

ADVANCED DESIGN OF MECHANISMS**Time : 3 Hrs.****Answer any 5 from the following****Full Marks : 100**

1. (a) Synthesis a 4-bar mechanism to guide a rod AB through three consecutive positions A_1B_1 , A_2B_2 and A_3B_3 as shown in Figure Q1(a). The rod end A and B are used as moving pivot points.

10

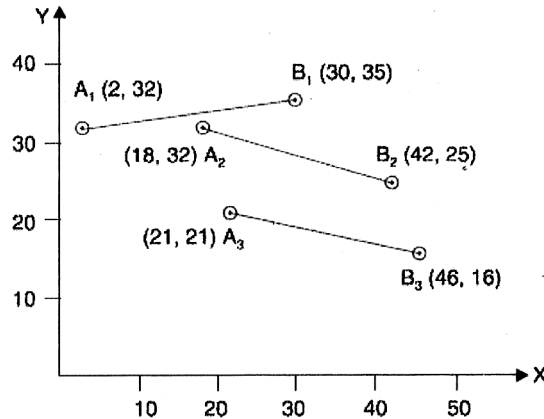


Figure Q1(a)

- (b) Determine the effective degrees of freedom of the following linkage

3+3+4=10

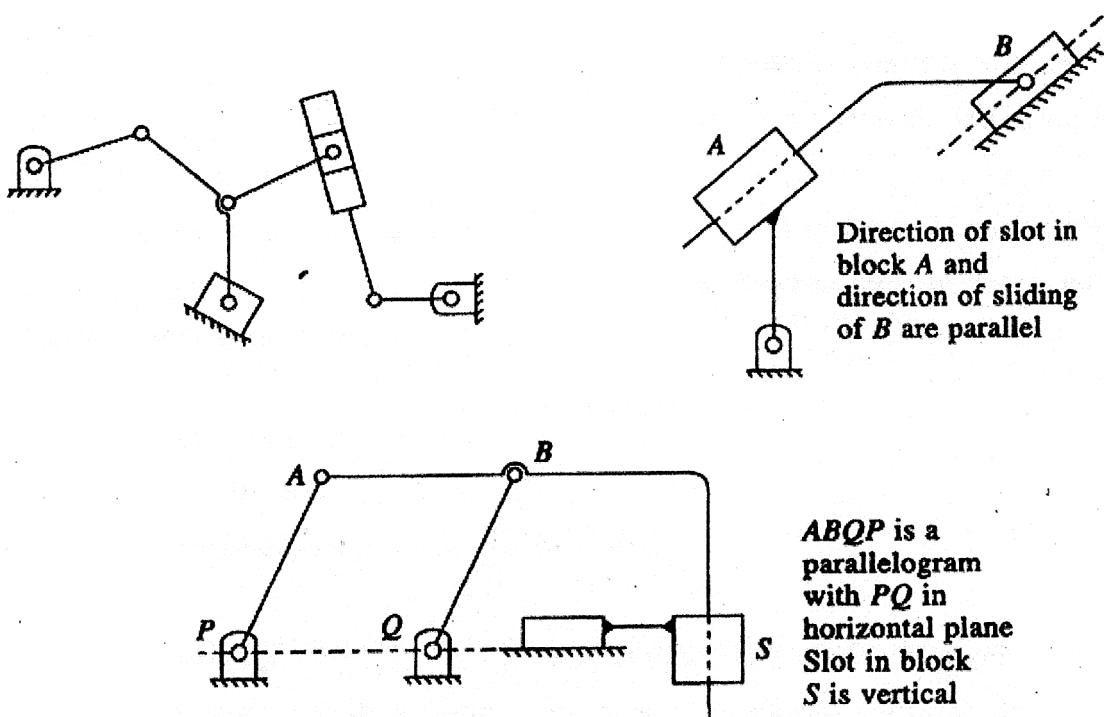


Figure Q1(b)

[Turn over

2. (a) Show a procedure of solution for dimensional synthesis of a four bar linkage function generation for 4 accuracy points. Established the function generation by Inversion method of four position synthesis. 15

(b) What is Chebyshev spacing? If a function varies from 10 to 20, find the Chebyshev spacing for 2, 3, 4 and 6 precision positions. 5

3. (a) For the purpose of synthesis of coupler curve do the required position analysis of the multi-bar linkage shown in Fig. Q3 where P is the coupler point. 15

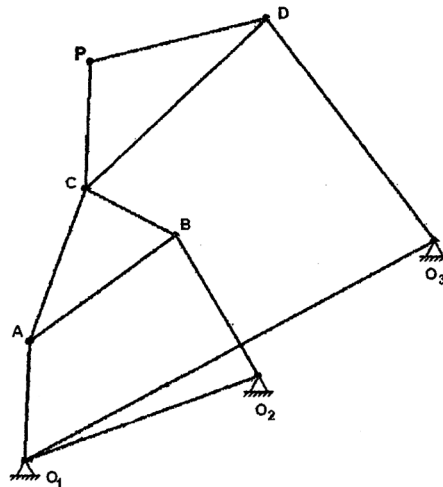


Fig. Q3

(b) What is least-square technique? How is it useful in synthesis of constrained linkages? 5

4. (a) Determine the maximum number of hinges on one link in a constrained mechanism with 'n' links. Applying Grubler criterion on planar kinematic chains show the minimum number of binary links in a chain is 4. 10

(b) What are the Kinematic representations of 6 link Watt's mechanism and Watt's walking beam mechanism. Apply Gruebler's criterion to find the Stephenson mechanism and inversion of Stephenson link mechanism? 10

5. Write answers the following questions

10×2=20

(i) Euler Angle Representation

(ii) Inverse composite homogeneous rotation matrix.

6. (a) Suppose that $[q]^M = [0, 0, 10, 1]^T$ represents the homogeneous coordinates of a point located 10 units along the third vector of a mobile coordinate frame M. If initially M is coincident with a fixed coordinate frame F and is rotated by $\pi/4$ radians about the first unit vector of F, find the resultant homogeneous transformation matrix. 10

(b) For the mobile (M) and fixed (F) reference planes to be both coincident initially, if the M is to translate along F^2 -axis by 3-units and then to rotate about F^3 -axis by π radians, find new coordinates of the point $a_M = [1 \ 0 \ 0]^T$ after the composite transformation. 10

7. (a) A rotating coordinate frame is to rotate about an arbitrary axis r through an angle θ . Find the rotation transformation matrix. 10

(b) It is required to rotate a point through α angle about the OX axis, followed by a translation of a unit along the same axis, followed by a translation of d unit along the OZ axis, all belonging to the fixed coordinate system and finally followed by a rotation of θ angle about the OZ of the body coordinate frame. Find a homogeneous transformation matrix. 10