Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (New) EXAMINATION – WINTER 2015

Subject Code:2142504 **Date:04/01/2015**

Subject Name: Theory of Machines

Time: 2:30pm to 5:00pm **Total Marks: 70**

Instructions:

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

Q.1	**(a)**	The crank & connecting rod of a theoretical steam engine are 0.5m & 2m long respectively. The crank makes 180 rpm in the clockwise direction. When it has turned 45° from the inner dead centre position, determine 1. Velocity of piston 2. Angular velocity of connecting rod. 3. Velocity of point E on the connecting rod 1.5 m from the gudgeon pin.	**07**
	(b)	What do you mean by rubbing velocity? Also find the velocities of rubbing for above problem at the pins of the crankshaft, crank & crosshead when the diameter of their pins is 50 mm, 60 mm & 30 mm respectively.	**07**
Q.2	**(a)**	Explain the classification of kinematic pair (any SEVEN) with suitable examples.	**07**
	(b)	What are straight line mechanisms? Describe one type of exact straight line motion mechanism with the help of a sketch.	**07**
		OR	
	(b)	With the help of steering gear mechanism explain the condition for correct steering.	**07**
Q.3	**(a)**	What is kinematic synthesis of mechanisms? Derive Freudenstein's equation.	**07**
	(b)	A four bar mechanism is to be designed, by using three precision points to generate the function $y=x^{1.5}$, for the range $1 \leq x \leq 4$. Assuming 30° starting position & 120° finishing position for the input link & 90° starting position & 180° finishing position for the output link, find the values of x & y.	**07**
		OR	

Q.3 A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below: **14**

1. To raise the valve through 50 mm during 120° rotation of the cam;
2. To keep the valve fully raised through next 30°.
3. To lower the valve during next 60°; and
4. To keep the valve closed during rest of revolution i.e.150°;

The diameter of the roller is 20 mm & the diameter of the cam shaft is 25 mm.
Draw the profile of the cam when
(a) the line of the stroke of the valve rod passes through the axis of the cam shaft, and
(b) the line of the stroke is offset 15 mm from the axis of the cam shaft.
The displacement of the valve, while being raised & lowered, is to take place with simple harmonic motion. Determine the maximum acceleration of the valve rod when the cam shaft rotates at 100 rpm.
Draw the displacement, the velocity diagrams & the acceleration diagrams for one complete revolution of the cam.

07

Q.4 (a) Establish a formula for the maximum torque transmitted by a single plate clutch of external & internal radii r1 & r2, if the limiting coefficient of friction is μ & the axial spring load is W. Assume that the pressure intensity on the contact surface is uniform. **07**

(b) Determine the maximum, minimum & the average pressure in plate clutch when the axial force is 4kN. The inside radius of the contact surface is 50 mm & the outside radius is 100 mm. Assume uniform wear. **07**

OR

Q.4 (a) For the flat belt, prove that $T_1/T_2 = e^{\mu\Theta}$, where **07**
T_1= Tension in the tight side of the belt, T_2 = Tension in the slack side of the belt, μ = Coefficient of friction between the belt & the pulley & θ = angle of contact between the belt & the pulley (in radians).

(b) Find the power transmitted by a belt running over a pulley of a 600 mm diameter at 200 rpm The coefficient of friction between the belt & the pulley is 0.25, angle of lap 160º and the maximum tension in the belt is 2500 N. **07**

Q.5 (a) State & prove the law of gearing. Show that involute profile satisfies the conditions for correct gearing. **07**

(b) The number of teeth on each of the two equal spur gears in mesh is 40.The teeth have 20º involutes profile and the module is 6 mm. If the arc of contact is 1.75 times the circular pitch, find the addendum. **07**

OR

Q.5 (a) What do you understand by 'gear train'? Discuss any THREE types of gear trains. **07**

(b) In an epicyclic gear train, an arm carries two gears A & B having 36 & 45 teeth respectively. If the arm rotates at 150 rpm in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of the gear B. If the gear A instead of being fixed makes 300 rpm in the clockwise direction, in the clockwise direction, what will be the speed of the gear B? **07**

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