R.N.G.PATEL INSTITUTE OF TECHNOLOGY-RNGPIT
(An Autonomous Institute U/s UGC Act 1956)

B.Tech. SEMESTER-III, SEMESTER END EXAMINATION – WINTER 2025

SUBJECT CODE: 1ME305	**DATE: 26-12-2025**
SUBJECT NAME: KINEMATICS AND THEORY OF MACHINES	
TIME: 11:00 AM to 01:30 PM	**TOTAL MARKS: 70**

Instructions

1. It is **compulsory** for students to write **Enrolment No. /Seat No.** on the question paper.
2. Write answers of **Section A** and **Section B** in **separate answer books**.
3. Attempt all questions from both **Section A** and **Section B**.
4. Each section carries **35 marks**, with a total of **70 marks** for the examination.
5. The figures to the right of each question indicate full marks, make suitable assumptions with justification.
6. BL - Cognitive Level (As per Revised Bloom's Taxonomy) (R-Remember, U-Understanding, A –Application, N –Analyze, E – Evaluate, C -Create), CO - Course Outcomes.

SECTION A

			Marks	BL	CO
Q.1	**(a)**	List the different types of kinematic pairs.	03	R	1
	(b)	Using suitable sketches, explain how the inversions of a four-bar chain mechanism are applied in real mechanical systems.	04	A	1
Q.2	**(a)**	Define synthesis. Explain in brief classification of synthesis.	03	U	2
	(b)	Describe freudenstein's equation for four bar mechanism.	04	U	2
	(c)	Using the inversion method, synthesize a four-bar mechanism to satisfy two specified positions of the output link.	07	A	2

OR

			Marks	BL	CO
Q.2	**(a)**	What do you mean by the relative pole method?	03	U	2
	(b)	Discuss function generation with suitable example.	04	U	2
	(c)	Design a four-bar mechanism with input link l_2, coupler link l_3 and output link l_4. Angles Θ and ϕ for three successive positions are given in table below.	07	A	2

Position→	1	2	3
Θ	40°	55°	70°
ϕ	50°	60°	75°

If the grounded link $l_1 = 30$ mm, using frudenstein's equation find out lengths of other links to satisfy the given positional conditions.

Q.3 **(a)** State aronhold kennedy theorem. | 03 | R | 3

(b) Discuss the three types of instantaneous centres for a mechanism. | 04 | U | 3

(c) In Figure-A, the angular velocity of the crank OA is 600 r.p.m. Determine the linear velocity of the slider D and the angular velocity of the link BD, when the crank is inclined at an angle of 75° to the vertical. The dimensions of various links are: OA = 28 mm; AB = 44 mm; BC = 49 mm; and BD = 46 mm. The centre distance between the centres of rotation O and C is 65 mm. The path of travel of the slider is 11 mm below the fixed-point C. The slider moves along a horizontal path and OC is vertical. (Relative velocity method) | 07 | A | 3
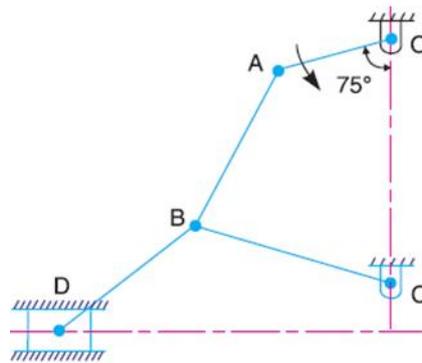

Figure-A

OR

Q.3 **(a)** What do you mean by tangential and radial(centripetal) acceleration in a mechanism? | 03 | R | 3

(b) Explain 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? | 04 | U | 3

(c) PQRS is a four-bar chain with link PS fixed. The lengths of the links are PQ = 62.5 mm; QR = 175 mm; RS = 112.5 mm; and PS = 200 mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagram when angle QPS = 60° and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of links QR and RS. | 07 | A | 3

SECTION B

			Marks	BL	CO

Q.4 **(a)** List the different types of followers based on their shape and motion.   **03**   **R**   **4**

(b) Draw the displacement diagram for a knife-edge follower using the following data: **04**   **A**   **4**
- (i) The follower moves outward through a distance of 40 mm during 100°.
- (ii) The follower dwells for the next 80°.
- (iii) The follower returns to its initial position during 90°.
- (iv) The follower dwells for the remaining cam rotation.

Assume that the displacement occurs with uniform acceleration and retardation during both the outward and return strokes."

Q.5 **(a)** What are the turning moment diagrams? Why are they drawn?   **03**   **U**   **5**

(b) Prove that the maximum fluctuation of energy, $\Delta E_{max} = 2.E.C_s$ with usual notations.   **04**   **U**   **5**

(c) A horizontal cross compound steam engine develops 300 kW at 90 rpm. The coefficient of fluctuation of energy as found from the turning moment diagram is to be 0.1 and the fluctuation of speed is to be kept within ±0.5% of the mean speed. Find the weight of the flywheel required, if the radius of gyration is 2 meters.   **07**   **A**   **5**

OR

Q.5 **(a)** Define Coefficient of fluctuation of energy and Coefficient of fluctuation of speed for flywheel.   **03**   **U**   **5**

(b) Explain turning moment diagram for 4-stroke engine with neat sketch.   **04**   **U**   **5**

(c) The turning moment diagram for a petrol engine is drawn to the following scales: Turning moment, 1 mm = 5 N-m; crank angle, 1 mm = 1°. The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line taken in order are 295, 685, 40, 340, 960, 270 mm2. The rotating parts are equivalent to a mass of 36 kg at a radius of gyration of 150 mm. Determine the coefficient of fluctuation of speed when the engine runs at 1800 rpm.   **07**   **A**   **5**

Q.6 **(a)** Write a brief classification of gears.   **03**   **R**   **6**

(b) State and prove the law of gearing.   **04**   **U**   **6**

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

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OR

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Q.6 **(a)** What do you understand by gear trains? List different types of gear trains.   **03   R   6**

(b) Explain with the neat sketch epicyclic gear train.   **04   U   6**

(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 rpm, in the anticlockwise direction about the center of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 rpm. in the clockwise direction, what will be the speed of gear B?   **07   A   6**

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