Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV • EXAMINATION – SUMMER 2013

Subject Code: 141902 **Date: 14-06-2013**

Subject Name: Kinematics of Machines

Time: 10.30 am - 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Define : **07**

(1) Lower Pair
(2) Kinematics Chain
(3) Completely Constrained Motion
(4) Angle of friction

(b) Derive the equation for finding out the ratio of angular velocities of two shafts of Hooke's joint. **07**

Q.2 **(a)** What is straight line motion mechanism? Explain Hart's straight line motion mechanism with neat sketch. **07**

(b) What is inversion? Explain the inversions of double slider crank chain with neat sketch. **07**

OR

(b) What is steering gear mechanism? Derive the relation for correct steering for Devis steering gear mechanism. **07**

Q.3 **(a)** Fig-1 shows the mechanism of a radial valve gear. The crank OA turns uniformly at 150 rpm and is pinned at A to rod AB. The point C in the rod is guided in the circular path with D as centre and DC as radius. The dimensions of various links are: OA = 150 mm; AB = 550 mm; AC = 450 mm; DC = 500 mm; BE = 350 mm. Determine velocity and acceleration of the ram E for the given position of the mechanism. **14**

OR

Q.3 **(a)** Explain the terms used in cam. **07**

(1) Trace point. (2) Pressure angle (3) Pitch circle.

(b) Determine a cam for operating the exhaust valve of an oil engine. It is required to give simple harmonic motion during opening and closing of the valve each of which corresponds to 60° of cam rotation. The valve must remain in the fully open position for 30° of cam rotation. The lift of the valve is 40 mm and the least radius of the cam is 40 mm. The follower is provided with a roller of radius 15 mm and its line of stroke passes through the axis of cam. Find out the maximum value of velocity and acceleration of follower if the cam rotates at 120 rpm. **07**

Q.4 **(a)** Derive the equation for finding out the torque required to lift the load by a screw jack. **07**

(b) A belt 100 mm wide and 100 mm thick is transmitting power at 900 m/min. the driving tension is 2.8 times the tension on the slack side. If the safe permissible stress for the belt is 1.8 N/mm^2, calculate the maximum power that can be transmitted at this speed. Assume the density of leather belt is 1000 kg/m^3. Consider the initial tension in the belt; also calculate the greatest power that can be transmitted by this belt and its corresponding speed. **07**

OR

Q.4 **(a)** Derive the equation for maximum efficiency of a screw jack for raising a load. **07**

(b) In an epicyclic gear train, the internal wheels A and B and compound wheels C and D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G. E gears with A and C and F gears with B and D. All the wheels have the same module and the numbers of teeth are: $T_C = 28$, $T_D = 26$, $T_E = T_F = 18$. **07**

(1) Find the number of teeth on A and B.

(2) If the arm G makes 100 rpm clockwise and A is fixed, find the speed of B.

(3) If the arm G makes 100 rpm clockwise and wheel A makes 10 rpm counterclockwise, find the speed of wheel B.

Q.5 (a) Derive the equation for finding out the length of path of contact for a pair of involute gears. **07**

(b) A pair 20° involute gears has module of 5 mm. The pinion has 20 teeth and gear has 60 teeth. Addendum on the pinion and gear wheel in terms of module is one. Find the followings: **07**

(1) Number of pairs in contact.

(2) Angle turned through by the pinion and gear wheel for one pair in contact.

OR

Q.5 (a) Derive equation for finding out the limiting tension ratio in a belt drive. **07**

(b) An open belt drive connects two pulleys 1.2 m and 0.5 m diameter, on parallel shafts 3.6 m apart. The mass of the belt is 1 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 slip on one of the pulleys, the velocity of the driven shaft is only 450 rpm. Calculate (1) The torque on each of the two shafts, (2) The power transmitted, and (3) Power lost in friction. **07**

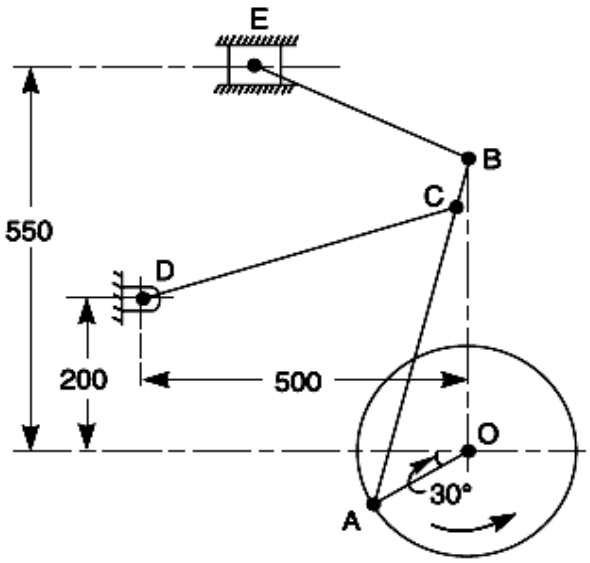

Figure – 1

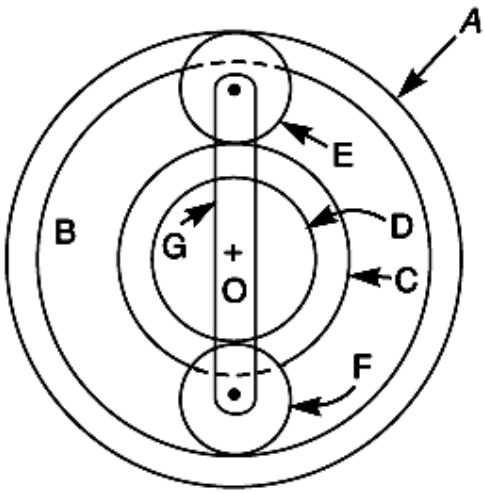

Figure – 2

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