Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 4 – EXAMINATION – SUMMER 2026

Subject Code: BE04000171 **Date: 25/05/2026**

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)**	Define the following terms with one example each: (i)Kinematic Pair (ii)Kinematic Chain (iii)Inversion of Mechanism.	**03**
	(b)	Explain the working of the Ackermann steering gear mechanism with a neat sketch.	**04**
	(c)	A four-bar chain has links of lengths 30 mm, 60 mm, 70 mm, and 80 mm. Verify whether the mechanism satisfies Grashof's law. Identify the exact type of mechanism obtained when: (i)The 30 mm link is fixed. (ii)The 70 mm link is fixed.	**07**
Q.2	**(a)**	Define 'Instantaneous Center of Rotation' and state Kennedy's theorem.	**03**
	(b)	Explain the Coriolis component of acceleration and state its direction rule.	**04**
	(c)	In a slider-crank mechanism, the crank is 180 mm long and the connecting rod is 720 mm long. The crank rotates at a uniform speed of 300 rpm clockwise. Using the analytical method, determine the velocity and acceleration of the piston when the crank has turned 45° from the inner dead center.	**07**
		OR	
Q.2	**(c)**	In a crank and slotted lever quick return mechanism, the crank length is 160 mm and the distance between the fixed centers is 400 mm. The crank rotates uniformly at 150 rpm. Determine the Coriolis component of acceleration of the slider when the crank is exactly at 90° to the line of stroke.	**07**
Q.3	**(a)**	Differentiate between Function Generation and Path Generation in mechanism synthesis.	**03**
	(b)	Explain the Simple Harmonic Motion (SHM) of a cam follower and draw its displacement diagram.	**04**
	(c)	Derive Freudenstein's equation for the analytical synthesis of a four-bar mechanism for three precision points.	**07**
		OR	
Q.3	**(a)**	Define 'Precision Points' and 'Structural Error' in dimensional synthesis.	**03**
	(b)	Explain Chebyshev's spacing of precision points.	**04**
	(c)	A radial cam rotates at 200 rpm and drives a knife-edge follower. The follower rises 40 mm during 120° of cam rotation with Simple Harmonic Motion. Determine the maximum velocity and maximum acceleration of the follower during the outstroke.	**07**

Q.4 **(a)** Define 'Slip' and 'Creep' in the context of belt drives. **03**

(b) State and explain the fundamental Law of Gearing. **04**

(c) An open belt drive connects two pulleys of diameters 500 mm and 250 mm. The center distance is 3 m. If the larger pulley rotates at 240 rpm, the maximum tension in the belt is 2000 N, and the coefficient of friction is 0.3, determine the power transmitted by the belt. **07**

OR

Q.4 **(a)** What is 'Interference' in involute gears? State one method to avoid it. **03**

(b) Derive the condition for maximum power transmission in a belt drive. **04**

(c) In an epicyclic gear train, the sun gear has 30 teeth and the internal ring gear has 90 teeth. If the arm carries the planet gears and rotates at 100 rpm clockwise while the sun gear is fixed, find the speed and direction of the internal ring gear. **07**

Q.5 **(a)** Define 'Self-locking brake' and 'Self-energizing brake'. **03**

(b) Differentiate between the uniform pressure theory and uniform wear theory as applied to clutches. **04**

(c) A multi-plate clutch has 4 pairs of contact surfaces. The inner and outer radii of the friction plates are 80 mm and 120 mm respectively. The maximum pressure is limited to 0.1 N/mm^2 and the coefficient of friction is 0.3. Assuming uniform wear theory, find the power transmitted at 800 rpm. **07**

OR

Q.5 **(a)** Classify the different types of mechanical brakes. **03**

(b) Explain the working of a centrifugal clutch with a neat sketch. **04**

(c) A simple band brake operates on a drum of 600 mm diameter rotating at 250 rpm. The angle of wrap is 220° and the coefficient of friction is 0.25. If the brake absorbs 15 kW of power, calculate the tensions in the tight and slack sides of the band. **07**

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