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Ex/ME/5/T/214/2017(OLD)(S)

B. Mechanical (Evening) 2nd Year 1st Sem. Supple Examination, 2017 (OLD)
Advanced Kinematics and Robotics (Old)

Full Marks 100 **Time: 3 hours**

Answer any five questions
Assume relevant data

1. Analytically synthesize a function generator consisting of a 4-bar chain to solve the equation:

$$y = \frac{1}{x^2} \text{ in a domain of } 1 \le x \le 5$$

using 3-precision Chebyshev model. Assume 45^0 starting position of input link with a total of 90^0-swing angle and a 240^0 starting position of output link with a range of 90^0-swing angle too. 20

2. Design a slider-crank mechanism to coordinate three positions of the input link and the slider for the following angular and linear displacements of the input link and the slider respectively: $\theta_{12}=30^0$, $S_{12}=100$ mm, $\theta_{13}=90^0$, $S_{13}=200$ mm. Take eccentricity of the slider as 10 mm. Use the relative pole method. 20

3. A point P in space is rotated by an angle $\pi/4$ about z-axis, and then translated by 2 units along x-axis and finally – 3 units along y-axis. Pictorially show the transformation of the vector. If the coordinates of P are $[2.0 \quad 4.0 \quad 6.0]^T$, find the coordinates in its new location. 20

4. (a) What is Kutzbach equation in connection with a 2D mechanism considering lower pair, higher pair, redundant pair and higher order hinges.

(b) Use the equation to determine the DOF of the linkages shown in Fig. Q4(b). (8+12)

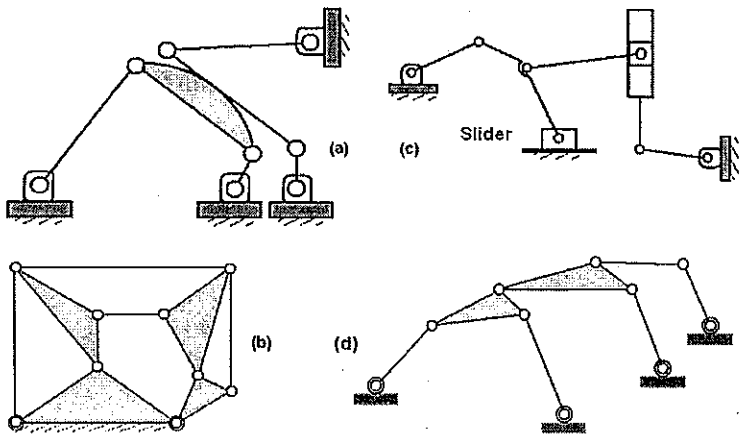

Fig. Q4(b)

5. Fig. Q5 shows three positions of a platform defined by coordinates: $A_1(5, 150)$, $B_1(105, 150)$, $B_2(110, 75)$, $A_3(165, 100)$. If the platform is to be positioned by a 4-bar chain with the axes of driver and driven links at O_2 and O_4 respectively coordinates being $O_2(10, 0)$ and $O_4(75, 10)$. Design the linkage graphically. 20

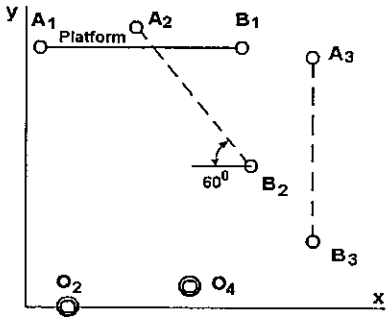

Fig. Q5

6. The Fig. Q6 shows a cylindrical robot. Draw its link coordinate diagram and construct the table showing the link parameters in order to find out the arm matrix using the principles of forward kinematics. 20

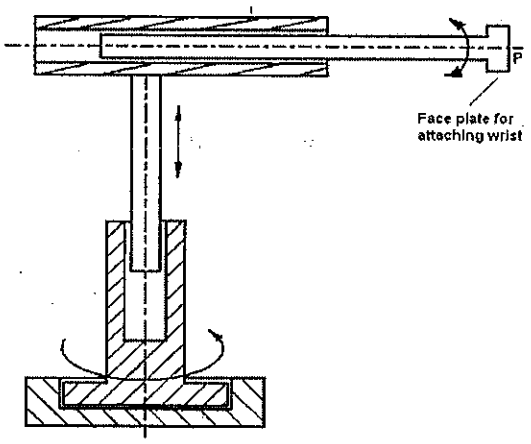

Fig. Q6

7. Write notes on (any four): 4x5

(a) Path, function and motion generation;

(b) Least Square Technique;

(c) Types of Robots;

(d) D-H algorithm;

(e) Relative Pole Method;