Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III (New) EXAMINATION – WINTER 2019

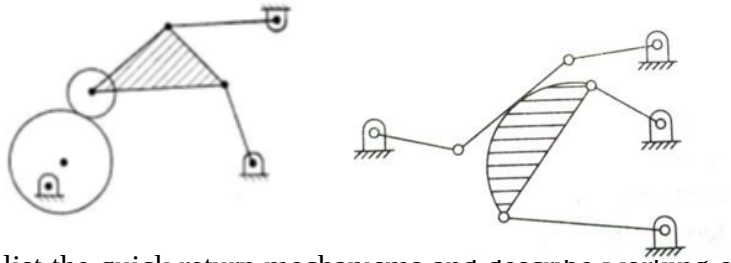
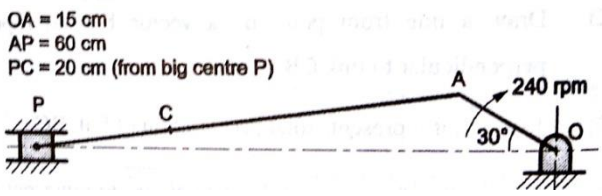
Subject Code: 3131906 Date: 3/12/2019

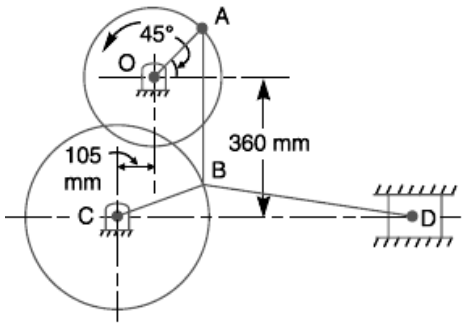
Subject Name: Kinematics and Theory of Machine

Time: 02:30 PM TO 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.**

			Marks
Q.1	**(a)**	Define the following terms. 1. Higher pair 2. Completely Constrained motion 3. Structure	**03**
	(b)	Apply Kutzbach's criterion to find degree of freedom of the following mechanisms and also predict the motion. 	**04**
	(c)	Enlist the quick return mechanisms and describe working of any one of them with neat sketch.	**07**
Q.2	**(a)**	Explain types of Instantaneous centers of mechanism.	**03**
	(b)	Prove that if three links move relatively to each other they have three instantaneous centers which must lie on a straight line.	**04**
	(c)	Following data related to reciprocating steam engine as shown in fig. When the crank has turned 30° from inner dead centre. Find: (i) Acceleration of piston (ii) Acceleration of C point on connecting rod. 	**07**
		OR	
	(c)	In the toggle mechanism, as shown in Fig., the slider D is constrained to move on a horizontal path. The crank OA is rotating in the counter-clockwise direction at a speed of 180 r.p.m. The dimensions of various links are as follows : OA = 180 mm ; CB = 240 mm ; AB = 360 mm ; and BD = 540 mm. For the given configuration, find : 1. Velocity of slider D, 2. Angular velocity of links AB, CB and BD	**07**



Q.3 **(a)** Explain the phenomena of slip and creep in a belt drive. **03**

(b) Construct two position synthesis of single slider crank mechanism by relative pole method. **04**

(c) A four bar mechanism is to be designed, by using three precision points, to generate the function **07**
$y = x^{1.5}$, for the range $1 \leq x \leq 4$.
Assuming 30° starting position and 120° finishing position for the input link and 90° starting position and 180° finishing position for the output link, find the values of x, y, θ and φ corresponding to the three precision points.

OR

Q.3 **(a)** List and describe the three phases of synthesis. **03**

(b) Derive the empirical relation for the ratio of driving tensions for flat belt drive. **04**

(c) A shaft rotating at 200 r.p.m. drives another shaft at 300 r.p.m. and transmits 6 kW through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4m. The smaller pulley is 0.5 m in diameter. Calculate the stress in the belt, if it is an open belt drive, Take $\mu = 0.3$. **07**

Q.4 **(a)** Define the following terms: **03**
(1) Dry friction
(2) Film friction
(3) Limiting angle of friction

(b) A vehicle moving on a rough plane inclined at 10° with the horizontal at a speed of 36 km/h has a wheel base 1.8 metres. The centre of gravity of the vehicle is 0.8 metre from the rear wheels and 0.9 metre above the inclined plane. Find the distance travelled by the vehicle before coming to rest and the time taken to do so when The vehicle moves up the plane. The brakes are applied to all the four wheels and the coefficient of friction is 0.5. **04**

(c) Construct a cam, with a minimum radius of 30 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 : **07**
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 the revolution i.e. 150° ;
The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when the line of stroke of the valve rod passes through the axis of the cam shaft, The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion.

OR

Q.4 **(a)** Explain with reason the case in which the shoe of the single shoe brake will be pivoted. **03**

(b) The inner and outer radii of a single plate clutch are 40 mm and 80 mm respectively. Determine the maximum, minimum and the average pressure when the axial force is 3 kN. **04**

(c) Construct 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 : **07**

1. To move outwards through 40 mm during 100° rotation of the cam ;
2. To dwell for next 80° ;
3. To return to its starting position during next 90°, and
4. To dwell for the rest period of a revolution i.e. 90°.

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.

Q.5 **(a)** Draw a neat sketch of single plate clutch and also label each component. **03**

(b) State and derive the law of gearing. **04**

(c) Two 20° involute spur gears have a module of 10 mm. The addendum is one module. The larger gear has 50 teeth and the pinion has 13 teeth. Does interference occur? If it occurs, to what value should the pressure angle be changed to eliminate interference? **07**

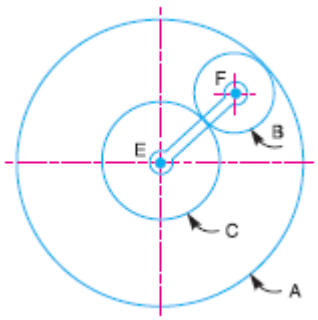
OR

Q.5 **(a)** Define the following terms: **03**

(1) Module of gear
(2) Backlash
(3) Self locking brake

(b) Make a comparison of cycloidal and involute tooth form. **04**

(c) An epicyclic gear consists of three gears A, B and C as shown in Fig. The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 r.p.m.. If the gear A is fixed, determine the speed of gears B and C. **07**



****

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–III (NEW) EXAMINATION – WINTER 2020

Subject Code:3131906 Date:05/03/2021

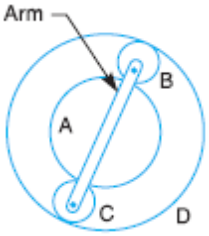
Subject Name:Kinematics and Theory of Machine

Time:10:30 AM TO 12:30 PM Total Marks:56

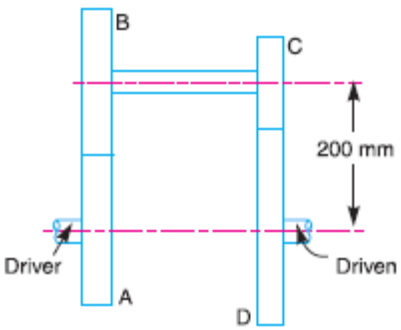
Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			Marks
Q.1	**(a)**	What are usual types of joints in a mechanism?	**03**
	(b)	Define: Kinematic link, Kinematic chain, Mechanism, Lower pair.	**04**
	(c)	Illustrate the inversion of a double slider crank mechanism giving example.	**07**
Q.2	**(a)**	Contrast Linear velocity & Velocity of rubbing.	**03**
	(b)	Interpret the Phenomenon of "slip"& "creep" in a belt drive.	**04**
	(c)	Derive the relation for ratio of belt tension in a flat belt drive.	**07**
Q.3	**(a)**	State and explain angular-velocity ratio theorem as applicable to mechanism.	**03**
	(b)	Explain briefly dimensional synthesis.	**04**
	(c)	An epicyclic train of gears is arranged as shown in Figure. How many revolutions does the arm, to which the pinions B and C are attached, make : 1. when A makes one revolution clockwise and D makes half a revolution anticlockwise, and 2. When A makes one revolution clockwise and D is stationary? The number of teeth on the gears A and D are 40 and 90 respectively.	**07**



Q.4	**(a)**	Explain solid friction, rolling friction and greasy friction.	**03**
	(b)	What are different types of pulleys? Explain briefly with sketch.	**04**
	(c)	The speed ratio of the reverted gear train, as shown in Figure, is to be 12. The module pitch of gears A and B is 3.125 mm and of gears C and D is 2.5 mm. Calculate the suitable numbers of teeth for the gears. No gear is to have less than 24 teeth.	**07**



Q.5	**(a)**	What is contact ratio? Explain its significance	**03**
	(b)	Formulate freudenstein's equation.	**04**
	(c)	Two pulleys, one 450 mm diameter and the other 200 mm diameter are on parallel shafts 1.95 m apart and are connected by a crossed belt. Find the length of the belt required and the angle of contact between the belt and each pulley. What power can be transmitted by the belt when the larger pulley rotates at 200 rev/min, if the maximum permissible tension in the belt is 1 kN, and the coefficient of friction between the belt and pulley is 0.25 ?	**07**
Q.6	**(a)**	Explain in brief Function, Path & Motion Generation.	**03**
	(b)	Differentiate between Involute and Cycloidal profile of gear tooth.	**04**
	(c)	State & prove the law of gearing.	**07**
Q.7	**(a)**	Explain types of constrain motion.	**03**
	(b)	Explain internal expanding shoe brake.	**04**
	(c)	The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 r.p.m. The crank is 150 mm and the connecting rod is 600 mm long. Determine : 1. Linear velocity and acceleration of the midpoint of the connecting rod, and 2. angular velocity and angular Acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position.	**07**
Q.8	**(a)**	Explain cone clutch with sketch.	**03**
	(b)	Classify followers & explain with neat sketch.	**04**
	(c)	A cam is to be designed for a knife edge follower with the following data : 1. Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion. 2. Dwell for the next 30°. 3. During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion. 4. Dwell during the remaining 180°. Draw the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft. The radius of the base circle of the cam is 40 mm.	**07**

****

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (NEW) EXAMINATION – WINTER 2021

Subject Code:3131906 Date:23-02-2022

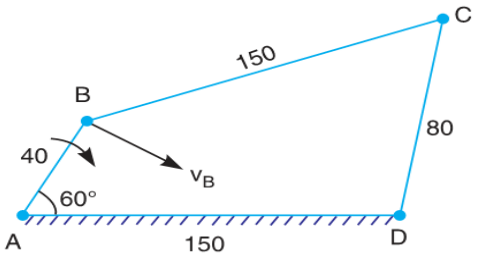
Subject Name:Kinematics and Theory of Machines

Time:10:30 AM TO 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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define the following term: a) Kinematic chain b) Degree of freedom c) Mechanism	**03**
	(b)	Explain different types of kinematic pairs.	**04**
	(c)	Explain various inversion of double slider kinematic chain with examples.	**07**
Q.2	**(a)**	Describe working principle of internal expanding shoe brake with a neat sketch.	**03**
	(b)	Construct three position synthesis of single slider crank mechanism by relative pole method.	**04**
	(c)	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 and 120° finishing position for the input link and 90° starting position and 180° finishing position for the output link, find the values of x, y, θ and φ corresponding to the three precision points.	**07**
		OR	
	(c)	Derive Freudenstein's equation for four bar mechanism.	**07**
Q.3	**(a)**	Explain and prove Arnold Kennedy theorem.	**03**
	(b)	Define the terms: a) Instantaneous center b) Body centrode & Space centrode c) Relative velocity	**04**
	(c)	In a four bar chain ABCD, AD is fixed and is 150 mm long. The crank AB is 40 mm long and rotates at 120 r.p.m. clockwise, while the link CD = 80 mm oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD when angle BAD = 60º.	**07**



OR

Q.3	**(a)**	Explain coriolis component and derive its equation.	**03**
	(b)	Draw an acceleration diagram of single slider crank mechanism.	**04**

(c) An engine mechanism is shown in fig. The crank CB=100mm and the connecting rod BA=300 mm with G point 100 mm from B. In the position shown, the crank shaft has a speed of 75 rad/sec and an angular acceleration of 1200 rad/sec^2. Find 1. velocity of G and angular velocity of AB and 2. acceleration of G and angular acceleration of AB. **07**

Q.4 **(a)** Classify the toothed gear. **03**

(b) State and derive law of gearing. **04**

(c) Design a cam for operating the exhaust valve of an oil engine. It is required to give equal uniform acceleration and retardation during opening and closing of the valve each of which corresponds to 60º of cam rotation. The valve must remain in the fully open position for 20º of cam rotation. **07**
The lift of the valve is 37.5mm and the least radius of the cam is 40mm. The follower is provided with a roller of radius 20mm and its line of stroke passes through the axis of cam.

OR

Q.4 **(a)** Define the terms: **03**
a) pressure angle
b) helix angle
c) circular pitch

(b) Explain the term 'Interference' as applied to gears. **04**

(c) A cam rotating CW at a uniform speed of 1000 rpm is required to give a roller follower the motion defined below: **07**
1. Follower move outwards through 50 mm during 120º of cam rotation
2. Follower to dwell for next 60º of cam rotation
3. Follower to return to its starting position during next 90º of cam rotation
4. Follower to dwell for the rest of the cam rotation.
The minimum radius of the cam is 50 mm and diameter of roller is 10mm. The line of stroke of the follower is off set by 20mm from the axis of the cam shaft. If the displacement of the follower takes place with uniform and equal acceleration and retardation on both the outward and return strokes, draw the profile of cam.

Q.5 **(a)** Derive the empirical relation for the ratio of driving tensions for flat belt drive. **03**

(b) A casting weighing 9 kN hangs freely from a rope which makes 2.5 turns round a drum of 300 mm diameter revolving at 20 r.p.m. the other end of the rope is pulled by a man. The coefficient of friction is 0.25. Determine: (1) The force required by the man and (2) the power to raise the casting. **04**

(c) A multi disc clutch has three discs on the driving shaft and two on the driven shaft. The outside diameter of the contact surfaces is 240mm and inside diameter 120mm. Assuming uniform wear and coefficient of friction as 0.3, find the maximum axial intensity of pressure between the discs for transmitting 25 KW at 1575 rpm. **07**

OR

Q.5 **(a)** Define the terms: **03**
a) Dry friction
b) film friction
c) limiting angle of friction

(b) Describe with a neat sketch the working of a single plate clutch. **04**

(c) A shaft rotating at 200 r.p.m. drives another shaft at 300 r.p.m. and transmits 6 kW through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4 m. the smaller pulley is 0.5 m in diameter. Calculate the stress in the belt, if it is (1) an open belt drive, and (2) a cross belt drive. Take $\mu = 0.3$. **07**

****

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III EXAMINATION – SUMMER 2020

Subject Code: 3131906 Date:04/11/2020

Subject Name: Kinematics and Theory of Machine

Time: 02:30 PM TO 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.**

			MARKS
Q.1	**(a)**	Define the following terms: (1) Module of gear (2) Pressure angle in cam-profile (3) Self-locking brake.	**03**
	(b)	Define the following terms (1) Lower pair (2) Higher pair (3) successfully constrained motion (4) completely constrained motion	**04**
	(c)	Explain the working principle of any quick return mechanism with net sketch.	**07**
Q.2	**(a)**	Explain the relation between linear and angular terms: displacement, velocity and acceleration	**03**
	(b)	In a crank and slotted lever quick return mechanism, the distance between the fixed centers is 300 mm and the length of the driving crank is 150 mm. Determine the ratio of the time taken on the cutting and return strokes	**04**
	(c)	The crank of a slider crank mechanism rotates clockwise at a constant speed of 10 rad/s. The crank OA is 150 mm and connecting rod AB is 600 mm long. Determine the acceleration of connecting rod AB, acceleration of slider B. When crank is at 45^{o} from inner dead center position.	**07**
		OR	
	(c)	A four-bar mechanism ABCD, the length of the various links is given as AB =190 mm, BC = CD =280 mm, AD = 500 mm. $\angle BAD = 55^{0}$. The crank rotates at 10 rad/s in the clock wise direction. Determine... (a) the acceleration of link BC and CD and (b) the angular acceleration of link BC and CD.	**07**
Q.3	**(a)**	Explain Rigid link, Flexible link and Fluid link with example.	**03**
	(b)	State and prove 'Aronhold Kennedy's Theorem' of three instantaneous centers.	**04**
	(c)	Synthesize a four-bar mechanism to meet the following instantaneous conditions for input output links: $\theta_2 = 60^0$, $\theta_4 = 90^0$ $\omega_2 = 3$ rad/sec, $\omega_4 = 2$ rad/sec $\alpha_2 = -1$ rad/sec^2, $\alpha_4 = 0$	**07**

OR

Q.3 **(a)** Define rubbing velocity at a pin joint. What will be the rubbing velocity at pin joint when the two links move in the same and opposite directions? **03**

(b) Explain in brief Function, Path & Motion Generation **04**

(c) Design a four-bar chain mechanism, governed by the function $y= 2x^2$ for the range $2 \leq x \leq 4$ **07**
Assuming θ vary between 40^0 and 120^0 for the input link and ϕ vary between 60^0 and 132^0 for the output link. Find the value of x , y , ϕ and φ corresponding to three precision point.

Q.4 **(a)** What do you understand by the term "interference" as applied to the gear? **03**

(b) Bridges and roof of workshop uses structure element, justify with reason. **04**

(c) Draw the cam profile operating knife edge follower from following data **07**
(i) Follower to move out through distance of 40mm during 100°
(ii) Follower to dwell for next 80°.
(iii) Follower to return to its initial position during 90°.
(iv) Follower to dwell for remaining cam rotation
The cam shaft rotates at 900rpm. The minimum radius of cam is 50mm and line of follower is offset 15mm from the axis of the cam and displacement to take place with uniform acceleration and retardation for both inward and outward stroke.

OR

Q.4 **(a)** Define the following terms: (1) Dry friction (2) Film friction (3) Limiting angle of friction **03**

(b) Find maximum velocity and acceleration for outward and return stroke for the data given in above problem 4(c) and draw the displacement, velocity and acceleration diagram. **04**

(c) Explain with sketches the different types of cams and followers **07**

Q.5 **(a)** Show that velocity ratio for compound belt drive is given by **03**
$$\frac{N_2}{N_1} \chi \frac{N_4}{N_3} = \frac{d_1}{d_2} \chi \frac{d_3}{d_4}$$

(b) Derive an expression for the length of path of contact for two involutes profile gear in mash. **04**

(c) The pressure angle of two gear in mesh is 20^0 and have a module of 10mm. The number of teeth on pinion are 24 and on gear 60. The addendum of pinion and gear is same and equals to one module. Determine ... **07**
(a) the number of pairs of teeth in contact
(b) the angle of action of the pinion and gear.

OR

Q.5 **(a)** Explain the phenomena of slip and creep in a belt drive. **03**

(b) Explain with the neat sketch the "sun and planet wheel". **04**

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

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (NEW) EXAMINATION – SUMMER 2021

Subject Code:3131906 Date:06/10/2021

Subject Name: Kinematics and Theory of Machine

Time:10:30 AM TO 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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Define the following terms: Link, Kinematic link, Kinematic chain	**03**
	(b)	List quick return motion mechanisms with application.	**04**
	(c)	Explain degree of freedom with neat sketch. Also State and explain Grashof's criterion.	**07**
Q.2	**(a)**	List and describe the three phases of synthesis.	**03**
	(b)	Construct two position synthesis of single slider crank mechanism by relative pole method.	**04**
	(c)	Derive analytical expression for the displacement and velocity analyses of a slider crank mechanism.	**07**
		OR	
	(c)	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 and 120° finishing position for the input link and 90° starting position and 180° finishing position for the output link. Find the values of x, y, θ and φ corresponding to the three precision points.	**07**
Q.3	**(a)**	Define the following terms as applied to cam with a neat sketch: - Base circle, Pressure angle, and Pitch circle.	**03**
	(b)	Classify "followers" and explain with neat sketch.	**04**
	(c)	Draw the profile of a cam rotating in anti-clock wise direction and operating a knife edge follower when the axis of the follower passes through the axis of the cam shaft from following data: 1. Follower moves outwards through 30 mm during 90° of cam rotation. 2. Follower dwells for next 120° 3. Follower returns to its original position during next 150°, 4. The displacement of the follower is to take place with SHM during outward stroke and with uniform velocity during inward stroke. 5. The least radius of the cam is 50 mm	**07**
		OR	
Q.3	**(a)**	Compare chain drive with rope drive.	**03**
	(b)	Explain the phenomenon of "slip" and "creep" in a belt drive.	**04**
	(c)	If two parallel shaft 6 m apart are to be connected by a belt running over a pulley of dia 600 mm and 400 mm respectively. Find exact and approx. lengths of belt when belt is open and when belt is crossed.	**07**

Q.4	**(a)**	Distinguish between the function of a clutch, brake and dynamometer.	**03**
	(b)	Derive an expression for the efficiency of an inclined plane when a body moves up a plane.	**04**
	(c)	A simple band brake is applied to a rotating drum of 500 mm diameter. The angle of lap of the band on the drum is 260°. One end of the band is attached to a fulcrum pin of the lever and other end is to a pin 100 mm from the fulcrum. If coefficient of friction is 0.25, and a braking force of 100 N is applied at a distance of 750 mm from the fulcrum, determine the braking torque when the drum rotates in anti-clock wise direction.	**07**

OR

Q.4	**(a)**	What do you mean by interference in gear?	**03**
	(b)	For gear, Define: (1) Contact Ratio (2) Module (3) Circular pitch (4) Addendum.	**04**
	(c)	Derive an expression for the length of the path of contact in a pair of meshed spur gears.	**07**
Q.5	**(a)**	Explain briefly the differences between simple, compound, and epicyclic gear trains.	**03**
	(b)	Explain compound gear train with neat sketch.	**04**
	(c)	Explain epicyclic gear train with the help of neat sketch. Write its merits and demerits as compared to reverted and compound gear trains.	**07**

OR

Q.5	**(a)**	Discuss coriolis component of acceleration.	**03**
	(b)	Formulate freudenstein's equation.	**04**
	(c)	State and prove the law of gearing. Show that involute profile satisfies the conditions for correct gearing.	**07**

****

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III (NEW) EXAMINATION – SUMMER 2022

Subject Code:3131906 Date:18-07-2022

Subject Name:Kinematics and Theory of Machines

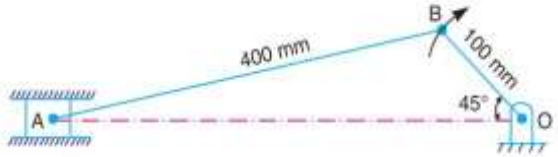
Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Sketch and describe four bar chain mechanism.	**03**
	(b)	Explain the terms: 1. Lower pair 2. Higher pair 3. Kinematic link 4. Mechanism	**04**
	(c)	Compare and discuss: kinematic link, kinematic pair, and kinematic chain.	**07**
Q.2	**(a)**	Create displacement diagram for Simple Harmonic motion for desired dimensions.	**03**
	(b)	Draw the displacement, velocity and acceleration diagrams for a follower when it moves with Uniform acceleration and retardation	**04**
	(c)	A cam is to be designed for a knife edge follower with the following data : 1. Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion. 2. Dwell for the next 30°. 3. During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion. 4. Dwell during the remaining 180°. Draw the profile of the cam when the line of stroke is offset 20 mm from the axis of the cam shaft. The radius of the base circle of the cam is 40 mm. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240 r.p.m	**07**
		OR	
	(c)	Draw the profile of the cam when the roller follower moves with cycloidal motion during out stroke and return stroke, as given below : 1. Out stroke with maximum displacement of 31.4 mm during 180° of cam rotation, 2. Return stroke for the next 150° of cam rotation, 3. Dwell for the remaining 30° of cam rotation. The minimum radius of the cam is 15 mm and the roller diameter of the follower is 10 mm. The axis of the roller follower is offset by 10 mm towards right from the axis of cam shaft.	**07**
Q.3	**(a)**	Explain the terms: Function Generation, Path Generation, Motion Generation	**03**
	(b)	Formulate freudenstein's equation.	**04**
	(c)	Locate all the instantaneous centres of the slider crank mechanism as shown in Fig. The lengths of crank OB and connecting rod AB	**07**

are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s,
find: 1. Velocity of the slider A, and 2. Angular velocity of the connecting rod AB



OR

Q.3 **(a)** State and prove 'Aronhold Kennedy's Theorem' of three instantaneous centres. **03**

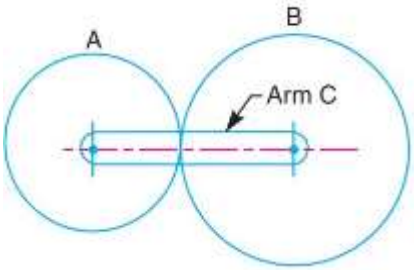
(b) Explain briefly dimensional synthesis. **04**

(c) A four bar chain mechanism is to be designed, by using three precision point to generate the function **07**
$Y = X^{1.5}$ for the range $1 \leq x \leq 4$
Assuming 30^0 starting position and 120^0 finishing position for the input link and 90^0 starting position and 180^0 finishing position for the output link, find the value of x , y , ɵ and φ corresponding to three precision point.

Q.4 **(a)** Differentiate between Involute and Cycloidal profile of gear tooth **03**

(b) Define the term: **04**
1. Pitch circle 2. Pitch Diameter 3. Pitch Point 4. Module

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



OR

Q.4 **(a)** Define the following terms: **03**
(1) Dry friction (2) Film friction (3) Limiting angle of friction

(b) Discuss the various types of the brakes **04**

(c) A bicycle and rider of mass 100 kg are travelling at the rate of 16 km/h on a level road. A brake is applied to the rear wheel which is 0.9 m in diameter and this is the only resistance acting. How far will the bicycle travel and how many turns will it make before it comes to rest? The pressure applied on the brake is 100 N and μ = 0.05. **07**

Q.5 **(a)** Explain what do you understand by 'initial tension in a belt' **03**

(b) Interpret the Phenomenon of "slip"& "creep" in a belt drive. **04**

(c) Power is transmitted using a V-belt drive. The included angle of V-groove is 30°. The belt is 20 mm deep and maximum width is 20 mm. If the mass of the belt is 0.35 kg per metre length and **07**

maximum allowable stress is 1.4 MPa, determine the maximum power transmitted when the angle of lap is 140°. $\mu = 0.15$.

OR

Q.5	**(a)**	Show cone clutch with sketch.	**03**
	(b)	Illustrate with the neat sketch the "sun and planet wheel."	**04**
	(c)	Explain the condition for correct steering. Sketch and show the Davis steering mechanism and discuss their advantages.	**07**

****