

# Assignment-1

## IL1206

2020BTECH CSE032  
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Degree of freedom using kutzbach criterion.

$$DOF = 3(n-1) - 2j - h$$

$n$  = number of links

$j$  = number of lower pair (or) Binary joints.

$h$  = number of higher pairs.

① If  $DOF = 0$  system is in static determinate.

② If  $DOF \geq 1$  system is in constrained motion.

③ If  $DOF < 0$ , system is in indeterminate structure.

1 ternary joint = 2 Binary joints

1 quaternary joint = 3 Binary joints.

Question - ①

Given

No fixed joints = 1

1 Binary joint = 1 Binary, D

4 ternary joints = 8 Binary, A, B, E, F

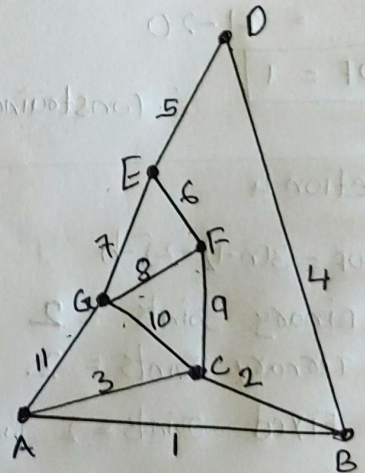
2 quaternary joints = 6 Binary, G, C

$$DOF = 3(n-1) - 2j - h$$

$$n = 11, j = 15, h = 0$$

$$DOF = 30 - 30$$

$$DOF = 0 \quad \text{static determinate.}$$





### Question 2

$$DOF = 3(n-1) - 2j - h$$

Binary joints = 0, 1

Ternary joints = 6 = B, A, C, F, E, G

Quaternary joints = 0

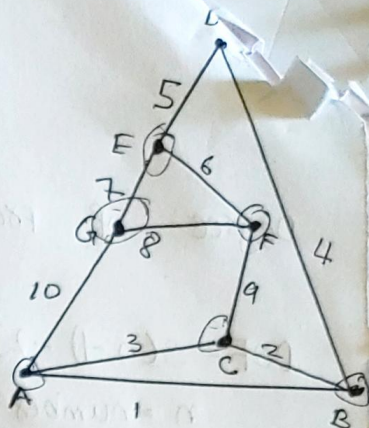
$$n = 10, j = 13$$

$$DOF = 3(10-1) - 2(13) - 0$$

$$= 27 - 26$$

$$DOF = 1$$

system is in constrained motion.



### Question 3

$$DOF = 3(n-1) - 2j - h$$

Fixed joints = 4 where we consider as 1, A, F, G, C

Binary joints = 8, A, B, C, D, E, F, G

Ternary joints = 1

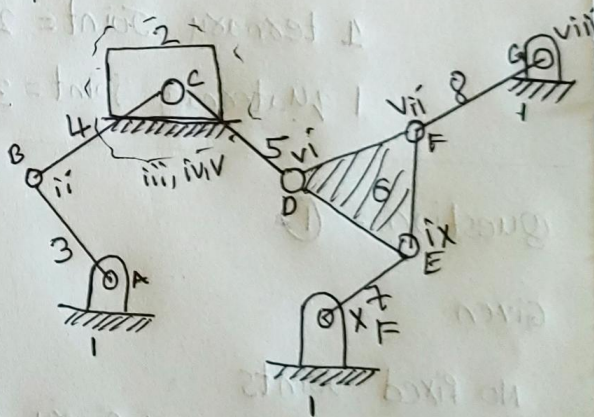
$$DOF = 3(8-1) - 2(10) - 0$$

$$= 3(7) - 20$$

$$= 21 - 20$$

$$DOF = 1$$

∴ constrained motion



### Question 4

$$DOF = 3(n-1) - 2j - h$$

Binary joints = 2

Ternary joints = 2

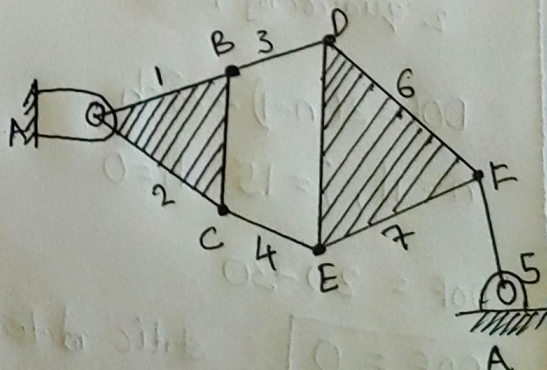
Fixed joints = 2 we consider as 1

$$DOF = 3(6-1) - 2(7) - 0$$

$$= 15 - 4$$

$$DOF = 1$$

∴ constrained motion.





5 question

As we can observe opposite links have same mechanism.

link 2 is parallel to link 4

$$DOF = 3(n-1) - 2(L) - h$$

$$n = 5$$

$$L = 5$$

$$= 3(4) - 2(5) - 0$$

$$= 12 - 10$$

$$\boxed{DOF = 2} \rightarrow \text{For a link structure}$$

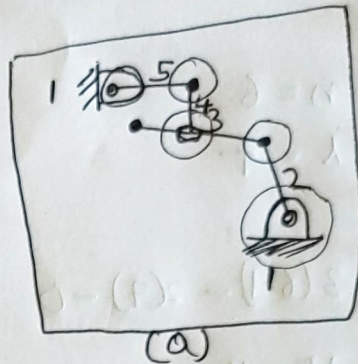
For ~~link~~ 2X structure.

As remaining also symmetrical we consider

$$\begin{aligned} \text{Total Degree of freedom} &= 2 \times (\text{each pair degree of freedom}) \\ &= 2 \times 2 \end{aligned}$$

$$\boxed{\text{Total Degree of freedom} = 4} //$$

constrained motion





6 Question

$$DOF = 3(n-1) - 2\lambda - h$$

$$n = 6$$

$$\lambda = 7$$

$$= 3(6-1) - 2(7) - 0$$

$$= 15 - 14$$

$$= 1$$

Degree of freedom = 1

constrained motion

