Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER–II • EXAMINATION – WINTER 2013

Subject Code: X21902   **Date: 23-12-2013**
Subject Name: Kinematics of Machines
Time: 02.30 pm - 05.00 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)** Derive an expression for minimum number of teeth required on the gear to avoid interference.   **07**

(b) Derive an equation of condition of correct steering of a vehicle.   **07**

Q.2 **(a)** What is machine? Give Examples. Differentiate between a machine and a structure.   **07**

(b) The dimensions and configuration of the four bar mechanism, shown in 2.1, The angle $AP_1P_2 = 60°$. The crank P_1A has an angular velocity of 10 radian/s and an angular acceleration of 30 radian/s^2, both clockwise. Determine the angular velocities and angular accelerations of P_2B, and AB and the velocity and acceleration of the joint B.   **07**
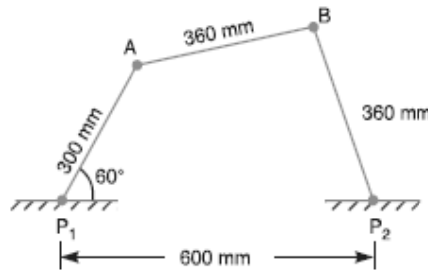

Figure 2.1

OR

(b) A reciprocating engine has connecting rod 200 mm long and crank 50 mm long. By using Klein's construction, determine (i) the velocity and acceleration of piston, (ii) angular acceleration of connecting rod. The crank has turned through 45^0 from IDC clockwise and is rotating at 240 rpm.   **07**

Q.3 **(a)** A cam running at a uniform speed in clockwise direction has a knife edge reciprocating follower;   **07**
Draw the profile of the cam to the following specifications:
   a) Follower to move outward through a distance of 30 mm during 150 degrees of cam rotation;
   ii) Follower to dwell for 50 degree of cam rotation;
   iii) Follower to return to its initial position during 70 degree of cam rotation;
   iv) Follower to dwell for the remaining degrees of cam rotation;
   v) The line of stroke of the follower is offset 15 mm from the axis of the cam and displacement of the follower is to taken place with uniform acceleration and retardation during the outward stroke and with SHM during return stroke.
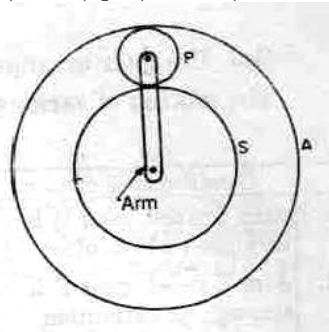
(b) A cam drives a roller follower of diameter 20 mm: during first 90^0 rotations of **07** the cam, follower moves outwards through a distance of 50 mm with uniform velocity. The follower dwells during next 60^0 cam rotation. During next 110^0 cam rotation, the follower moves outwards with uniform acceleration and deceleration. Follower dwells for the remaining cam rotation. Draw the cam profile.

OR

Q.3 **(a)** In a thrust bearing, the external and internal diameters of the contacting **07** surfaces are 320 mm and 200 mm respectively. The total axial load is 80 KN and the intensity of pressure is 0.35 N/mm^2. The shaft rotates at 400 rpm. Taking the coefficient of friction as 0.06, calculate the power lost in overcoming the friction. Also, find the number of collars required for the bearing.

(b) Derive an expression for torque transmitting capacity of multi-plate clutch. **07**

Q.4 **(a)** A pair of 20° full depth involute spur gears having 30 and 50 teeth respectively **07** of module 4 mm is in mesh. The smaller gear rotates at 1000 rpm.
Determine: (i) Sliding velocities at engagement and at disengagement of pair of a teeth, and (ii) contact ratio

(b) In a simple epicyclic gear train as shown in figure below, the sun wheel S has **07** T_1 teeth and the annulus A has T_2 teeth (internal). A planet wheel P meshes with S and A and turns on the end of an arm whose axis is coincident with that of S and A. If X and Y are the speeds of S and A respectively, show that the speed of the arm is
$$[(T_1 * X) + (T_2 * Y)] / (T_1 + T_2)\#$$

OR

Q.4 **(a)** Explain the phenomenon of 'slip' and 'creep' in a belt drive. **07**
Q.4 **(b)** The following data relate to a flat belt drive; **07**
Power transmitted 18 Kw, pulley diameter 1800 mm, angle of contact 175^0, speed of pulley 300 rpm, coefficient of friction between belt and pulley surface is 0.30, permissible stress for belt 3 N/mm^2, thickness of belt 8 mm, density of belt material 0.95 gm/cm^3. Determine the width of belt required taking centrifugal tension into account.

Q.5 **(a)** What is cam? What type of motion can be transmitted with a cam and follower **07** combination? What are its elements?

(b) A Hooke's joint connects a shaft running at a uniform speed of 1000 rpm to a **07** second shaft. The angle between their axes being 15^0. Find the velocity and acceleration of the driven shaft at an instant when the fork of the driving shaft has turned through an angle of 10^0 from the plane containing the shaft axes.

OR

Q.5 **(a)** Derive an expression for length of open belt drive. **07**
(b) Explain Grubler's criterion for determining degree of freedom for **07** mechanisms.

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