Reg. No.																

Question Paper Code	14369

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2026

Fourth Semester

Mechanical Engineering

24MEPC403 - THEORY OF MACHINES

Regulations - 2024

(A3 size Drawing Sheets need to be provided)

Duration: 3 Hours | Max. Marks: 100

PART – A (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	K – Level	CO
1.	Which of the following is an inversion of double slider crank chain? a) Coupling rod of a locomotive b) Pendulum pump c) Elliptical trammel d) Oscillating cylinder engine	1	K1	CO1
2.	The two elements of a pair are said to form a _____ when they permit relative motion between them. a) open pair b) kinematic pair c) higher pair d) lower pair	1	K2	CO1
3.	Which of the following is an inversion of single slider crank chain? a) Beam engine b) Watt's indicator mechanism c) Elliptical trammel d)Whitworth quick return motion mechanism	1	K1	CO1
4.	An imaginary circle which by pure rolling action, gives the same motion as the actual gear, is called a) addendum circle b) dedendum circle c) pitch circle d) clearance circle	1	K1	CO2
5.	Law of gearing ensures a) Constant torque b) Constant angular velocity ratio c) Maximum efficiency d) Minimum wear	1	K1	CO2
6.	For a pair of spur gears to mesh properly, they must have the same: a) Circular pitch b) Module c) Diametral pitch d) Pressure angle	1	K2	CO2
7.	In a radial cam, the follower moves a) in a direction perpendicular to the cam axis b) in a direction parallel to the cam axis c) in any direction irrespective of the cam axis d) along the cam axis	1	K1	CO3
8.	Offset is provided to a cam follower mechanism to a) minimize the side thrust b) accelerate c) avoid jerk d) none of these	1	K1	CO3
9.	For high speed engines, the cam follower should move with a) uniform velocity b) simple harmonic motion c) uniform acceleration and retardation d) cycloidal motion	1	K2	CO3

10.	D'Alembert's principle converts dynamic problem into		1	K2	CO4
	a) Static problem	b) Kinematic problem			
	c) Thermal problem	d) None			
11.	Balancing of a single rotating mass involves:		1	K1	CO4
	a) adding a mass at 90°	b) adding an equal mass in the same position			
	c) adding an equal mass diametrically opposite	d) removing part of the original mass			
12.	The unbalanced force in a reciprocating engine is due to:		1	K1	CO4
	a) Inertia of reciprocating parts	b) Friction			
	c) Gear ratio	d) None			
13.	Longitudinal vibrations are said to occur when the particles of a body moves		1	K2	CO5
	a) perpendicular to its axis	b) parallel to its axis			
	c) in a circle about its axis	d) inclined to its axis			
14.	Damping in a vibrating system means:		1	K1	CO5
	a) The system's tendency to vibrate at a higher amplitude	b) The reduction of energy in the system, leading to decreased amplitude			
	c) The increase in the number of oscillation	d) The system oscillates indefinitely			
15.	A self-locking screw jack means:		1	K1	CO6
	a) It cannot lower the load unless operated manually	b) It lifts automatically when a load is applied			
	c) It requires continuous force to hold the load	d) It increases efficiency			
16.	The main advantage of using a V-belt over a flat belt is:		1	K2	CO6
	a) Cheaper cost	b) Better grip and less slip			
	c) Easier installation	d) High flexibility			

PART - A (ii) (Short Answer Questions)
(6 × 3 = 18 Marks)
Answer ALL Questions

17.	Write the Grubler's criterion for plane mechanisms.	3	K2	CO1
18.	Explain the term Interference of gears.	3	K2	CO2
19.	Which type of follower motion is preferred for High speed cams?	3	K2	CO3
20.	How will you find the Thrust on bearings, in Dynamic analysis of I.C.Engine?	3	K3	CO4
21.	Outline the meaning of Damping factor.	3	K3	CO5
22.	Why rolling motion of a ship has no gyro effect?	3	K3	CO6

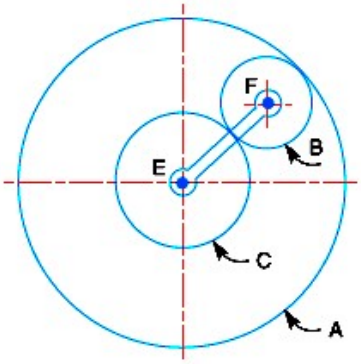
PART - B (Descriptive Answer Questions)
(6 × 11 = 66 Marks)
Answer ALL Questions

23.	a)	With neat sketches, Explain the inversions of Double slider crank mechanism.	11	K3	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 diagram when angle QPS = 60° and Q and R lie on the same side of PS. Find the angular velocity of links QR and RS.	11	K3	CO1

24. a) Two gears of module 4mm have 24 and 33 teeth. The pressure angle is 20° and each gear has a standard addendum of one module. Find the length of arc of contact and the maximum velocity of sliding if the pinion rotates at 120 r.p.m. — *11* *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. — *11* *K3* *CO2*



25. a) A cam is to be designed for a knife edge follower with the following data : — *11* *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) A cam rotating clockwise at a uniform speed of 1000 r.p.m. is required to move outwards 50 mm with an roller follower moves with a uniform and equal acceleration and retardation on both the outward and return strokes. The angle of ascent, the angle of dwell 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 50 mm, and the diameter of the roller is 10mm. The line of stroke of the follower is offset by 20 mm from the axis of the cam. Draw the cam profile . — *11* *K3* *CO3*

26. a) A vertical petrol engine 100 mm diameter and 120 mm stroke has a connecting rod 250 mm long. The mass of the piston is 1.1 kg. The speed is 2000 r.p.m. On the expansion stroke with a crank 20° from top dead centre, the gas pressure is 700 kN/m^2. Determine:1. Net force on the piston, 2. Resultant load on the gudgeon pin, 3. Thrust on the cylinder walls, and 4. Speed above which, other things remaining same, the gudgeon pin load would be reversed in direction. — *11* *K3* *CO4*

OR

b) 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. — *11* *K3* *CO4*

27. 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 neglecting the mass of the shaft. Take E = 200 GN/m^2. — *11* *K3* *CO5*

OR

b) The mass of a single degree damped vibrating system is 7.5 kg and makes 24 free oscillations in 14 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.25 of its initial value after five oscillations. Determine: 1. Stiffness of the spring, 2. Logarithmic decrement and 3. Damping factor, i.e. the ratio of the system damping to critical damping. *11* *K3* *CO5*

28. a) A square threaded bolt of root diameter 22.5 mm and pitch 5 mm is tightened by screwing a nut whose mean diameter of bearing surface is 50 mm. If coefficient of friction for nut and bolt is 0.1 and for nut and bearing surface 0.16, find the force required at the end of a spanner 500 mm long when the load on the bolt is 10 kN. *11* *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: 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. *11* *K3* *CO6*