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Question Paper Code : 60561

M.E./M.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

First Semester

Computer Aided Design

ED 4152 — ADVANCED MECHANISMS IN DESIGN

(Common to: Engineering Design)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by mechanical advantage of a mechanism?

2. State D'Alembert's principle.

3. Differentiate between forward and inverse kinematic manipulators.

4. State the significance of D-H parameters.

5. Give any one form of Euler-Savary equation and state its application.

6. Define branch defects, order defects with reference to mechanisms.

7. Determine the Chebysbev spacing for a four-bar linkage generating the function $y = 2x^2 - 1$ in the range $1 < x < 2$, where three precision points are to he prescribed.

8. List out the different types of synthesis in designing a mechanism.

9. State Robert-Chebyshev theorem on cognate linkages.

10. State principle of super position with an example.

PART B — (5 × 13 = 65 marks)

11. (a) Derive the Goodman's relations for the determination of angular velocity and angular acceleration of any link of a mechanism in terms of the angular velocity and angular acceleration of the input link.

Or

(b) Design a four-link mechanism so that $\theta_{12} = 60°$ and $\phi_{12} = 60°$. Both input and output links should move in counter-clockwise directions. Check if the resulting mechanism is Grashofian. Determine the minimum transmission angle.

12. (a) List and explain the factors that are to be considered for the design of a parallel kinematic manipulator for use in a machine for simple milling of automotive parts.

Or

(b) Define concatenation of finite displacements. Also show that the concatenation for rotation followed by translation and for translation followed by rotation are different.

13. (a) Synthesize a four-bar linkage that will satisfy the following angular velocities and accelerations in one of its positions.

Input link	$\omega_2 = 8$ rad/s	$\alpha_2 = 0$
Coupler	$\omega_3 = 1$ rad/s	$\alpha_3 = 20$ rad/s^2
Output line	$\omega_4 = 3$ rad/s	$\alpha_4 = 0$

Or

(b) Design a four-bar mechanism using complex number modeling to coordinate three positions of point P on a coupler at (20, 30), (40, 20) and (60,10). Assume the suitable data wherever required.

14. (a) Design a four-bar mechanism to generate the function $y = x^{\frac{3}{2}}, 0 < x < 100, d\theta = d\phi = 60°$.

Or

(b) Find the inflection circle for motion of the coupler relative to the frame for the four-bar mechanism shown in Figure 1. Also find the center of curvature of the coupler curve point C.
$O_2A = 150mm, O_2O_4 = 75mm, AD = 150mm, CD = 100mm,$
$AB = O_4B = 300mm.$

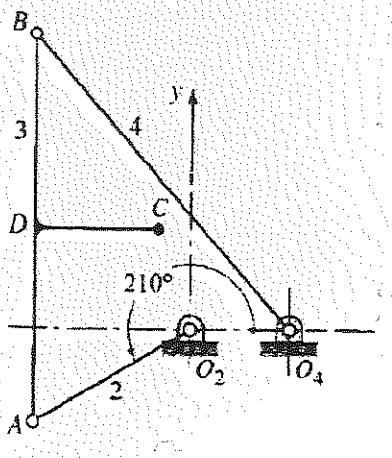

Figure 1

15. (a) Identify a suitable method for kinematic analysis of the following mechanism and determine the angular velocity of links 3 and 6 of the mechanism shown in Figure 2. All dimensions are in mm.

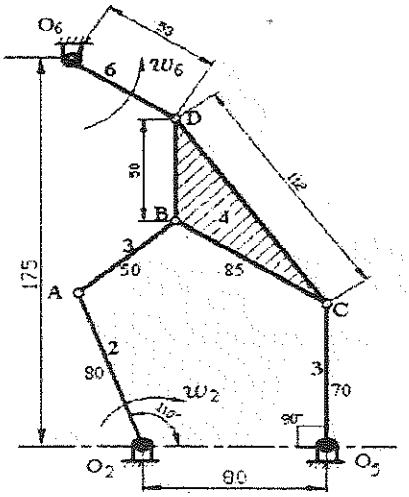

Figure 2

Or

(b) Determine the angular velocities of link 4, 5 and 6 for the mechanism shown in Figure 3 using auxiliary point method. $O_2O_6 = 60mm$, $O_2A = 18mm$, $AB = 20mm$, $BD = 22mm$, $DO_6 = 18mm$, $CD = 22mm$, $BC = 28mm$, $CO_5 = 18mm$, angle between O_2A and the frame is 90°. O_2O_6 may be drawn horizontal. O_5 is at a height of 60mm above O_2O_6.

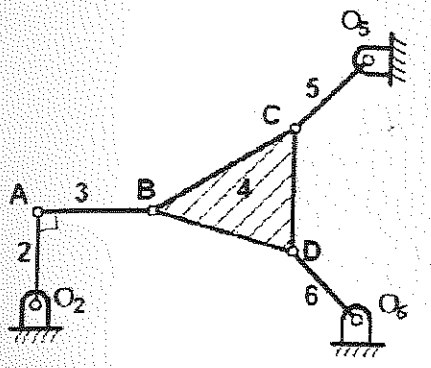

Figure 3

PART C — (1 × 15 = 15 marks)

16. (a) Derive the forward kinematic equations for the three-link planar manipular shown in Figure 4 using the Denavit-Hartenberg convention.

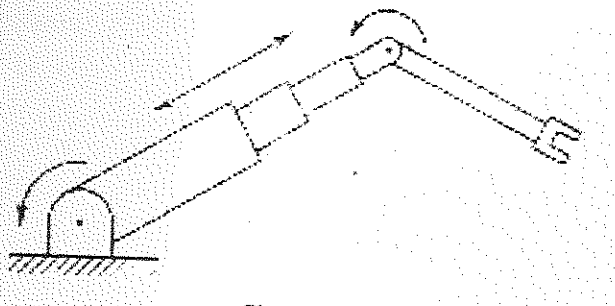

Figure 4

Or

(b) (i) What is meant by inversion? Describe the possible inversions obtained out of double – slider – crank chain? (5)

(ii) Explain Harts mechanism with sketch. (5)

(iii) State Grubler's criterion. (5)

Derive minimum number of links required to form a mechanism using the criterian.