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

Q 2398

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Third Semester

Mechanical Engineering

ME 232 — KINEMATICS OF MACHINES

(Common to Mechatronics Engineering)

Time : Three hours Maximum : 100 marks

A3 - Size drawing sheet is to be provided.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define a kinematic pair and illustrate the working of a screw pair and a turning pair.

2. List the types of kinematic chains, with four lower pairs of importance.

3. Write the relation between the number of instantaneous centers and the number of links in a mechanism.

4. Define rubbing velocity at a pin joint, what will be the rubbing velocity at pin joint when the two links move in the same direction.

5. Define the following terms as applied to Cam.

   (a) Base circle

   (b) Pitch circle

   (c) Prime circle.

6. Draw the displacement and velocity diagrams for a follower moves with simple harmonic motion.

7. Define the term "interference" as applied to gears. Suggest any one method to avoid the same.

8. What is the advantage of epicycle gear train and state any two applications of it?

9. What is the function of friction clutch? Name two types of friction clutch used in practice?

10. Define efficiency of a screw jack in term of helix angle of screw and friction angle.

PART B — (5 × 16 = 80 marks)

11. (a) Sketch the various in versions of a double slider crank and state its applications.

Or

(b) What are the straight-line mechanisms? Describing any one type of exact straight line motion mechanism with the help of a neat sketch.

12. (a) Fig. 12 (a) shows a toggle mechanism in which link D is constrained to move in horizontal direction. For the given configuration, find out: (i) velocities of points B and D; and (ii) angular velocities of links AB, BC, and BD. The crank OA rotates at 60 rpm. in anticlockwise direction.

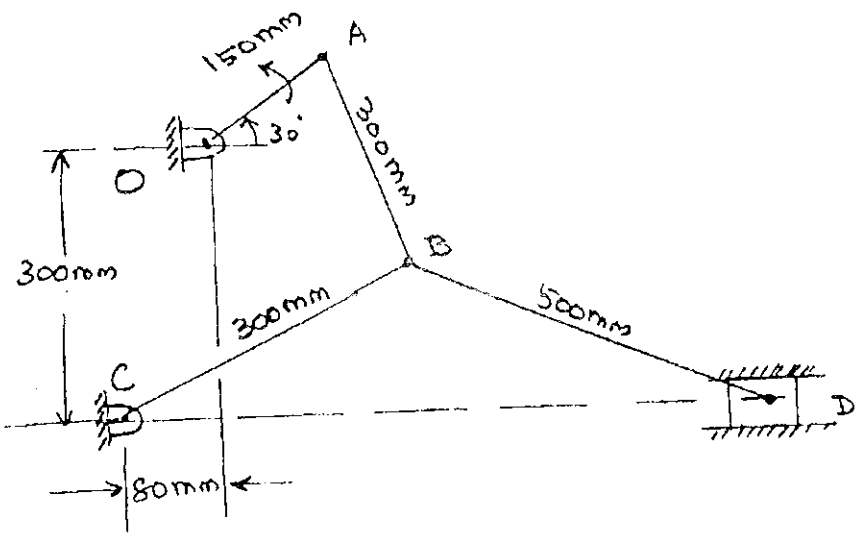

Fig. 12 (a)

Or

(b) A mechanism of a crank and slotted lever quick return motion is shown in Fig. 12 (b). If the crank rotates counter clockwise at 120 rpm. Determine for the configuration shown, the velocity and acceleration of the ram D. Also determine the angular acceleration of the slotted lever.

Crank AB = 150 mm; Slotted arm, OC = 700 mm and link CD = 200 mm.

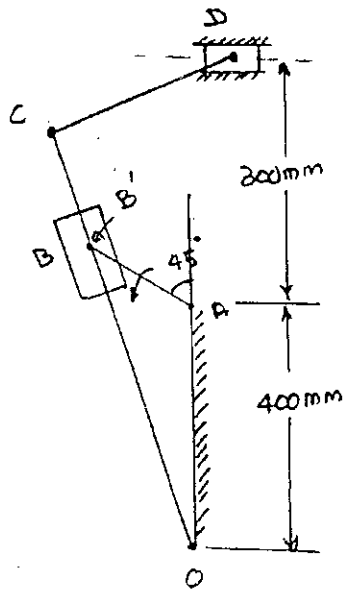

Fig. 12 (b)

13. (a) A cam rotating clockwise at a uniform speed of 1000 rpm. is required to give motion to a roller follower as 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 the roller is 10 mm. The line of stroke of the follower is offset by 20 mm from the axis for the camshaft. If the displacement of the follower takes place with uniform acceleration and retardation on both the outward and return strokes, draw profile of the cam and find the maximum velocity and acceleration during out stroke and return stroke.

Or

(b) A cam has straight working faces, which are tangential to a base circle of diameter 90 mm. The follower is a roller of diameter 40 mm and the center of a roller moves along a straight line passing through the centerline of the camshaft. The angle between the tangential faces of the cam is 90° and the faces are joins by a nose circle of 10 mm radius. The speed of rotation of the cam is 120 revolutions per min.

Find the acceleration of the roller center (i) during the lift when the roller is just about to leave the straight flank, and (ii) when the roller is at the outer end of its lift.

14. (a) A pair of spur wheels with involute teeth is to give a gear ratio of 3 to 1. The arc of approach is not to be less than the circular pitch and the smaller wheel is the driver. The pressure angle is 20°. What is the least number of teeth that can be used on each wheel? What is the addendum of the wheel in terms of the circular pitch?

Or

(b) An epicycle gear train consists of a Sun wheel S, a stationary internal gear E and three identical planet wheels P carried on a star shaped planet carrier C. The size of different toothed wheels are such that the planet carrier C rotates at 1/5th of the speed of the sun wheel S. The minimum number of teeth on any wheel is 16. The driving torque on the sun wheel is 100 N-m. Determine (i) number of teeth on different wheels of the train and (ii) torque necessary to keep the internal gear stationary.

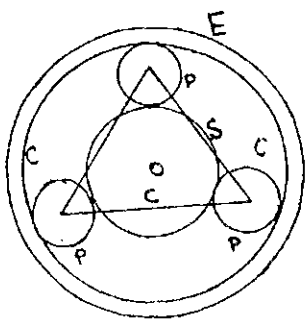

Fig. 14 (b)

15. (a) The spindle of a screw jack has single start square threads with an outside diameter of 45 mm and a pitch of 10 mm. The spindle moves in a fixed nut. The load is carried on a swivel head but is not free to rotate. The bearing surface of the swivel head has a mean diameter of 60 mm. The coefficient of friction between the nut and screw is 0.12 and that between the swivel head and the spindle is 0.10. Calculate the load, which can be raised by efforts of 100 N each, applied at the end of two levers each of effective length of 350 mm. Also determine the velocity ratio and the efficiency of the lifting arrangement.

Or

(b) A dry single plate clutch is to be designed for an automotive vehicle whose engine is rated to give 100 kW at 2400 rpm, and maximum torque 500 N-m. The outer radius of friction plate is 25% more than the inner radius. The intensity of pressure between the plates is not to exceed 0.07 N/mm^2. The coefficient of friction may be assumed equal to 0.3. The helical springs required by this clutch to provide axial force necessary to engage the clutch are eight. If each spring has stiffness equal to 40 N/mm, determine the initial compression in the springs and dimensions of the friction plate.
