) spherical faced follower (d) roller follower	1	K1	CO3
7.	When the crank is at the inner dead centre, in a horizontal reciprocating steam engine, then the velocity of the piston will be (a) zero (b) minimum (c) maximum (d) none of these	1	K2	CO4
8.	For dynamic balancing of a shaft, (a) the net dynamic force acting on the shaft is equal to zero (b) the net couple due to dynamic forces acting on the shaft is equal to zero (c) both (a) and (b) (d) none of the above	1	K2	CO4
9.	The factor which affects the critical speed of a shaft is (a) diameter of the disc (b) span of the shaft (c) eccentricity (d) all of these	1	K2	CO5
10.	The angle of inclination of the plane, at which the body begins to move down the plane, is called (a) angle of friction (b) angle of repose (c) angle of projection (d) none of these	1	K1	CO6

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

		Marks	K – Level	CO
11.	Give the classification of kinematic link	2	K1	CO1
12.	Differentiate mechanism from a machine.	2	K2	CO1
13.	State the Law of gearing.	2	K1	CO2
14.	Elaborate about interference in gears.	2	K2	CO2
15.	Classify the types of cams and followers	2	K2	CO3
16.	List the four types of follower motions	2	K1	CO3

17.	State the D'Alembert's principle.	2	K1	CO4
18.	Discuss the need to balance rotating masses in a machine element.	2	K2	CO4
19.	Define the term whirling speed of shaft	2	K1	CO5
20.	Define the term vibration isolation	2	K1	CO5
21.	State the Laws of friction	2	K1	CO6
22.	List the functions of a governor.	2	K1	CO6

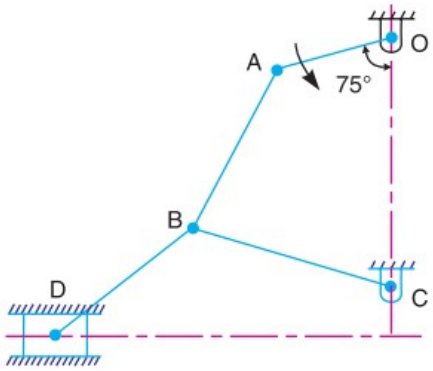
PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	Illustrate with neat sketches the various inversions of single slider crank mechanism and discuss their applications.	11	K3	CO1

OR

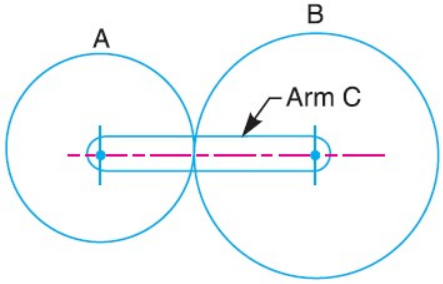
	b)	In the given diagram, the angular velocity of the crank OA is 600 r.p.m. Determine the linear velocity of the slider D and the angular velocity of the link BD, when the crank is inclined at an angle of 75° to the vertical. The dimensions of various links are: OA = 28 mm; AB = 44 mm; BC 49 mm; and BD = 46 mm. The distance between the centres of rotation O and C is 65 mm. The path of travel of the slider is 11 mm below the fixed point C. The slider moves along a horizontal path and OC is vertical.	11	K3	CO1



24.	a)	Two mating involute spur gears of 20° pressure angle have a gear ratio of 2. The number of teeth on the pinion is 20 and its speed is 250 r.p.m. The module pitch of the teeth is 12 mm. If the addendum is equal to 1 module, determine the length of the arc of contact, length of path of contact and the maximum velocity of sliding during approach and recess. Assume pinion to be the driver.	11	K3	CO2

OR

	b)	The arm C of the epicyclic gear train, shown in figure 1 carries two gears A and B having 36 and 45 teeth respectively. Determine the speed of gear B when the arm rotates at 150 rpm in CCW direction about the centre of gear A which is fixed. If the gear A instead of being fixed, rotates at 300 rpm, in CW direction, identify the speed of gear B.	11	K3	CO2



25.	a)	A cam is to be designed for a knife edge follower with the following data: 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 of the follower passes through the axis of the cam shaft. The radius of the base circle of the cam is 40 mm.	*11*	*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 Lift through 40 mm during first 100° of its rotation, dwell for the next 80° and return to initial position during next 90°. The follower is at rest for the remaining revolution of cam. Draw the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft. The follower motion is uniform acceleration and uniform retardation in nature during both rise and return.	*11*	*K3*	*CO3*
26.	a)	A horizontal steam engine running at 210 rpm has a bore of 190 mm and stroke of 350 mm. The piston rod is 20 mm diameter and connecting rod length is 950 mm. The mass of the reciprocating parts is 8 kg and the frictional resistance is 350 N. Determine the following when the crank is at 115° from the inner dead centre, with steam pressure being 4500 N/m² on the cover side and 100 N/m² on the crank side: 1. Thrust on the connecting rod 2. Thrust on the cylinder walls 3. Loads on the bearings 4. Turning moment on the crankshaft.	*11*	*K3*	*CO4*
		OR			
	b)	In an industrial machine, four masses A, B, C and D are 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.	*11*	*K3*	*CO4*
27.	a)	A shaft 50mm diameter and 3m long is simply supported at the ends. It carries three loads of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m respectively from the left support. The Young's modulus for shaft material is 200 GN/m^2. Find the frequency of vibration.	*11*	*K3*	*CO5*
		OR			
	b)	A body of mass of 50 kg is supported by an elastic structure of stiffness 10 kN/m. The motion of the body is controlled by a dashpot such that the amplitude of vibration decreases to one-tenth of its original value after two complete vibrations. Determine the damping force at 1 m/s, the damping ratio and the natural frequency of vibration.	*11*	*K3*	*CO5*
28.	a)	A vertical screw with single start square threads 50 mm mean diameter and 12.5 mm pitch is raised against a load of 10 kN by means of a hand wheel, the boss of which is threaded to act as a nut. The axial load is taken up by a thrust collar which supports the wheel boss and has a mean diameter of 60 mm. If the coefficient of friction is 0.15 for the screw and 0.18 for the collar and the tangential force applied by each hand to the wheel is 100 N; find suitable diameter of the hand wheel.	*11*	*K3*	*CO6*
		OR			
	b)	An aero plane makes a complete half circle of 50 metres radius, towards left, when flying at 200 km per hour. The rotary engine and the propeller of the plane have a mass of 400 kg with a radius of gyration of 300 mm. The engine runs at 2400 r.p.m. clockwise, when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it. What will be the effect, if the aeroplane turns to its right instead of to the left?	*11*	*K3*	*CO6*