QP CODE : 555401

**(3 Hours)**   **Total Marks: 80**

N.B. 1) Question No.1 is compulsory.
    2) Attempt any three questions out of the remaining five questions.
    3) Figures to the right indicate full marks.
    4) Assume suitable data wherever required but justify the same.

Q1.   **Attempt any four**   (20)

   A. What is degree of freedom of plane mechanism? In what way Kutzback's differs from Grubler's criterion?

   B. Draw a neat sketch of Hart's mechanism and prove that it produces an exact straight line motion.

   C. Define the following terms as applied to cam with a neat sketch,

       i) Base circle ii) Pitch circle iii) Prime circle

   D. State and explain law of belting.

   **E.** Differentiate between involute and cycloidal gear tooth profile.

Q2 A. The driving crank AB of the quick return mechanism as shown in **figure** revolves (14) at a uniform speed of 150 rpm. Find the velocity and acceleration of the toolbox R, in the position shown, when the crank makes an angle of 60^0 with the vertical line of centres PA. What is the acceleration of sliding of the block at B along the slotted lever PQ?
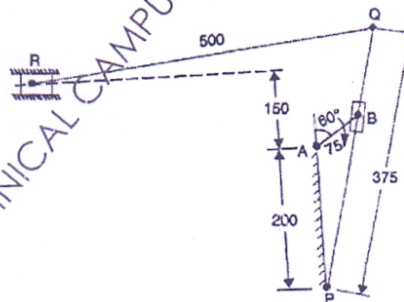
All dimensions in mm.

   B. Derive an expression for velocity ratio of driving and driven shaft speed in a (6) single Hooke's joint.

Q3 A. The lengths of various links of a mechanism, as shown in the **figure** are: (14)
     OA = 0.3 m, AB = 1 m, CD = 0.8 m, AC = CB.
     Determine for the given configuration, the velocity of the slider D if the crank OA rotates at 100 rpm in the clockwise direction. Also find the angular velocity of the link CD. Use instantaneous centre method.

                                                    {Turn Over
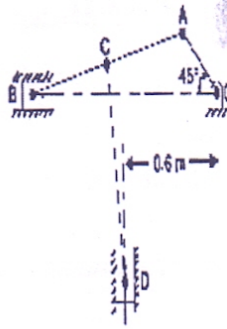
B. A sphere of radius 0.2 m starts rolling without slip up an inclined plane, inclined **(6)** at an angle 30^0 with the horizontal. If the initial angular velocity of the sphere is 10 rad/s, determine how far the sphere will travel before it reverses its motion.

Q4 A. 3 kW of power is transmitted by an open belt drive. The linear velocity of the belt **(10)** is 2.5 m/s. The angle of lap on the smaller pulley is 165^0. The coefficient of friction is 0.3. Determine the effect on power transmission in the following cases:
i) initial tension in the belt is increased by 8%
ii) angle of lap is increased by 8% by the use of an idler pulley, for the same speed and the tension on the tight side.

B. Two involute gears of 20^0 pressure angle are in mesh. The number of teeth on **(10)** pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module, find:
    i) the angle turned through by pinion when one pair of teeth is in mesh
    ii) the maximum velocity of sliding.

Q5 A. A cam rotating clockwise at a uniform speed of 150 rpm is required to give **(10)** motion to knife edge follower as below:
    i) Follower to move outwards through 25 mm during 120^0 of cam rotation.
    ii) Follower to dwell for the next 60^0 of cam rotation.
    iii) Follower to return to its starting position during next 90^0 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 line of stroke of the follower passes through the axis of the cam shaft. If the displacement of the follower takes place with uniform acceleration and retardation during the outward stroke and SHM during return strokes, find and draw the maximum velocity and acceleration during outward and return stroke.

B. Derive the equation for the length of chain with the help of a neat sketch. **(10)**

Q6.A. Derive an expression for critical number of teeth on pinion meshing with a wheel **(07)** to avoid interference.

B. Explain any one inversion of double slider crank chain. **(05)**

C. Differentiate between Davis and Ackerman's steering gear mechanism. **(05)**

D. What do you mean by "rubbing velocity at pin joints". **(03)**