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

Elective - I : Synthesis of Mechanisms

P. Pages : 4 **NRJ/KW/17/4611**

Time : Three Hours * 0 4 9 2 * 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 drawing sheets for all graphical solutions.
12. Retain all construction line.

1. a) What is kinematic synthesis ? Explain type, number and dimensional synthesis. **5**

b) Define mobility. Derive relation for mobility using Kubbach theory. Explain how Grublers criterion is an extension of Kubbach theory. What are the exceptions to the theory ? **8**

OR

2. a) Define coupler curve. How coupler curves are useful in the design mechanisms? **4**

b) Define class - I & Class - II mechanisms. Draw neat sketches of any class - II four bar chain. Using Grashoff's law prove that it is class - II. Show the class - II mechanism by fixing longest link in its extreme positions. **9**

3. a) What are precession points? Structural error? How Chebychev spacing is useful in minimizing errors? Explain with an example. **7**

b) A crank and rocker mechanism is to have a length of 500 mm and swing through a total angle of 45° with a time ratio of 1.25. Determine a suitable set of dimensions for remaining three links. **7**

OR

4. a) For the fig. 4 (a) synthesize a mechanism to move AB successively through positions 1, 2 & 3. **8**

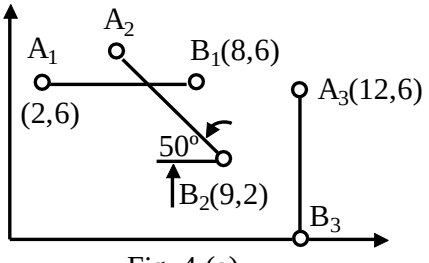


Fig. 4 (a)

b) Explain : **6**

i) Inflection points & inflection circle.

ii) Bobillier construction.

iii) Hartman's construction.

5. Synthesize a four-bar linkage to give the following values for the angular velocities and accelerations. **13**

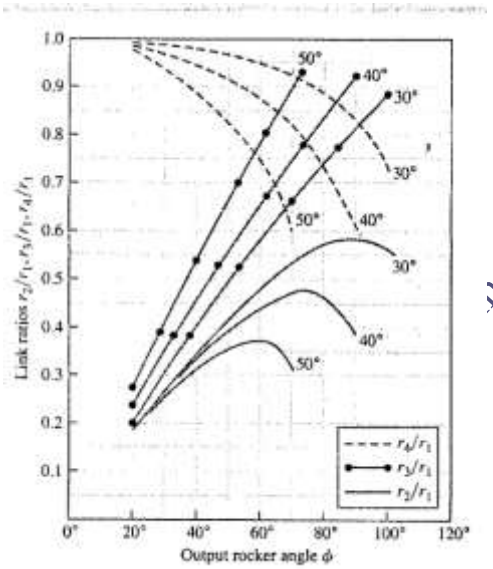
$w_2 = 100\,\text{rad/s}$ $w_3 = 42\ \text{rad/s}$ $w_4 = 65\,\text{rad/s}$

$\alpha_2 = 0\ \text{rad/s}^2$ $\alpha_3 = -500\,\text{rad/s}^2$ $\alpha_4 = -800\,\text{rad/s}^2$

OR

6. Using Frendenstein equation synthesize a function generator to solve the equation $y = 1/x$ over the range $1 \le x \le 2$ .Use three precision positions. **13**

7. Design a crank rocker mechanism with optimum transmission angle, a unit time ratio, and a rocker angle of 45º using a rocker 250 mm in length. Use the chart of fig. 7 and $\gamma_{min} = 50^o$ **13**



The Brodell-Soni chart for the design of the crank-rocker linkage with optimum transmission angle and unity time ratio. The angles shown on the graph are γ_{min}.

Fig. 7

OR

8. a) Explain with example how Powell's search method is used for optimum design of the planar mechanisms. **7**

b) What is least square approximation ? Explain. **6**

9. a) What is mobility in spatial mechanisms ? What are the exceptions ? **6**

b) Draw neat sketches of four bar spatial linkages having mobility of m = 1. **8**
i) RCCC ii) PCCC iii) RGCR iv) RGCP

OR

10. Determine the advance to return time ratio for the mechanism shown in fig. 10. What is total angle of oscillation of link 4 ? **14**

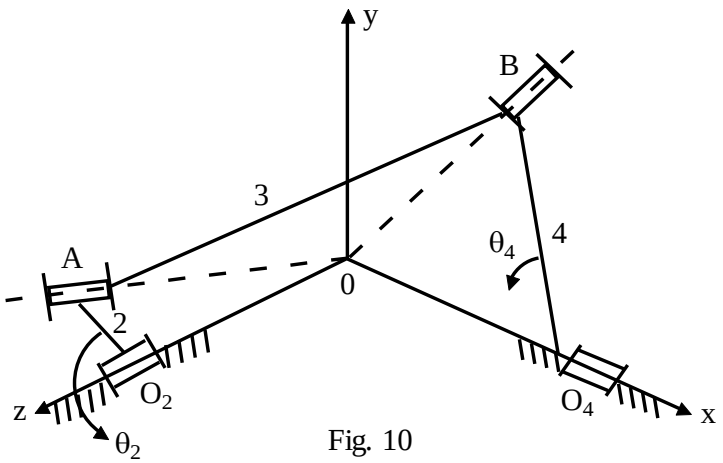


Fig. 10

$R_{\theta_4 O} = 50\,i$ mm, $R_{AO_2} = -75\,i$ mm

$R_{BO_4} = 225\,j$ mm, $R_{BA} = 125\,i + 225\,j - 175\,k$ mm

$R_{O_2O} = 175\,k$ mm

$W_2 = -60\,k$ rad/s

11. a) Explain the term inverse kinematic analysis with respected to Robots. **6**

b) Explain the identification of task of mechanisms for robot. **7**

OR

12. For the SCARA robot shown in fig. 12 find the transformation matrix T_{15} relating the position of the tool co-ordinate system to the ground coordinate system when the joint actuators are set to the values. **13**

$\phi_1 = 30^o$, $\phi_2 = -60^o$, $\phi_3 = 50$ mm $\phi_4 = 0$

Also find the absolute position of the tool point which has coordinate $x_5 = y_5 = 0$ and $z_5 = 38$ mm.