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Question Paper Code: 50742

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2017

Fourth Semester

Mechanical Engineering

15UME402 - KINEMATICS OF MACHINERY

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Mention Grubler's criterion for plane mechanisms with constrained motion

   (a) $3l + 2j - 4 = 0$ (b) $3l - 2j - 4 = 0$
   (c) $3l - 2j - 5 = 0$ (d) $3l - 4j - 2 = 0$

2. Which one of the following is incompletely constrained motion?

   (a) Square bar in a square hole (b) Shaft with collars in a circular hole
   (c) Shaft in a circular hole (d) Shaft in a foot step bearing

3. What will be the rubbing velocity at a pin joint when the two links move in opposite directions?

   (a) $(\omega 1 - \omega 2).r$ (b) $(\omega 1 + \omega 2).r$ (c) $(\omega 1 + \omega 2).2r$ (d) $(\omega 1 - \omega 2).2r$

4. Determine the magnitude of the Coriolis component of acceleration.

   (a) $a^c = 4.v.\omega$ (b) $a^c = 2.v.\omega^2$ (c) $a^c = 4.v.\omega^2$ (d) $a^c = 2.v.\omega$

5. Which one of the following is not a CAM nomenclature?

   (a) Prime circle (b) Pitch circle (c) Clearance circle (d) Base circle

6. Maximum acceleration of the follower during UAUR motion

   (a) Max a = $\frac{\pi^2 \omega^2 S}{2\theta^2}$ (b) Max a = $\frac{2\omega^2 S}{\theta^2}$ (c) Max a = $\frac{2\pi\omega^2 S}{\theta^2}$ (d) Max a = $\frac{4\omega^2 S}{\theta^2}$

7. State the relationship between circular pitch and the module

   (a) $p_c = \pi . m$ (b) $p_c = \pi / m$ (c) $p_c = 2\pi / m$ (d) $p_c = \pi . T / D$

8. Interference may only be prevented, if the addendum circles of the two mating gears cut the common tangent to the _____ between the points of tangency**.**

   (a) Pitch circles (b) Prime circles (c) Base circles (d) Clearance circles

9. The speed ratio of compound gear train is

(a) $\frac{\textbf{Product of number of teeth on the drivens}}{\textbf{Product of number of teeth on the drivers}}$ (b) $\frac{\textbf{Sum of number of teeth on the drivens}}{\textbf{Sum of number of teeth on the drivers}}$

(c) $\frac{\text{Product of number of teeth on the drivers}}{\text{Product of number of teeth on the drivens}}$ (d) $\frac{\text{Sum of number of teeth on the drivers}}{\text{Sum of number of teeth on the drivens}}$

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

(a) Simple (b) Compound (c) Reverted (d) Epi-cyclic

PART - B (5 x 2 = 10 Marks)

11. How many inversions are possible from a four-bar kinematic chain? Name them based on their input-output motions.

12. Distinguish normal component of acceleration and tangential component of acceleration.

13. Define undercutting in cam. How is occurs.

14. Define normal and axial pitch in helical gears.

15. Explain briefly the use of differential in an automobile.

PART - C (5 x 16 = 80 Marks)

16. (a) (i) Explain the different types of kinematic pairs with suitable illustrations. (8)

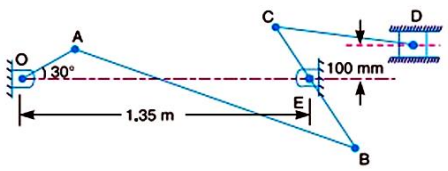
(ii) In a crank and slotted lever quick return motion mechanism, the distance between the fixed centers is 120 mm and the length of the driving crank is 60 mm. Determine the inclination of the slotted bar with the vertical in the extreme position and the time ratio. If the length of the slotted bar is 225 mm, find the length of the stroke if the line of stroke passes through the extreme positions of the free end of the lever. (8)

Or

(b) (i) Describe the working of Peaucellier mechanism and Indexing mechanism. (8)

(ii) Explain the Rotary engine and Scotch yoke mechanism with neat sketches. (8)

17. (a) A mechanism, as shown in below figure, has the following dimensions: OA = 200 mm; AB = 1.5 m; BC = 600 mm; CD = 500 mm and BE = 400 mm. If crank OA rotates uniformly at 120 r.p.m clockwise, find (i) the velocity of D and (ii) the angular velocity of the links AB and CD. (16)



Or

(b) An engine mechanism is shown in below figure. The crank CB = 100 mm and the connecting rod BA = 300 mm with centre of gravity G, 100 mm from B. In the position shown, the crankshaft has a speed of 75 rad/s and an angular acceleration of 1200 rad/s^2. Find: (i) Velocity of G and angular velocity of AB, and (ii) Acceleration of G and angular acceleration of AB. (16)

18. (a) A cam rotating clockwise at a uniform speed of 1000 r.p.m. is required to give a roller follower the motion defined below:

(i) Follower to move outwards through 50 mm during 120° of cam rotation

(ii) Follower to dwell for next 60° of cam rotation

(iii) Follower to return to its starting position during next 90° of cam rotation

(iv) Follower to dwell for the rest of the cam rotation

The minimum radius of the cam is 50 mm and the diameter of roller is 10 mm. The line of stroke of the follower is off-set by 20 mm from the axis of the cam shaft. If the displacement of the follower takes place with uniform and equal acceleration and retardation on both the outward and return strokes, draw profile of the cam and find the maximum velocity and acceleration during outstroke and return stroke. (16)

Or

(b) Draw a cam profile to drive an oscillating roller follower to the specifications given below: (i) Follower to move outwards through an angular displacement of 20° during the first 120° rotation of cam; (ii) Follower to return to its initial position during next 120° rotation of cam; (iii) Follower to dwell during the next 120° of cam rotation. The distance between pivot centre and roller centre = 120 mm; distance between pivot centre and cam axis = 130 mm; minimum radius of cam = 40 mm; radius of roller = 10 mm; inward and outward strokes take place with SHM. (16)

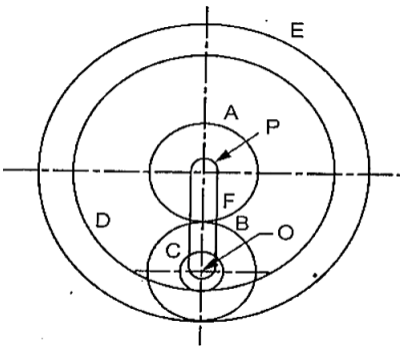
19. (a) (i) Derive an expression for the minimum number of teeth on the pinion in order to avoid interference. (6)

(ii) Two mating gears have 20 and 40 involute teeth of module 10mm and 20º pressure angle. The addendum on each wheel is to be made of such a length that the line of contact on each side of the pitch point has half the maximum possible length. Determine the addendum height for each gear wheel, length of path of contact. (10)

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, find: (i) the angle turned through by pinion and wheel when one pair of teeth is in mesh; and (ii) the maximum velocity of sliding at each side of the pitch point. (16)

20. (a) A compound epicyclic gear is shown in below figure. The gears A, D and E are free to rotate on axis P. The compound gears B and C rotate together on the axis O at the end of arm F. All gears have equal pitch. The number of external teeth on gears A, B and C are 35, 45 and 20 respectively. The gears D and E are annulus gears. The gear A rotates at 100 rpm in anticlockwise and gear D rotates at 450 rpm clockwise. Find the speed and direction of the arm and the gear E. (16)



Or

(b) The below figure shows a differential gear used in a motor car. The pinion A on the propeller shaft has 12 teeth and gears with the crown gear B which has 60 teeth. The shafts P and Q form the rear axles to which the road wheels are attached. If the propeller shaft rotates at 1000 r.p.m. and the road wheel attached to axle Q has a speed of 210 r.p.m. while taking a turn, find the speed of road wheel attached to axle P. (16)