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H 2313

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2009.

Third Semester

Mechanical Engineering

ME 232 — KINEMATICS OF MACHINES

(Common to Mechatronics Engineering)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Explain the Kutzbach criterion for movability of a mechanism having plane motion.

2. Describe the working of Oldham's coupling with a neat sketch.

3. State and prove Kennedy's three centre theorem.

4. Define Coriolis component of acceleration.

5. What type of follower is suitable for high speed cam? Give reasons.

6. Discuss the effect of pressure angle and under cutting in Cams.

7. Define the term interference as applied to gears.

8. State and prove Law of gearing.

9. Which of the two assumptions — Uniform intensity of pressure or uniform rate of wear would be recommended while designing a clutch?

10. Explain the terms slip and creep in a belt drive.

PART B — (5 × 16 = 80 marks)

11. (a) In a quick return motion mechanism of crank and slotted lever type the ratio of the maximum velocities is 2. If the length of stroke is 25 cm find (i) The length of the slotted lever, (ii) The ratio of times of cutting and return strokes (iii) The maximum cutting velocity per second if the crank rotates at 300 rpm.

Or

(b) (i) Extend Grublers criterion for planar mechanism to obtain the 'Degree of freedom' of a space mechanism as

$F = 6(L - 1) - 5g - 4c - 4s.$

Where g = total number of sliding pairs

c = Total number of cylindrical pairs

s = Total number of spherical pairs

L = Total number of links,

(ii) Sketch and explain any two inversions of single slider crank chain.

12. (a) In a four bar chain ABCD, link AD is fixed and the crank AB rotates at 10 rad./s Clockwise. Lengths of the links are AB = 60 mm; BC = CD = 70 mm; DA = 120 mm. When angle DAB = 60° and both B and C lie on the same side of AD, find (i) Angular velocities of BC and CD with magnitude and direction and (ii) angular acceleration of BC and CD.

Or

(b) Locate all the instantaneous centers of the mechanism as shown in Fig.1 the length of various links are

AB = 150 mm; BC = 300 mm; CD = 225 mm and CE = 500 mm

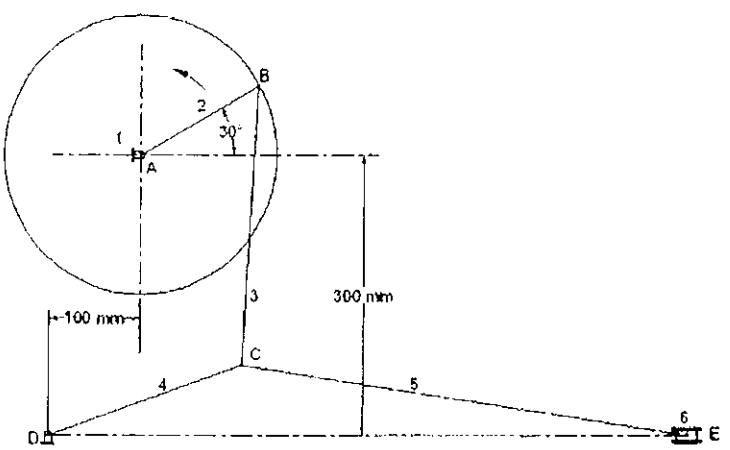

Figure 1

When the crank AB rotates in the anticlockwise direction at a uniform speed of 240 r.p.m find (i) velocity of the slider E, and (ii) angular velocity of the links BC and CE.

13. (a) Design a cam to raise a valve with simple harmonic motion through 15 mm in 1/3rd of a revolution, keep it fully raised through 1 / 12th of a revolution and to lower it with SHM in 1/6th of a revolution. The valve remains closed during the rest of the revolution. The diameter of the roller is 20 mm and the minimum radius of the cam is 25 mm. The axis of the valve rod passes through the axis of the cam shaft. If the cam shaft rotates at uniform speed of 100 rpm; find the maximum velocity and acceleration of the valve during raising and lowering. Also draw the profile of the cam.

Or

(b) A cam, with a minimum radius of 50 mm, rotating clock wise at a uniform speed, is required to give a knife edge follower the motion as described below; To move out wards through 40 mm during 100° rotation of the cam; To dwell for next 80°; To return to its starting position during next 90° and to dwell for the rest of the period of revolution. Draw the profile of the cam when the line of the follower is off-set by 15 mm to the right. The displacement of the follower is to take place with uniform retardation. Determine the maximum velocity and acceleration of the follower when the cam shaft rotates at 900 rpm.

14. (a) Two gear wheels mesh externally and are to give a velocity ratio of 3. The teeth are of involute form of module 6. The standard addendum is 1 module. If the pressure angle is 18° and pinion rotates at 90 rpm, find (i) The number of teeth on each wheel, so that the interference is just avoided, (ii) the length of the path of contact and (iii) the maximum velocity of sliding between the teeth.

Or

(b) Fig.2 shows an epicyclic gear train known as Ferguson's paradox. Gear A is fixed to the frame and is therefore stationary. The arm B and gears C and D are free to rotate on the shaft S. Gears A, C and D have 100, 101, and 99 teeth respectively. The planet gear has 20 teeth. The pitch circle diameters of all are same so that the planet gear P meshes with all of them. Determine the revolutions of gears C and D for one revolution of the arm B.

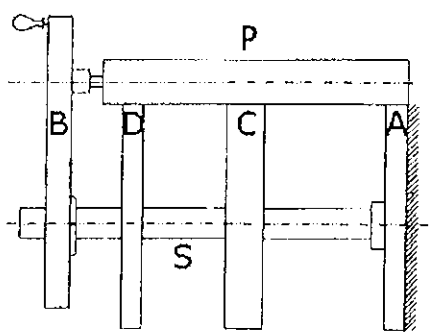

Figure 2

15. (a) (i) The mean diameter of a square threaded screw jack is 55 mm. The pitch of a thread is 10 mm the coefficient of friction is 0.15. What force must be applied at the end of 0.7 m. long lever, which is perpendicular to the longitudinal axis of the screw to raise a load of 20 kN, and to lower it?

(ii) Single plate clutch, effective on both sides is required to transmit 25 kW at 3000 rpm. Determine the outer and inner radii of frictional surface if the coefficient of friction is 0.255. The ratio of radii is 1.25 and the maximum pressure is not to exceed $0.1 N/mm^2$ Also determine the axial thrust to be provided by springs. Assume uniform wear.

Or

(b) An open belt drive connects two pulleys 1.2 m and 0.5 m diameter, on parallel shafts 4 m apart. The mass of the belt is 0.9 kg / m length and the maximum tension is not to exceed 2000 N. The coefficient of friction is 0.3. The 1.2 m pulley which is the driver, runs at 200 rpm. Due to belt slip on one of the pulleys, the velocity of the driven shaft is only 450 rpm. Calculate the torque on each of the two shafts, the power transmitted and the power lost in friction. What is the efficiency of the drive?
