B.E. Seventh Semester (Mechanical Engineering) (C.B.S.)

Elective - I : Synthesis of Mechanisms

P. Pages : 3 **NKT/KS/17/7472**

Time : Three Hours * 0 1 4 8 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.

1. a) What is kinematic synthesis? Explain type number and dimensional synthesis. **7**

b) Define Mobility. What is Gruebler's criterion? How is it used to decide number of joints and links for a mechanism. **4**

c) Find the degree of freedom shown in figure 1. **3**

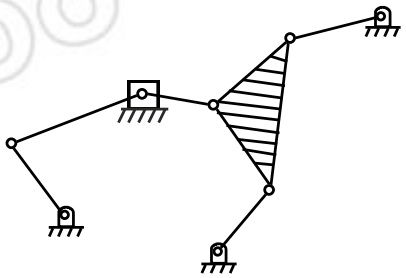


Fig. 1

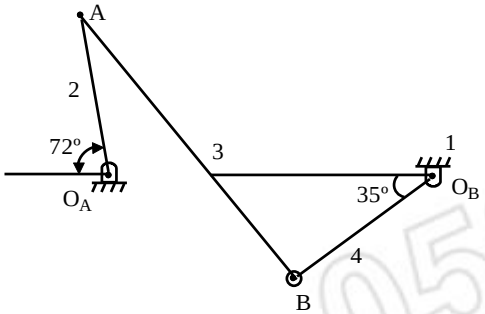
OR

2. a) Define cognates. State Robert – Chebyshev theorem. What is Robert's triangle? How is it used to design a new mechanism? **7**

b) Explain function generation, Path generation and motion generation in brief. **7**

3. a) Plot the cubic of stationary curve (circle point curve) associated with link 3 of mechanism. **7**

$O_A O_B = 6$; $O_2 A = 4$; $O_4 B = 3.75$



b) Derive Euler-Savary equation for inflection circle. **6**

OR

4. Synthesize a function generator to solve the equation: $y = 1/x$ over the range $1 \le x \le 2$. **13**
Using three precision position by choosing Chebyshev spacing.

5. a) Derive Freudenstein's equation for analytical synthesis. **7**

b) Explain matrix method approach for analytical synthesis. **7**

OR

6. Using Freudenstein's equation, synthesize a four bar mechanism to coordinate crank and rocker displacements as below. **14**

Position	Crank Angle	Rocker Angle
1	30º	45º
2	45º	60º
3	60º	90º

7. a) What is optimal synthesis? Explain. **6**

b) Explain how kinematic synthesis task is formulated? Give example. **7**

OR

8. a) Explain the Powell's search method in optimal synthesis of planar mechanism. **7**

b) How least square approximation is useful in optimum synthesis of a planar mechanism? **6**

9. a) What is spatial mechanism? What is the difference between planar and spatial mechanism? **6**

b) Explain Kinematic analysis for linkages for RSSR mechanism. **7**

OR

10. a) Explain Deneritt Herterinberg notation used in spatial mechanisms. **6**

b) Describe Kinematic analysis for Linkage for RCCC mechanism. **7**

11. a) How Robot arm is a kinematic device? Explain. **6**

b) Explain procedure and steps involved in kinematic synthesis in robotic application. **7**

OR

12. For the gantry robot shown in the figure 12, find the transformation matrix T_{15} relating the position of the tool coordinate system to the ground co-ordinate system when the joint actuators are set to the values $\phi_1 = 450\,\text{mm}$, $\phi_2 = 180\text{mm}$, $\phi_3 = 50\,\text{mm}, \phi_4 = 0$. Also find the absolute position of the tool point which has co-ordinates. **13**

$x_5 = y_5 = 0.\quad z_5 = 45\,\text{mm}$

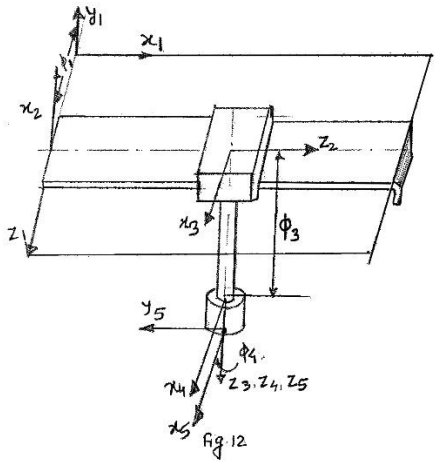


Fig 12

$a_{12} = a_{23} = a_{34} = a_{45} = 0,\ \alpha_{12} = 90^o, \alpha_{23} = 90^o$

$\alpha_{34} = \alpha_{45} = 0, \theta_{12} = \theta_{23} = 90^o$

$\theta_{34} = 0,\ \theta_{45} = \phi_4, S_{12} = \phi_1, S_{23} = \phi_2,$

$S_{34} = \phi_3, S_{45} = 50\text{mm}.$

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