Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III (NEW) • EXAMINATION – SUMMER 2015

Subject Code: 2131906 **Date:15/06/2015**

Subject Name: Kinematics of Machines

Time:02.30pm-05.00pm **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 and classify kinematic pairs with neat sketches. **07**

(b) Explain all inversions of double slider crank chain with neat sketches. **07**

Q.2 **(a)** State and prove 'Aronhold Kennedy's Theorem' of three instantaneous centres. **04**

(b) A toggle mechanism is shown in figure-1 along with the dimensions of the links in mm. Find the velocities of the points B and C and the angular velocities of links AB, BQ and BC. The crank rotates at 50 rpm in the clockwise direction. Use Relative Velocity Method. **10**

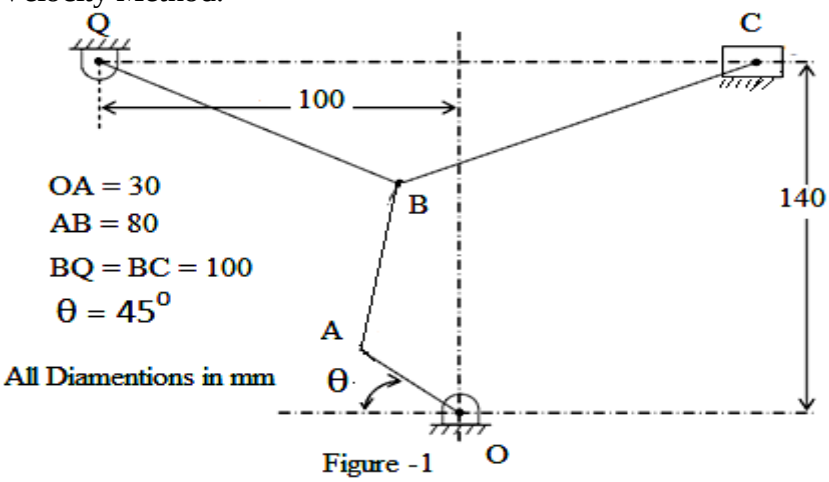

Figure -1

OR

(b) The crank and connecting rod of a reciprocating engine are 120 mm and 600 mm respectively. The centre of gravity (C.G.) of the connecting rod is 240 mm from the crank end. The crank is rotating uniformly at speed of 300RPM clockwise. Find at the instant when the crank is at 30° from inner dead centre 1. Velocity and acceleration of the piston, 2. Velocity and acceleration of the C.G. of the connecting rod, and 3. Angular velocity and angular acceleration of the connecting rod. Use Klein's Construction **10**

Q.3 **(a)** Synthesize a four bar chain mechanism by using Freudenstein's Equation for the following positions of input-output links. The input link "b" coupler link "c" and output link "d" makes angles θ, β and φ respectively along fixed link "a" Synthesize the mechanism for following three successive position with length of fixed link = 50mm. **07**

$\theta_1 = 180^0$ $\varphi_1 = 90^0$

$\theta_2 = 135^0$ $\varphi_2 = 80^0$

$\theta_3 = 90^0$ $\varphi_3 = 60^0$

	(b)	What is the condition for correct steering? Discuss with neat sketch Ackerman steering gear mechanism of automobile.	**07**

OR

Q.3	**(a)**	Derive an expression for the ratio of shafts velocities for Hooke's joint and draw the polar diagram depicting the salient features of driven shaft speed.	**07**
	(b)	Explain three position synthesis of four bar chain mechanism by relative pole method.	**07**
Q.4	**(a)**	What is meant by the term 'Interference' in involute gears? Discuss various methods used to avoid interference.	**07**
	(b)	An epicyclic gear train is composed of fixed annular wheel A having 150 teeth. Meshing with A is wheel B which drives wheel D through and idle wheel C, wheel D being concentric with A. Wheels B and C are carried on an arm E which resolves clockwise at 100 R.P.M. about the axis of A and D. If the wheel B and D have 25 and 40 teeth respectively, find the number of teeth on C and sense of rotation of C. Also sketch the arrangement.	**07**

OR

Q.4	**(a)**	Define terms related to gears: (i) Module (ii)Pressure Angle (iii) Circular Pitch (iv) Backlash (v) Tooth Space (vi) Contact Ratio (vii) Length of Path of Contact	**07**
	(b)	Two gear wheels mesh externally and are to give a gear ratio of 3 to 1. The teeth are of involute form; module = 6 mm, addendum = one module, pressure angle = 20°. The pinion rotates at 90 R.P.M. Determine: 1. The number of teeth on the pinion to avoid interference on it and the corresponding number of teeth on the wheel, 2. The length of path and arc of contact, 3.The number of pairs of teeth in contact, and 4. The maximum velocity of sliding.	**07**
Q.5	**(a)**	Explain with sketches the different types of cams and followers.	**07**
	(b)	A cam, with a minimum radius of 50 mm, rotating clockwise at a uniform speed, is required to give a knife edge follower the motion as described below : 1. To move outwards through 40 mm during 100^0 rotation of the cam; 2. To dwell for next 80^0; 3. To return to its starting position during next 90^0, and 4. To dwell for the rest period of a revolution. Draw the profile of the cam when the line of stroke of the follower is off-set by 15 mm. The displacement of the follower is to take place with uniform acceleration and uniform retardation. Determine the maximum velocity and acceleration of the follower when the cam shaft rotates at 900 R.P.M.	**07**

OR

Q.5	**(a)**	Draw the displacement, velocity and acceleration diagrams for a follower when it moves with (i) Uniform acceleration and retardation (ii) Cycloidal motion	**07**
	(b)	Construct the profile of a cam to suit the following specifications : Cam shaft diameter = 40 mm; Least radius of cam = 25 mm; Diameter of roller = 25 mm; Angle of lift = 120^0; Angle of fall = 150^0; Lift of the follower = 40 mm; Number of pauses are two of equal interval between motions During the lift, the motion is S.H.M. During the fall the motion is uniform acceleration and deceleration. The speed of the cam shaft is uniform. The line of stroke of the follower is off-set 12.5 mm from the centre of the cam.	**07**

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