Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III EXAMINATION – SUMMER 2025

Subject Code:3131906 Date:06-06-2025

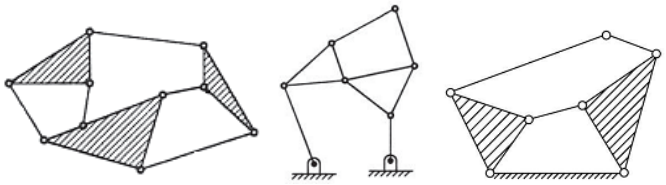
Subject Name:Kinematics and Theory of Machines

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

Instructions:

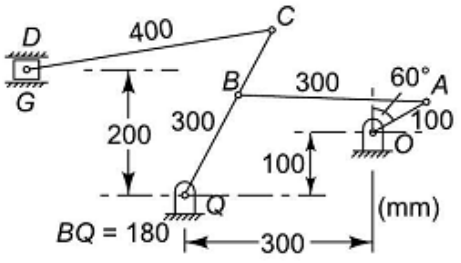
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Find the degrees of freedom for the given configurations.	**03**



(i) (ii) (iii)

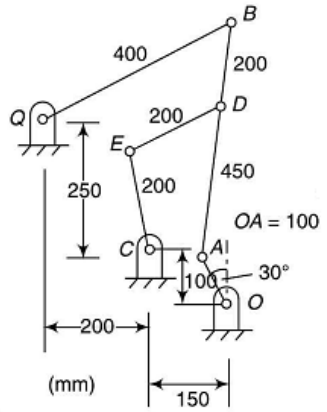
	(b)	How are the kinematic pairs classified? Explain with examples.	**04**
	(c)	Explain the inversions of the single slider crank mechanism.	**07**
Q.2	**(a)**	Define Type, Number and Dimensional synthesis.	**03**
	(b)	In a crank and slotted lever mechanism, the length of crank is 560 mm and the ratio of time of working stroke to return stroke is 2.8. Determine (a) distance between the fixed centres, and (b) the length of the slotted lever, if length of stroke is 250 mm.	**04**
	(c)	A four bar mechanism is to be synthesized by using three precision points from Chebyshev's spacing to generate the function $y = x^2$, for the range $0 \leq x \leq 1$. Input link is to start from 30º and $\Delta\theta = 90º$. The output link is to start at 30º and $\Delta\phi = 90º$. Find out the values of corresponding θ and ϕ.	**07**
		OR	
	(c)	Design a slider crank mechanism to coordinate three positions of the input and of the slider for the following data by inversion method. Eccentricity = 20 mm. $\theta_{12} = 30º$, $\theta_{13} = 60º$, $S_{12} = 40$ mm, $S_{13} = 96$ mm.	**07**
Q.3	**(a)**	In the mechanism shown in figure the crank OA rotates at 210 rpm clockwise. For the given configuration, determine (i) velocity and acceleration of slider D, (ii) angular velocity and angular acceleration of the link CD.	**14**



OR

Q.3	**(a)**	Explain the types of I- Centres. What is the use of Kennedy's theorem?	**04**
	(b)	Figure shows a six link mechanism. The dimensions of the links are OA = 100 mm, AB = 450 mm, BD = 200 mm, QB = 400 mm, DE = 200 mm,	**10**

CE = 200 mm. Find all the I-Centers for the given configuration. Also find velocity of point B and E and an angular velocity of links CE and BQ. Link OA rotates at 20 rad/s clockwise.



Q.4 **(a)** What are the advantages of the V-belt drive? **03**

(b) Derive the expression for the ratio of the friction tensions for a flat belt. **04**

(c) A cam is to operate an offset roller follower. The least radius of the cam is 50 mm, roller diameter is 30 mm, and offset is 20 mm. The cam is to rotate at 360 rpm. The angle of ascent is 48°, angle of dwell is 42°, and angle of descent is 60°. The motion is to be SHM during ascent and uniform acceleration and deceleration during descent. Draw the cam profile. **07**

OR

Q.4 **(a)** Calculate the maximum velocity and acceleration during return for the data given in Q.4 (c) above. **03**

(b) How are the followers classified? Describe in detail. **04**

(c) An open belt drive is required to transmit 10kW of power from a motor running at 600 rpm. Diameter of the driving pulley is 250 mm. The speed of the driven pulley is 220 rpm. The belt is 12 mm thick and has a mass density of 0.001 g/mm^2. Safe stress in the belt is not to exceed 2.5 N/mm^2. The two shafts are 1.25 m apart. The coefficient of friction is 0.25. Determine the width of the belt. **07**

Q.5 **(a)** What are various kinds of friction? Discuss each in brief. **03**

(b) A differential band brake has a drum with a diameter of 800 mm. The two ends of the band are fixed to the pins on the opposite sides of the fulcrum of the lever at distances of 40 mm and 200 mm from the fulcrum. The angle of contact is 270º and the $\mu = 0.2$. Determine the brake torque when a force of 600 N is applied to the lever at a distance of 800 mm from the fulcrum. Consider clockwise rotation of the drum. **04**

(c) Two 20º involute spur gears mesh externally and give a velocity ratio of 3. The module is 3 mm and the addendum is equal to 1.1 module. If the pinion rotates at 120 rpm, determine the (i) minimum number of teeth on each wheel to avoid interference, (ii) contact ratio. **07**

OR

Q.5 **(a)** Define Circular pitch, Diametral pitch and Module for gears. **03**

(b) Explain simple, compound and reverted gear trains. **04**

(c) A single-plate clutch, with both sides effective, has inner and outer diameters of friction surface 250 mm and 350 mm, respectively. The maximum intensity of pressure is not to exceed 0.15 MPa. The coefficient of friction is 0.3. Determine the power transmitted by the clutch at a speed of 2400 rpm for (a) uniform wear and (b) uniform pressure. **07**

****