C 3376

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Third Semester

Mechatronics Engineering

ME 1252 — KINEMATICS OF MACHINERY

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

A3 size drawing sheet will be supplied.

PART A — (10 × 2 = 20 marks)

1. Differentiate lower pair and higher pair.

2. Define transmission angle. Discuss the effect of transmission angle on mechanical advantage.

3. How will you find the linear velocity of a point situated on a rotating body?

4. Define the term Coriolis component of acceleration.

5. What's the function of a cam?

6. Explain the term pressure angle in a cam.

7. A toothed wheel has a circular pitch of 17 mm. If its number of teeth is 100, calculate the pitch diameter and the diameteral pitch.

8. What do you mean by interference in involute gears?

9. A block of 50 N rests on a horizontal plane and whose co-efficient of friction is 0.3. What is the force required to pull the block at an angle of 30° to the horizontal?

10. State any two functions of clutches.

PART B — (5 × 16 = 80 marks)

11. (a) (i) State and explain Kutzbach criterion to determine degree of freedom for plane and spatial mechanisms. (8)

    (ii) Explain any two inversions of a four bar mechanism with suitable sketches. (8)

Or

(b) (i) Sketch and explain the following mechanisms :

    (1) Ratchet and Escapement mechanism and

    (2) Indexing mechanism. (8)

    (ii) A Crank and slotted lever mechanism used in a shaper has a centre distance of 250 mm between the centre of oscillation of the slotted lever and the centre of rotation of the crank. The radius of the crank is 100 mm. Find the ratio of the time of cutting to the time of return stroke. (8)

12. (a) In a slider crank mechanism, the length of crank OB and connecting rod AB are 125 mm and 500 mm respectively. The centre of gravity of the connecting rod is 250 mm from the slider A. The crank speed is 600 rpm clockwise. When the crank has turned 45° from the inner dead centre position, determine :

    (i) Linear velocity and acceleration of the mid point of the connecting rod and

    (ii) Angular velocity and angular acceleration of the connecting rod.

Or

(b) A link AB of a four bar linkage ABCD revolves uniformly at 120 rpm in a clockwise direction. Find the angular acceleration of links BC and CD and acceleration of point E in link BC. Given: AB = 75 mm, BC = 175 mm, EC = 50 mm, CD 150 mm, DA = 100 mm and angle BAD = 90°.

13. (a) Draw the profile of a cam operating a knife-edge follower when the axis of the follower is off-set by 20 mm to the right from the axis of the cam shaft as per the following data :

(i) Follower to move outwards through 40 mm during 60° of cam rotation

(ii) Follower to dwell for the next 45°

(iii) Follower to return to its original position during next 90°

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

The displacement of the follower is to take place with simple harmonic motion during both the outward and the return strokes. The least radius of cam is 50 mm. If the cam rotates at 300 rpm clockwise, determine the maximum velocity and acceleration of the follower during the outward and return strokes.

Or

(b) A symmetrical tangent cam with a least radius of 25 mm operates a roller follower of radius 10 mm. The angle of ascent is 60° and total lift is 15mm. If the speed of the cam is 400 rpm, then calculate :

(i) the principal dimensions of the cam and

(ii) the acceleration of the follower at the beginning of the lift, when the roller just touches the nose and at the apex of the circular nose.

Assume that there is no dwell between ascent and descent.

14. (a) Two gear wheels mesh externally and are to give a velocity ratio of 3 to I The teeth are of involute form; module = 6 mm; addendum = one module; pressure angle = 20°. The pinion rotates at 90 rpm, find :

(i) Number of teeth on pinion and wheel to avoid interference

(ii) The length of path and arc of contact

(iii) The number of pairs of teeth in contact, and

(iv) The maximum velocity of sliding.

Or

(b) In an epicyclic gear train, a gear C is keyed to the driving shaft A which rotates at 900 rpm. Gears D and E are integral together and rotate freely on a pin carried by the arm M which is keyed to the driven shaft B. Gear D is in mesh with gear C while the gear E is in mesh with a fixed annular wheel F. The annular wheel is concentric with the driven shaft B. If the shafts A and B are collinear and number of teeth on gears C, D, E and F are 21, 28, 14 and 84 respectively. Determine the speed and sense of rotation of the driven shaft B.

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15. (a) (i) Derive an expression to determine the centrifugal tension in a belt drive. (6)

    (ii) A pulley used to transmit power by means of ropes has a diameter of 3.6 metres and has 15 grooves of 45° angle. The angle of contact is 170° and the coefficient of friction between the ropes and the groove slides is 0.28. The maximum possible tension in the ropes is 960 N and the mass of the rope is 1.5 kg per metre length. What is the speed of pulley in rpm and the power transmitted if the condition of maximum power prevail? (10)

Or

(b) (i) Derive an expression for the ratio of the driving tension in a band and block brake. (6)

    (ii) In a band and block brake, the band is lined with 14 blocks, each of which subtends an angle of 20° at the drum centre. One end of the band is attached to the fulcrum of the brake lever and the other to a pin 150 mm from the fulcrum. Find the force required at the end of the lever 1 metre long from the fulcrum to give a torque of 4 kN-m. The diameter of the brake drum is 1 metre and the coefficient of friction between the blocks and the drum is 0.25. (10)

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