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D 4243

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

Fourth Semester

(Regulation 2004)

Mechanical Engineering

ME 1252 — KINEMATICS OF MACHINERY

(Common to B.E. (Part-Time) Third Semester Regulation 2005)

Time : Three hours

Maximum : 100 marks

Sketches to be drawn neatly.

A3 size drawing sheet will be issued, if required.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define DOF of a mechanism.
2. State Grubler's criterion for planar mechanisms.
3. Define "Actual Mechanical advantage".
4. How the direction of coriolis component of acceleration is determined?
5. Draw at least any four types of cam with followers.
6. What are the different types of motion with which a follower can move?
7. State "Law of gearing".
8. What are various types of torques in an epicyclic gear train?
9. How centrifugal tension affects the power transmission in belt drive?
10. Define the term "Limiting friction".

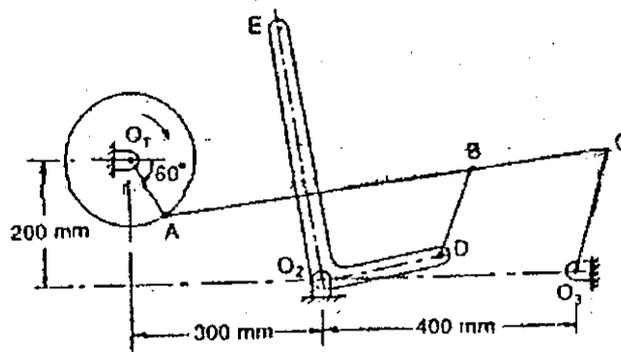
11. (a) (i) Explain the following mechanisms in kinematics point of view
- (1) Ratchet and pawl mechanism. (6)
 - (2) Indexing mechanism. (6)
- (ii) State and prove the Kutzbach criteria for the following kinematic chains
- (1) Cam with roller follower. (2)
 - (2) Two bar chain. (2)

Or

- (b) (i) Sketch and explain any three inversions of a double slider crank chain. (8)
- (ii) In a crank and slotted lever quick return motion mechanism, the distance between the fixed centers is 240 mm and the length of the driving crank is 120 mm. Determine the inclination of the slotted bar with the vertical in the extreme position and the time ratio of cutting stroke to the return stroke. (8)
12. (a) Derive the expression for determining the angular position of the coupler link and the output link of a four bar mechanism.

Or

- (b) The mechanism of a warping machine is shown in the *fig.Q.12.b*. Various dimensions are as follows. $O_1A = 100$ mm; $AC = 700$ mm; $BC = 200$ mm; $BD = 150$ mm; $O_2D = 200$ mm; $O_2E = 400$ mm; $O_3C = 200$ mm. The crank O_1A rotates at a uniform speed of 100 rad/sec. Determine
- (i) Linear velocity of the point E on the bell crank lever
 - (ii) Acceleration of the points B and E
 - (iii) Angular acceleration of the bell crank lever.



13. (a) It is required to set out the profile of a cam to give the following motion to the reciprocating follower with a flat mushroom contact face :

- (i) Follower to have a stroke of 20 mm during 120° of cam rotation.
- (ii) Follower to dwell for 30° of cam rotation.
- (iii) Follower to return to its position during 120° of cam rotation.
- (iv) Follower to dwell for the remaining period.

The minimum radius of the cam is 25 mm. The outstroke of the follower is performed with simple harmonic motion and the return stroke with equal uniform acceleration and retardation. Draw the profile of the cam.

Or

(b) A symmetrical circular cam operating a flat faced follower has the following particulars :

Minimum radius of the cam = 30 mm; Total lift = 20 mm; Angle of lift = 75° ;
Nose radius = 5 mm; Speed = 600 rpm.

Determine :

- (i) The principal dimensions of the cam.
- (ii) Acceleration of the follower at the beginning of lift, at the end of contact with the circular flank, at the beginning of contact with the nose and at the apex of the nose.

14. (a) (i) Derive an expression for minimum number of teeth on the wheel in order to avoid interference. (8)

- (ii) Two mating gears have 20 and 40 involute teeth of module 10 mm and 20° 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 of the maximum possible length. Determine the addendum height for each gear wheel, length of the path of contact, arc of contact and contact ratio. (8)

Or

(b) (i) Explain the procedure adopted for designing the spur wheels. (6)

- (ii) A compound epicyclic gear is shown in *fig. 1*. The gears A, D and E are free to rotate on axis P. The compound gears B and C rotate together on the axis Q at the end of arm F. All the gears have

equal pitch. The number of external teeth on gears A, B and C are 18, 45 and 21 respectively. The gears D and E are annulus gears. The gear A rotates at 100 rpm in anticlockwise direction and the gear D rotates at 450 rpm clockwise. Find the speed and direction of the arm and the gear E. (10)

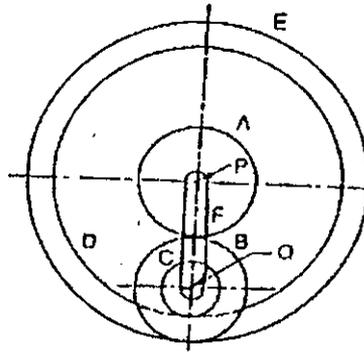


Fig 1.

15. (a) (i) Derive an expression for the torque required to lift a load by a screw jack, if l is the length of the arm. (8)
- (ii) A leather faced conical clutch has a cone angle of 30° . If the intensity of pressure between the contact surfaces is limited to 0.35 MPa and the breadth of the conical surface is not to exceed one-third of the mean radius, find the dimensions of the contact surfaces to transmit 22.5 kW at 2000 rpm . Assume uniform rate of wear and take coefficient of friction as 0.15 . (8)

Or

- (b) (i) A compressor requires 90 kW to operate at 250 rpm . The drive is by V belts from an electric motor running at 750 rpm . The diameter of the pulley on the compressor shaft must not be greater than 1 meter while the center distance between the pulleys is limited to 1.75 m . The belt speed should not exceed 1600 m/min . Determine the number of V belts required to transmit the power if each belt has a cross sectional area of 375 mm^2 ; density 1000 kg/m^3 and an allowable tensile stress of 2.5 MPa . The groove angle of the pulley is 35° . The coefficient of friction between the belt and the pulley is 0.25 . Also calculate the length required for each belt. (10)
- (ii) Derive an expression for braking torque on the drum of Simple band brake. (6)