

Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering - SEMESTER - III EXAMINATION - WINTER 2025

Subject Code: 3131906

Date: 22-12-2025

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) Identify difference between machine and structure.	03
(b) Define (1) kinematics (3) link (3) Mechanism (4) Lower pair	04
(c) What is degree of freedom? Explain Kutzbach Criterion and Grubler's Criterion for Plane Mechanisms	07
Q.2 (a) Elaborate difference between type synthesis and number.	03
(b) Explain briefly function generation.	04
(c) Derive Freudenstein's Equation for Synthesis of four-bar mechanism.	07
OR	
(c) Design a four-bar mechanism to co-ordinate the input and output angles as follows: Input angles = 15° , 30° , and 45° and Output angles = 30° , 40° , and 55° .	07
Q.3 (a) List advantages and disadvantages of chain drive over belt drive.	03
(b) Explain slip and creep in belt drive.	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 = 60° .	07
OR	
(a) Summaries liner velocity, angular velocity and liner acceleration.	03
(b) Explain reverted gear train with neat sketch.	04
(c) A pair of gears, having 40 and 20 teeth respectively, are rotating in mesh, the speed of the smaller being 2000 r.p.m. Determine the velocity of sliding between the gear teeth faces at the point of engagement, at the pitch point, and at the point of disengagement if the smaller gear is the driver. Assume that the gear teeth are 20° involute form, addendum length is 5 mm and the module is 5 mm. Also find the angle through which the pinion turns while any pairs of teeth are in contact.	07
Q.4 (a) Explain various follower motion.	03
(b) What are epicyclic gear trains? state its special advantages.	04

- (c) Derive formula for frictional torque transmitted by flat pivot bearing considering (1) uniform pressure distribution and (2) uniform wear condition with usual notations. 07

OR

- (a) What is instantaneous center? also state its property. 03
- (b) Explain method of finding velocity of point on link by relative velocity method. 04
- (c) The crank of the slider-crank mechanism rotates clockwise at a constant speed of 300 RPM. The crank is 150 mm and the connecting rod is 600 mm long. Determine: Linear velocity and acceleration of the midpoint of the connecting rod, and Angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from the inner dead center position. 07

- Q.5** (a) Define (1) clearance (2) pitch Circle (3) Backless for gear. 03
- (b) What do you understand by the term 'interference' as applied to gears? 04
- (c) 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 passes through the center of the cam shaft, and The displacement of the follower is to take place with uniform acceleration and uniform retardation.

OR

- (a) State laws of static and dynamic friction. 03
- (b) Explain single block or shoe brake with neat sketch. 04
- (c) Derive formula for power transmitted by cross belt drive with usual notations. 07

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-III (NEW) EXAMINATION – WINTER 2024

Subject Code:3131906

Date:10-12-2024

Subject Name:Kinematics and Theory of Machines

Time:10:30 AM TO 01:00 PM

Total Marks:70

Instructions:

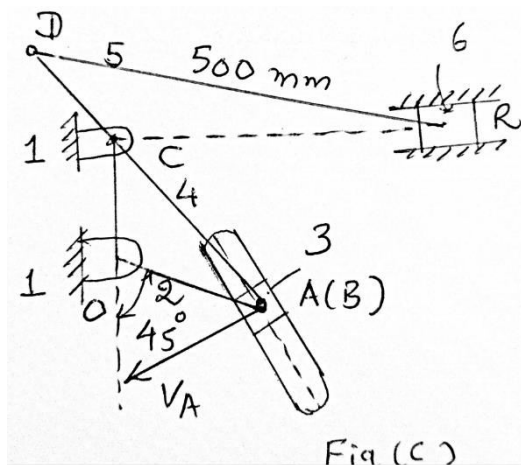
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1**
- | | | |
|-----|--|-----------|
| (a) | Explain: Lower Pair, Degree of Freedom , Mechanical Advantage | 03 |
| (b) | What is inversion ? Explain any one inversion of slider Crank chain | 04 |
| (c) | Explain Grubler crieteria of determing degree of freedom For mechanisms & for plane mechanism prove that minimum number of binary links in constrained mechanism with simple hinges is four. | 07 |

- Q.2**
- | | | |
|-----|---|-----------|
| (a) | With neat sketch explain space centroide & body centroide. | 03 |
| (b) | What is instantaneous center ? Explain kenedys theorm for IC. | 04 |
| (c) | Explain corrolis component and derive its equation in quick return mechanism. | 07 |

OR

- (c) A whth worth quick return motion mechanism shown in figure c . OA is a crank rotating at 30 rpm in clockwise direction.OA is 150 mm, OC= 100 mm, CD= 125 mm, DR = 500 mm. Determine the acceleration of sliding block R and angular acceleration of slotted lever CA.



- Q.3**
- | | | |
|-----|--|-----------|
| (a) | Explain terms: Type synthesis, Number synthesis, Dimensional synthesis | 03 |
| (b) | Describe the classification of synthesis problem | 04 |
| (c) | Draw the cam profile for a cam in which moves with SHM during ascent while it moves with uniformly accelerated motion during descent. Lift of follower 40 mm , least radius of cam 60 mm, angle of ascent 48° . angle of dwell between ascent and descent 42°, angle of descent 60°, diameter of roller 40 mm. Distance between axis of follower and axis of cam 20 mm. If cam rotates | 07 |

at 360 rpm anticlockwise find maximum velocity and acceleration of follower during descent.

OR

- Q.3** (a) Explain the effect of pressure angle in cam design. **03**
 (b) Classify follower motion in cam and explain SHM in cam. **04**
 (c) For four bar mechanism for three precession points to generate a function $Y = X^{1.5}$ for range $1 \leq x \leq 4$. Assuming starting position 40° and finishing position 130° for input link and 100° starting position and 190° finishing position for the input link, find values of x, y, θ, ϕ corresponding to three precession points. **07**

- Q.4** (a) Explain phenomenon of slip and creep in belt **03**
 (b) For flat belt drive derive $T_1/T_2 = e^{\mu\theta}$, where μ = coefficient of friction and θ is angle of contact. **04**
 (c) Engine with 45 KW power at 1000 rpm is connected with cone clutch built inside the flywheel. Cone has face angle 12.5° and maximum mean diameter of 600 mm. The coefficient of friction is 0.2. The normal pressure on clutch face is not to exceed 0.1 N/mm^2 . Find the axial spring force necessary to engage to clutch and face width required. **07**

OR

- Q.4** (a) Explain limiting friction, angle of friction and coefficient of friction. **03**
 (b) Derive expression for flat collar bearing Assume uniform intensity of pressure. **04**
 (c) Two pulleys are 450 mm diameter and other 200 mm diameter are on parallel shafts 1.95 m apart and are connected by cross belt. Find the length of belt required and angle of contact between the belt and each pulley. What power can be transmitted by belt when larger pulley rotates at 300 rpm. If the maximum permissible tension in belt is 1000 N and coefficient of friction between belt and pulley is 0.25? **07**

- Q.5** (a) What is self locking in brakes? Explain it in shoe brake. **03**
 (b) Differentiate between involute and cycloidal gear. **04**
 (c) What is law of gearing ? Derive the equation for sliding velocity in gear. **07**

OR

- Q.5** (a) Explain Addendum, Module, Backlash in Gear **03**
 (b) Write short note on differential gear box. **04**
 (c) In an epicyclic gear train arm carries two gears A and B having 30 and 45 teeth respectively. If arm rotates at 150 rpm in clockwise direction about center of gear A which is fixed, Determine speed of gear B. If the gear A instead of being fixed makes 300 rpm in clockwise direction what will be speed of gear? **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-III (NEW) EXAMINATION – WINTER 2023****Subject Code:3131906****Date:25-01-2024****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) What is a machine? Giving Example, Differentiate between a machine and a structure.	03
	(b) Explain the terms: 1. Higher Pair, 2. Inversion, 3. Constrain motion, 4. Degree of Freedom	04
	(c) Sketch and explain any two inversions of a double slider crank chain.	07
Q.2	(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 direction?	03
	(b) Prove that the three bodies move relatively to each other, they have three instantaneous centres and lies on a straight line.	04
	(c) Derive an expression for the magnitude and direction of Coriolis component of acceleration.	07
OR		
(c)	For the configuration of a slider crank mechanism shown in Fig.1. Determine: (i) the acceleration of the slider (ii) the acceleration of point E (iii) the angular acceleration of the link AB. The crank OA rotates at 200 r.p.m. clockwise. OA = 500 mm, AB = 1500 mm, AE = 450 mm.	07

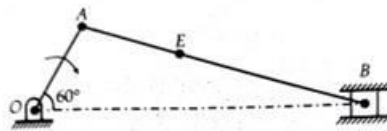


Fig.1

Q.3	(a) Explain what do you understand by 'initial tension in a belt'.	03
	(b) The width of a belt is 15 cm and the maximum tension per cm width is not to be exceeded 140 N. the ratio of tensions on the two sides is 2.25, the diameter of the driver is 1.05 m and it makes 220 r.p.m, find the power that can be transmitted.	04
	(c) Explain two position synthesis of four bar chain mechanism by pole method.	07
OR		
Q.3	(a) Explain the phenomena of slip and creep in a belt drive.	03
	(b) Discuss relative merits and demerits of belt, rope and chain drive for transmission of power.	04

- (c) A four-bar mechanism is used to generate the function $y = 1/x$ for the range $1 \leq x \leq 3$. Find the three-precision position from Chebyshev spacing, if the initial values of the crank angle and follower angle is 30° and 200° respectively. Take $\Delta\theta = \Delta\phi = 90^\circ$. Find the corresponding values of θ and ϕ . 07
- Q.4** (a) Write a short note on internal expanding shoe brake. 03
 (b) State the law of 04
 (i) Static friction (iii) Solid Friction
 (ii) Dynamic Friction (iv) Fluid Friction
- (c) From the following data draw the profile of a cam in which the follower moves with S.H.M. during ascent while it moves with uniform accelerated motion during descent: 07
 Lift of follower = 4 cm; Least radius of cam = 5 cm;
 Angle of ascent = 48° ; Angle of dwell between ascent and descent = 42° ; Angle of descent = 60° ; The diameter of roller = 3 cm; Distance between line of action of the follower and the axis of cam = 2 cm.
- OR**
- Q.4** (a) Distinguish between brakes and clutches. 03
 (b) A multiplate clutch has three pairs of contact surfaces. The outer and inner radii of the contact surfaces are 100 mm and 50 mm respectively. The axial spring force is limited to 1 kN. Assuming uniform wear, find the power transmitted at 1500 rpm. Take $\mu = 0.35$. 04
 (c) Classify and elaborate the types of followers with a neat sketch. 07
- Q.5** (a) Define the term: Circular pitch, Backlash, Pressure angle. 03
 (b) What do you understand by gear train? Discuss the various types of gear train. 04
 (c) Two gear wheels of 10 cm and 15 cm pitch diameters have involute teeth of 1.6 DP and pressure angle 20° . The addenda are 3 mm. Determine (i) length of path of contact (ii) contact ratio, and (iii) angle turned by the pinion, while any pair of teeth is in contact. 07
- OR**
- Q.5** (a) Prove that the velocity of sliding is proportional to the distance of the point of contact from the pitch point. 03
 (b) What do you understand by the term 'interference' as applied to gears? 04
 (c) In an epicyclic gear train as in Fig.2, the arm A is fixed to shaft S. The wheel B having 100 teeth rotates freely on the shaft S and wheel F with 150 teeth is separately driven. If the arm A runs at 200 rpm and wheel F at 100 rpm in the same direction, find (a) Number of teeth on wheel C, (b) speed of wheel B. 07

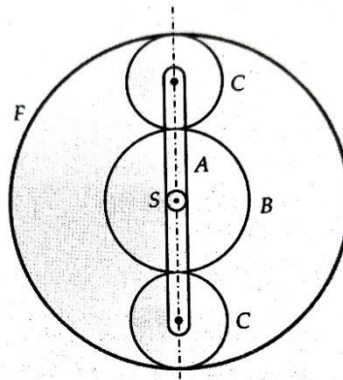


Fig.2

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Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3131906

Date:27-02-2023

Subject Name:Kinematics and Theory of Machines

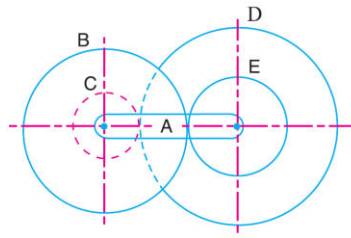
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Total Marks:70

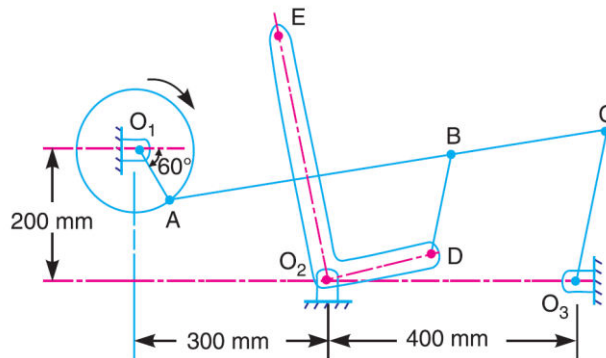
Instructions:

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) Differentiate Lower pair and Higher Pair	03
	(b) Classify different types of constrained motions.	04
	(c) Draw and explain Peaucellier mechanism and	07
Q.2	(a) Classify different types of cams according to types of shape.	03
	(b) Classify and draw different follower displacement diagram.	04
	(c) Two involute gears of 20° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module, find the angle turned through by pinion when one pair of teeth is in mesh and the maximum velocity of sliding.	07
OR		
	(c) Construct cam profile for knife edge follower with offset to right by 15 mm. Minimum radius of the cam = 30 mm, stroke of the follower = 24 mm. angle of rise = 90° , dwell after rise = 60° , angle of return = 120° , dwell after return for the rest of the period. Follower move outward with uniform velocity and return back with simple harmonic motion. The cam is rotating in clockwise direction.	07
Q.3	(a) Explain the term coupler curves.	03
	(b) Explain chebychev spacing method	04
	(c) A four-bar chain mechanism is to be designed by using three precision points to generate the function $Y = X^{1.5}$ for the angle range $1 \leq x \leq 4$. Assuming 30° starting position and 120° finishing position for the input link and 90° starting position and 180° for finishing position for the output link, find the value of x , y , θ , Φ corresponding to three precision point.	07
OR		
Q.3	(a) State the law of gearing.	03
	(b) Differentiate spur and helical gear.	04
	(c) In a reverted epicyclic gear train, the arm A carries two gears B and C and a compound gear D - E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed and the arm A makes 100 r.p.m. clockwise.	07

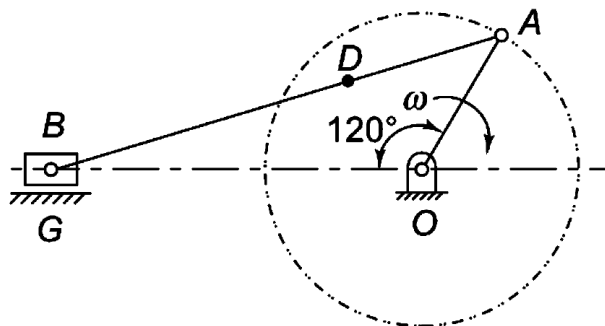


- Q.4** (a) Explain Klein's construction. **03**
 (b) Explain the term rubbing velocity. **04**
 (c) The mechanism of a machine, as shown in Figure, has the following dimensions: $O_1A = 100$ mm, $AC = 700$ mm, $BC = 200$ mm, $O_3C = 200$ mm, $O_2E = 400$ mm, $O_2D = 200$ mm and $BD = 150$ mm. The crank O_1A rotates at a uniform speed of 100 rad/s. Find the velocity of the point E of the bell crank lever by instantaneous center method. **07**



OR

- Q.4** (a) State and explain aronhold- kennedy theorem. **03**
 (b) Explain angular velocity, linear velocity, angular acceleration and linear acceleration. **04**
 (c) Figure shows configuration of an engine mechanism. The dimensions are the following: Crank $OA = 200$ mm; Connecting rod $AB = 600$ mm; distance of center of mass from crank end, $AD = 200$ mm. At the instant, the crank has an angular velocity of 50 rad/s clockwise and an angular acceleration of 800 rad/s². Calculate the (i) velocity of D and angular velocity of AB (ii) acceleration of D and angular acceleration of AB **07**



- Q.5** (a) State the law of belting **03**
 (b) Compare belt drive, rope drive and chain drive. **04**
 (c) In an open-belt drive, the diameters of the larger and the smaller pulleys are 1.2 m and 0.8 m respectively. The smaller pulley rotates at 320 rpm. The center distance between **07**

the shafts is 4 m. When stationary, the initial tension in the belt is 2.8 kN the mass of the belt is 1.8 kg/m and the coefficient of friction between the belt and the pulley is 0.25. Determine the power transmitted.

OR

- Q.5**
- | | | |
|-----|--|-----------|
| (a) | Classify the different type of brakes. | 03 |
| (b) | Explain the working of multi plate clutch with neat sketch. | 04 |
| (c) | A rope drive transmits 600 kW from a pulley of effective diameter 4 m, which runs at a speed of 90 r.p.m. The angle of lap is 160° ; the angle of groove 45° ; the coefficient of friction 0.28; the mass of rope 1.5 kg / m and the allowable tension in each rope 2400 N. Find the number of ropes required. | 07 |