Reg. No. : | | | | | | | | | | |

K 4391

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

Third Semester

Mechanical Engineering

ME 1252 — KINEMATICS OF MACHINERY

(Common to B.E. Third Semester Mechatronics Engineering)

(Regulation 2004)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are lower pairs and higher pairs?

2. State the purpose of an indexing mechanism.

3. What is configuration diagram? State its significance.

4. State the conditions for existence of Coriolis acceleration component.

5. "Cycloidal motion of cam is preferred for high speed follower motion"– Justify.

6. Define the pressure angle of a cam.

7. What are interchangeable gears?

8. What is a reverted gear train?

9. "The helix angle (α) of a screw thread is not to be more than the angle of friction (ϕ)" - Why?

10. Define the term co-efficient of friction.

PART B — (5 × 16 = 80 marks)

11. (a) (i) State Kutzbach criterion for the mobility of mechanism having plane motion. Identify the mobility of the following linkages shown in Fig. 1 and Fig. 2. What can you infer if the mobility of a set-up is 0 and –1? (8)

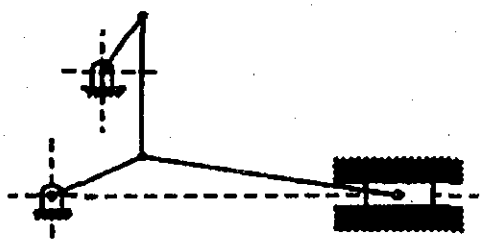

Fig.1

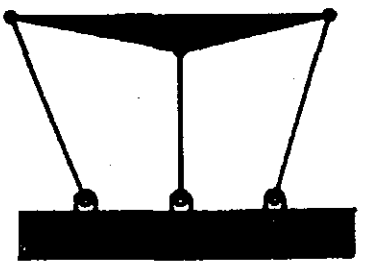

Fig.2

(ii) Find the maximum and minimum transmission angles for the mechanism shown in Fig. 3. The figure indicates the dimensions in standard units of length. (4)

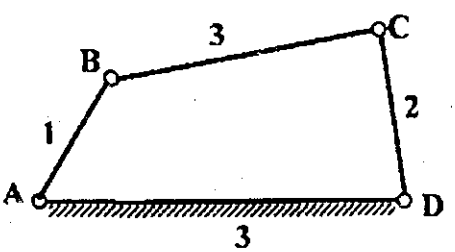

Fig.3

(iii) What is mechanical advantage? State the difference between ideal mechanical advantage and actual mechanical advantage. (4)

Or

(b) (i) The dimensions of four links are given as follows :

AB = 65 mm; BC = 175 mm; CD = 115 mm and AD = 200 mm. Construct

(1) Double crank mechanism

(2) Double lever mechanism

(3) Crank rocker mechanism

(4) Why a double-rocker mechanism cannot be constructed using the above four links? (8)

(ii) Sketch Whitworth and Crank and slotted lever quick return mechanisms and compare them. (8)

12. (a) In the toggle mechanism, as shown in the Fig. 4, the slider D is constrained to move on a horizontal path. The crank OA is rotating in the counter-clockwise direction at a speed of 180 rpm.

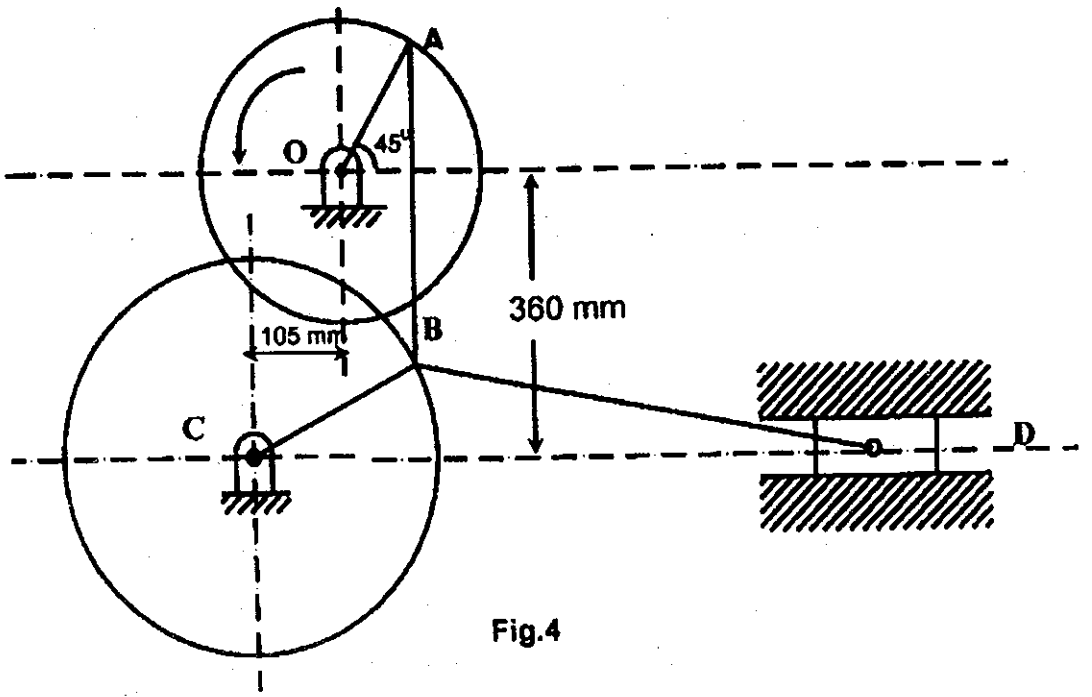

Fig.4

The dimensions of various links are as follows :

OA = 180 mm; CB = 240 mm; AB = 360 mm; BD = 540 mm

For the given configuration, find (i) velocity of slider D (ii) Angular velocity of links AB, CB and BD. (16)

Or

(b) (i) Let a point P move along the path P'PP" relative to moving coordinate system x'y'z' as shown in Fig. 5. xyz is the fixed coordinate system. Using vector approach, prove that the absolute velocity of point P moving relative to a moving reference system is equal to the velocity of the point relative to the moving system plus

the absolute velocity of a coincident point fixed to the moving reference system. (12)

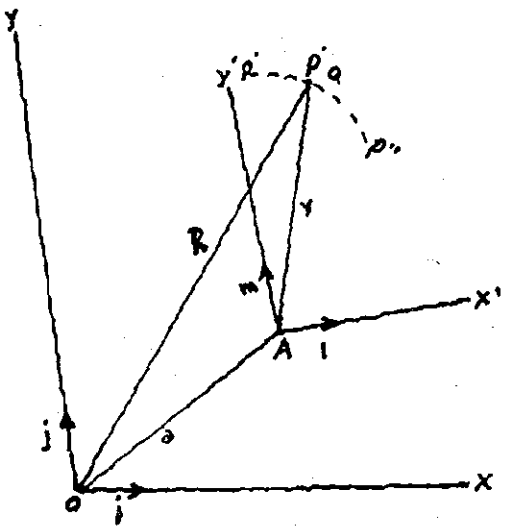

Fig. 5

(ii) Identify the direction of Coriolis component for the given velocity vector ${}_qV_p$ that rotates at an angular velocity ω (Fig. 6). (4)

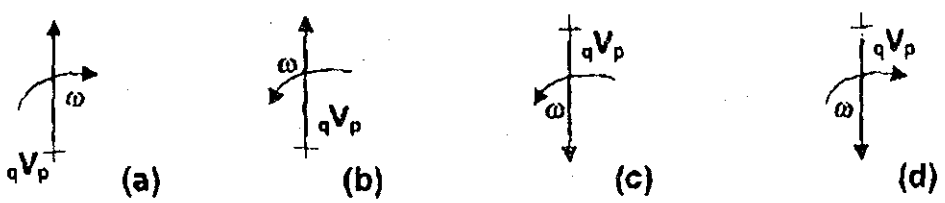

Fig.6

13. (a) Draw the profile of a cam operating a knife-edge follower having a lift of 30 mm. The cam raises the follower with SHM for 150° of the rotation followed by a period of dwell for 60°. The follower descends for the next 100° rotation of the cam with uniform velocity, again followed by a dwell period. The cam rotates at a uniform velocity of 120 rpm and has a least radius of 20 mm. What will be the maximum velocity and acceleration of the follower during the lift and return? (16)

Or

(b) A tangent cam has straight working faces which are tangential to a base circle of diameter 120 mm. The diameter of the roller follower is 48 mm. The line of stroke of roller passes through the axis of cam. The nose circle radius of cam is 12 mm and angle between the tangential faces of the cam is 90°. If the speed of the cam is 180 rpm, determine the acceleration of the follower when

(i) during the lift, the roller just leaves the straight flank

(ii) the roller is at the outer end of its lift, i.e. at the top of the nose. (16)

14. (a) Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth are of involute form; module = 6 mm, addendum = one module, pressure angle = 20°. The pinion ratates at 90 rpm. Determine (i) The number of teeth on the pinion to avoid interference on it and the corresponding number of teeth on wheel (ii) The length of path and arc of contact (iii) The number of pairs of teeth in contact (iv) The maximum velocity of sliding. (16)

Or

(b) (i) Explain the terms with respect to a spur gear (1) pitch circle (2) module (3) dedendum (4) circular pitch. (4)

(ii) With a neat sketch, explain the following terms with respect to a helical gear (1) Helix angle (2) Normal circular pitch. (4)

(iii) With neat sketches, explain compound gear train and epicyclic gear train. (8)

15. (a) A centrifugal clutch transmits 20 kW of power at 750 rpm. The engagement of the clutch commences at 70 per cent of the running speed. The inside diameter of the drum is 200 mm and the distance of the centre of mass of each shoe is 40 mm from the contact surface. Determine (i) the mass of each shoe (ii) net force exerted by each shoe on the drum surface (iii) power transmitted when the shoe is worn 2 mm and is not readjusted. Assume μ to be 0.25 and stiffness of spring to be 150 kN/m. (16)

Or

(b) Two pulleys, one of 450 mm diameter and the other 200 mm diameter are on parallel shafts 1.95 m apart and are connected by a crossed belt. Find the length of the belt required and the angle of contact between the belt and each pulley. What power can be transmitted by the belt when the larger pulley rotates at 200 rpm, if the maximum permissible tension in the belt is 1 kN, and the coefficient of friction between the belt and pulley is 0.25? (16)