Reg. No.																

Question Paper Code	14670

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

Fifth Semester

Mechanical Engineering

20MEPC503 - THEORY OF MACHINES

Regulations - 2020

(Use of A3 Drawing sheet is permitted)

Duration: 3 Hours | Max. Marks: 100

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

		Marks	K – Level	CO
1.	A ball and a socket joint forms a a) Turning Pair b) Rolling Pair c) Sliding Pair d) Spherical Pair	1	K1	CO1
2.	The purpose of an oscillating cylinder engine is a) To convert rotary into oscillatory motion b) To convert oscillatory into rotary motion c)To convert rotary into reciprocating motion d)To convert reciprocating into rotary motion	1	K2	CO1
3.	The two elements of a pair are said to form _____ when they permit relative motion between them. a) open pair b) kinematic pair c) higher pair d) lower pair	1	K1	CO1
4.	The contact ratio for gears is a) Zero b) Less than One c) Greater than One d) Equal to One	1	K1	CO2
5.	In a gear train, when the axes of the shafts, over which the gears are mounted, move relative to a fixed axis, is called a) Simple Gear Train b) Compound Gear Train c) Reverted Gear Train d) Epicyclic Gear Train	1	K2	CO2
6.	The smaller and generally the driving gear of a pair of mated gears is called a) rack b) pinion c) module d) pitch	1	K2	CO2
7.	The size of a cam depends upon _____ a) base circle b) prime circle c) pitch circle d) pitch curve	1	K1	CO3
8.	The purpose of a cam in a mechanical system is to a) Convert rotational into linear motion b) Transmit torque c) Store energy d) Reduce friction	1	K2	CO3
9.	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
10.	The net force acting on the piston is known as _____. a) crank pin effort b) crank effort c) piston effort d) shaft effort	1	K1	CO4

11.	The force that acts on IC engine parts due to their reciprocating motion is a) centrifugal force c) frictional force	b) gravitational force d) inertia force	*1*	*K2*	*CO4*
12.	Balancing of a single rotating mass involves a) adding an equal mass in the same position c) removing part of the original mass	b) adding an equal mass diametrically opposite d) adding a mass at 90°	*1*	*K2*	*CO4*
13.	When there is a reduction in amplitude over every cycle of vibration, then the body is said to have a) free vibration c) forced vibration	b) damped vibration d) linear vibration	*1*	*K2*	*CO5*
14.	The speed at which the shaft runs so that the additional deflection of the shaft from the axis of rotation becomes _____ is known as critical or whirling speed. a) zero c) negative	b) minimum d) infinite	*1*	*K1*	*CO5*
15.	The steering of a ship means a) movement of a complete ship up and down in vertical plane about transverse axis c) rolling of a complete ship side-ways	b) turning of a complete ship in a curve towards the right or left, while it moves forward d) none of the above	*1*	*K2*	*CO6*
16.	The primary function of a screw jack is to a) To transmit rotary motion c) To transmit power	b) To lift heavy loads d) To reduce friction	*1*	*K2*	*CO6*

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

17.	Explain about the Kutzbach criterion.	*3*	*K2*	*CO1*
18.	Define the terms i) Module ii) Circular pitch.	*3*	*K1*	*CO2*
19.	Why Roller Follower is preferred over Knife edge follower?	*3*	*K1*	*CO3*
20.	Mention the importance of balancing.	*3*	*K1*	*CO4*
21.	Compare longitudinal vibration and transverse vibration.	*3*	*K3*	*CO5*
22.	Justify 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)	Illustrate the inversions of Double slider crank Mechanism with neat sketches.	*5*	*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 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.	*11*	*K3*	*CO1*

24.	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 the angle turned through by pinion when one pair of teeth is in mesh and maximum velocity of sliding.	*11*	*K3*	*CO2*
		OR			
	b)	In a reverted epicyclic gear train, the arm A carries two gears B and C and a compound gear D - E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed and the arm A makes 100 r.p.m. clockwise.	*11*	*K3*	*CO2*
25.	a)	Draw the profile of a cam operating a roller reciprocating follower and with the following data: Minimum radius of cam = 25 mm; lift = 30 mm; Roller diameter = 15 mm. The cam lifts the follower for 120° with SHM, followed by a dwell period of 30°. Then the follower lowers down during 150° of cam rotation with uniform acceleration and retardation followed by a dwell period.	*11*	*K3*	*CO3*
		OR			
	b)	Draw the profile of a cam operating a Knife-edged follower from the following data: (a) Follower to move outward through 40 mm during 60° of a cam rotation; (b) Follower to dwell for the next 45° (c) Follower to return its original position during next 90° (d)Follower to dwell for the rest of cam rotation. The displacement of the follower is to take place with simple harmonic motion during both the outward and return strokes. The least radius of the cam is 50mm.	*11*	*K3*	*CO3*
26.	a)	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 pressure on slide bars, thrust in the connecting rod, and turning moment on the crank shaft.	*11*	*K3*	*CO4*
		OR			
	b)	A rotating shaft carries four unbalanced masses 18 kg, 14 kg, 16 kg and 12 kg at radii 5 cm, 6 cm, 7 cm and 6 cm respectively. The 2nd, 3rd and 4th masses revolve in planes 8 cm, 16 cm and 28 cm respectively measured from the plane of the first mass and are angularly located at 60°, 135° and 270° respectively measured clockwise from the first mass looking from this mass end of the shaft. The shaft is dynamically balanced by two masses, both located at 5 cm radii and revolving in planes mid-way between those of 1^{st} and 2^{nd} masses and mid-way between those of 3rd and 4th masses. Determine graphically or otherwise, the magnitudes of the masses and their respective angular positions	*11*	*K3*	*CO4*
27.	a)	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.	*11*	*K3*	*CO5*
		OR			
	b)	Calculate the whirling speed of a shaft of 20 mm diameter and length 0.6 m, carrying a mass of 1 kg at its mid-point. The density of the shaft material is 40 Kg/m^3, and Young's modulus is 200 GN/m^2. Assume the shaft to be freely supported.	*11*	*K3*	*CO5*

28. a) The mass of the turbine rotor of a ship is 20 tonnes and has a radius of gyration of 0.60 m. Its speed is 2000 r.p.m. The ship pitches 6° above and 6° below the horizontal position. A complete oscillation takes 30 seconds and the motion is simple harmonic. Determine Maximum gyroscopic couple, and the direction in which the bow will tend to turn when rising, if the rotation of the rotor is clockwise when looking from the stern. *11 K3 CO6*

OR

b) A Porter governor has all four arms 250 mm long. The upper arms are attached on the axis of rotation and the lower arms are attached to the sleeve at a distance of 30 mm from the axis. The mass of each ball is 5 kg and the sleeve has a mass of 50 kg. The extreme radii of rotation are 150 mm and 200 mm. Determine the range of speed of the governor. *11 K3 CO6*