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Question Paper Code: 96701

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2022

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. A ball and a socket joint forms a CO1- U
(a) turning pair (b) rolling pair (c) sliding pair (d) spherical pair
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- R
(a) Inertia (b) Resultant (c) Torque (d) Sliding
4. Angular momentum of the disc CO2- R
(a) $I\omega$ (b) $I\omega^2$ (c) $m\omega$ (d) $I\alpha$
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. Explain the rubbing velocity. CO1- U
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) In a slider crank mechanism, the length of crank OB and connecting rod AB are 125 mm and 500 mm respectively. The centres of gravity G of the connecting rod is 275 from the slider A. the crank speed is 600 r.p.m. clockwise. when the crank has turned 45° from inner dead centre position, determine the velocity of slider A, velocity of the point G and angular velocity of the connecting rod AB. CO1- App (16)

17. (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: 1. pressure on slide bars, 2. thrust in the connecting rod. 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) A cam is designed for a knife edge follower with following data: Cam lift = 40mm during 90° of cam rotation with SHM, dwell for next 30° , during the next 60° of cam rotation, the follower returns to its original position with SHM, dwell during remaining 180° . Draw the profile of the cam when the line of stroke is offset 20mm from axis of cam shaft. The radius of base circle of cam is 40mm CO3- App (16)

Or

- (b) 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)
19. (a) 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)

Or

- (b) 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, calculate the length of path of contact 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) A shaft 50 mm diameter and 3 meters long is simply supported at the ends and carries three loads of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m from the left support. The Young's modulus for shaft material is 200 GN/m^2 . Find the frequency of transverse vibration CO5- App (16)