Reg.No. : | | | | | | | | | | |

Question Paper Code: 96701

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2024

Fourth Semester

Mechanical Engineering

19UME401 - Theory of Machines

(Regulations 2019)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The magnitude of linear velocity of a point B on a link AB relative to point A is CO1- U

   (a) ω x AB (b) $\omega(AB)^2$ (c) ω x AB (d) $\omega(AB)^2$

2. In a kinematic chain, a quaternary joint is equivalent to CO1- U

   (a) one binary joint (b) two binary joints

   (c) three binary joints (d) four binary joints

3. The_____force is an imaginary force CO2- U

   (a) Inertia (b) Resultant (c) Torque (d) Sliding

4. Angular momentum of the disc CO2- U

   (a) Iω (b) $I\omega^2$ (c) mω (d) Iα

5. Cam size depends upon CO3- U

   (a) base circle (b) pitch circle (c) prime circle (d) outer circle

6. The cam follower generally used in aircraft engines is CO3- U

   (a) knife edge follower (b) flat faced follower

   (c) spherical faced follower (d) roller follower

7. The size of a gear is usually specified by CO4- U

   (a) pressure angle (b) circular pitch

   (c) diametral pitch (d) pitch circle diameter

8. When the axes of first and last gear are co-axial, then gear train is known as CO4- U

(a) simple gear train (b) compound gear train

(c) epicyclic gear train (d) reverted gear train

9. When no external force acts on the body, after giving it an initial displacement, then the body is said to be __ CO5- U

(a) free vibration (b) forced vibration

(c) resonance (d) None of these

10. If the damping factor for a vibrating system is unity, then the system will be CO5- U

(a) critically damped (b) without vibrations

(c) over damped (d) under damped

PART – B (5 x 2= 10 Marks)

11. ABCD is a mechanism with link lengths AB = 200, BC = 300, CD = 400 and DA = 350. Which one of the following links should be fixed for the resulting mechanism to be a double crank mechanism? (All lengths are in mm) CO1- App

12. Explain the piston effort. CO2- U

13. Explain tangential cam CO3- U

14. Illustrate the law of gearing CO4- U

15. Illustrate critical or whirling or whipping speed of a shaft. CO5- U

PART – C (5 x 16= 80 Marks)

16. (a) A four bar chain mechanism PQRS it is drive by the crank PQ which rotates at 600 rpm in clockwise direction. The link PS is fixed. Find the angular velocity of the links QR and RS. Link PQ = 62.5mm, QR =175mm, RS = 112.5mm, PS = 200mm, QPS = 50°. CO1- App (16)

Or

(b) A link AB of a four bar linkage ABCD revolves uniformly at 120rpm in a clockwise direction. Given AB=75mm, BC=175mm, CD=150mm,DA=100mm and angle BAD equal to 90°.AD is fixed link. Using graphical approach, find the angular accelerations of links BC and CD and acceleration of point E on the link BC, if EC = 150mm. CO1- App (16)

17.	(a)	A vertical petrol engine with cylinder of 150mm diameter and 200mm strokes has a connecting rod of 350mm long. The mass is 1.6kg and the engine speed is 1800 rpm. On the expansion stroke with crank angle 30° from TDC, the gas pressure is 750KPa. Determine the net thrust on the piston.	CO2- App	(16)
		Or		
	(b)	The crank-pin circle radius of a horizontal engine is 200 mm. The length of connecting rod is 1 m. The crank is rotating at 400 rpm. When the crank has turned 30° from the IDC, the difference of pressure between the cover end and piston end is 4 bar. The mass of reciprocating parts is 100 kg and cylinder bore is 0.4 m. Determine, (1) Inertia forces of piston ; (2) Force on piston by gas ; (3) Piston effort	CO2-App	(16)
18.	(a)	Draw the cam profile for the following data: (AU Dec 2010) Basic circle radius of cam = 50mm, Lift = 40mm, Angle of ascent with cycloidal = 60°, angle of dwell = 90°, angle of descent with uniform velocity = 90°, speed of cam = 300rpm, Follower offset = 10mm, Type of follower = knife – Edge.	CO3- App	(16)
		Or		
	(b)	The following data refer to two cylinder locomotive with cranks at 90°: Reciprocating mass per cylinder = 300 kg; Crank radius = 0.3 m; Driving wheel diameter = 1.8 m; Distance between cylinder centre lines = 0.65 m; Distance between the driving wheel central planes = 1.55 m. Find the magnitude M_A and position of the balancing mass at θ_A.	CO3- App	(16)
19.	(a)	Pressure angle of two gears is 20° and has a module of 10mm. The number of teeth on pinion and gear is same and equal to one module. Determine (i) the number of pairs of teeth in contact and (ii) the angle of action of pinion and gear and the ratio of sliding to rolling velocity at the beginning of contact.	CO4- Ana	(16)
		Or		
	(b)	A pinion of 20 involute teeth and 125 mm pitch circle diameter drives a rack. The addendum of both pinion and rack is 6.25mm.What is the least pressure angle which can be used to avoid interference? With this pressure angle, find the length of arc and the minimum number of teeth in contact at a time.	CO4- Ana	(16)

20. (a) A cantilever shaft 50 mm diameter and 300 mm long has a disc of mass 100 kg at its free end. The Young's modulus for the shaft material is 200 GN/m^2. Determine the frequency of longitudinal and transverse vibrations of the shaft. CO5- App (16)

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. CO5- App (16)