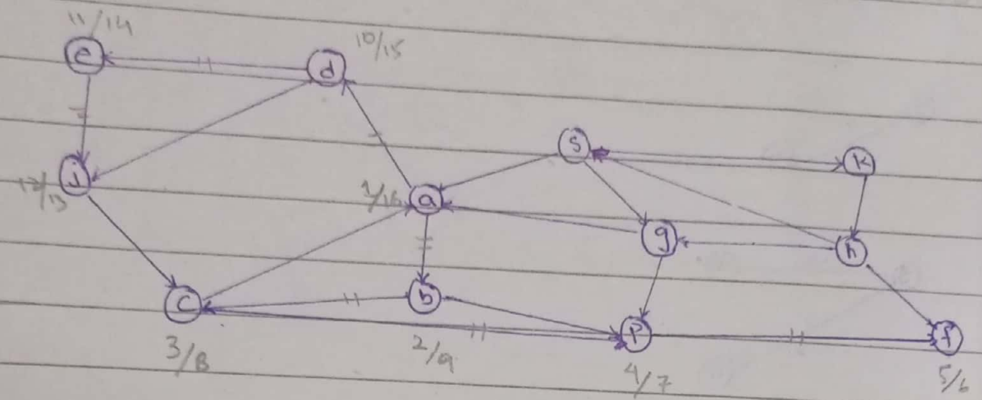
ASSIGNMENT 4

Date

QUESTION No 1 :-

a)



→ start time / finish time ..

b) All Tree edges:- (a, b) (b, c) (c, p) (p, f) (a, d) (d, e) (e, j)

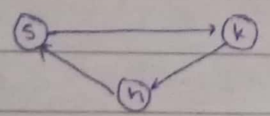
- (d, j) → Forword edge
- (b, p) → Forward edge.
- (c, a) → Back edge
- (j, c) → Back edge.

c) 1) f

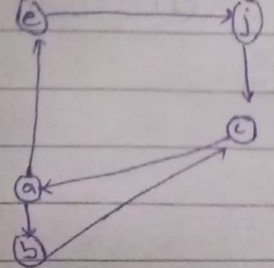
2) g

3) p

4)



5)

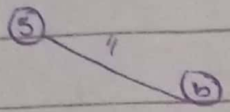


- Total 5 component possible.

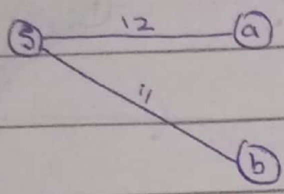
QUESTION NO 3 :-

steps

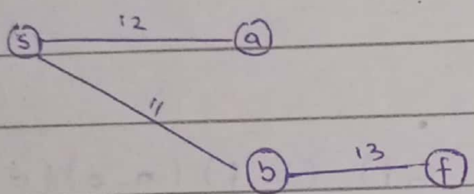
1)



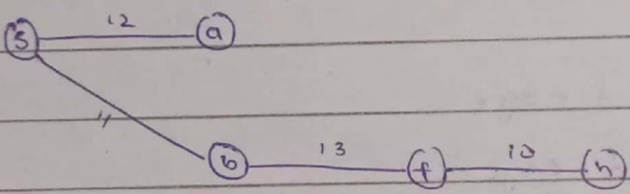
2)



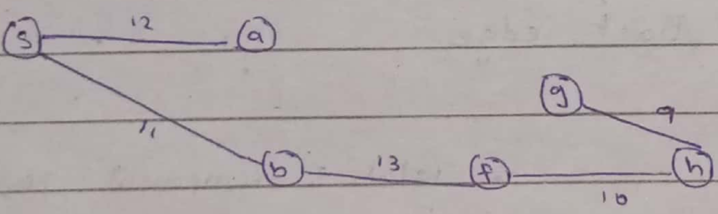
3)



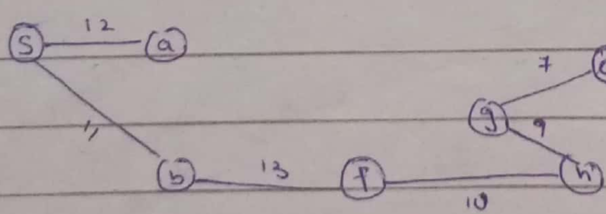
4)



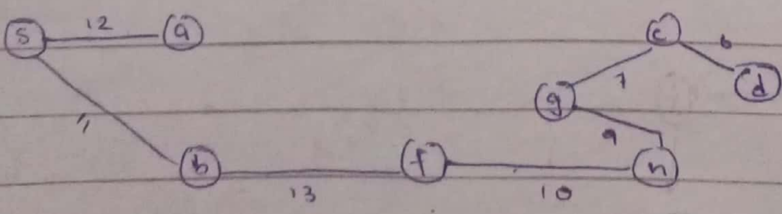
5)



6)



7)



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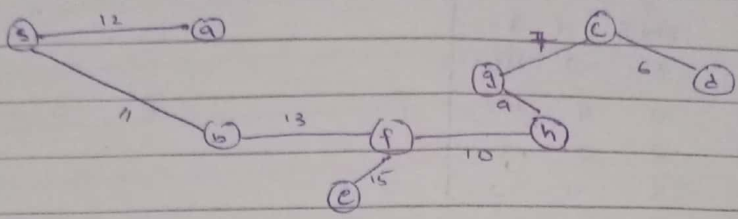
8) 

MST cost = 12 + 11 + 13 + 15 + 10 + 9 + 7 + 6

= 83.

QUESTION NO 4:-

D^0 = Given.

$$\therefore D^0 = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 0 & 2 & \infty & 1 & 8 \\ 2 & 6 & 0 & 3 & 2 & \infty \\ 3 & \infty & \infty & 0 & 4 & \infty \\ 4 & \infty & \infty & 2 & 0 & 3 \\ 5 & 3 & \infty & \infty & \infty & 0 \end{array}$$

$$D^1 = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 0 & 2 & \infty & 1 & 8 \\ 2 & 6 & 0 & 3 & 2 & 14 \\ 3 & \infty & \infty & 0 & 4 & \infty \\ 4 & \infty & \infty & 2 & 0 & 3 \\ 5 & 3 & 5 & \infty & 4 & 0 \end{array}$$

$\rightarrow D^0[2,3] \quad D^0[2,1] + D^0[1,3]$

$3 < 6 + \infty$

$\rightarrow D^0[2,4] \quad D^0[2,1] + D^0[1,4]$

$2 < 6 + 1$

$\rightarrow D^0[5,2] \quad D^0[5,1] + [1,2]$

$\infty > 3 + 2$

$\rightarrow D^0[5,3] \quad D^0[5,1] + [1,3]$

$\infty \quad 3 + \infty$

$\rightarrow D^0[5,4] \quad D^0[5,1] + [1,4]$

$\infty \quad 3 + 1$

$\rightarrow D^0[4,5] \quad D^0[4,1] + D^0[1,5]$

$3 < \infty + 8$

$\rightarrow D^0[2,5] \quad D^0[2,1] + D^0[1,5]$

$\infty > 6 + 8$

$\rightarrow D^0[3,2] \quad D^0[3,1] + D^0[1,2]$

$\infty \quad \infty + 2$

$\rightarrow D^0[3,4] \quad D^0[3,1] + D^0[1,4]$

$4 < \infty + 1$

$\rightarrow D^0[3,5] \quad D^0[3,1] + [1,5]$

$\infty < \infty + 8$

$\rightarrow D^0[4,2] \quad D^0[4,1] + [1,2]$

$\infty \quad \infty + 2$

$\rightarrow D^0[4,3] \quad D^0[4,1] + [1,3]$

$2 < \infty + \infty$

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$$D^1 = \begin{bmatrix} 0 & 2 & 5 & 1 & 8 \\ 6 & 0 & 3 & 2 & 14 \\ INF & INF & 0 & 4 & INF \\ INF & INF & 2 & 0 & 3 \\ 3 & 5 & 8 & 4 & 0 \end{bmatrix}$$

$$D^2 = \begin{bmatrix} 0 & 2 & 5 & 1 & 8 \\ 6 & 0 & 3 & 2 & 14 \\ INF & INF & 0 & 4 & INF \\ INF & INF & 2 & 0 & 3 \\ 3 & 5 & 8 & 0 & 0 \end{bmatrix}$$

$$D^3 = \begin{bmatrix} 0 & 2 & 3 & 1 & 4 \\ 6 & 0 & 3 & 2 & 5 \\ INF & INF & 0 & 4 & 7 \\ INF & INF & 2 & 0 & 3 \\ 3 & 5 & 6 & 4 & 0 \end{bmatrix}$$

$$D^4 = \begin{bmatrix} 0 & 2 & 3 & 1 & 4 \\ 6 & 0 & 3 & 2 & 5 \\ 10 & 12 & 0 & 4 & 7 \\ 6 & 8 & 2 & 0 & 3 \\ 3 & 5 & 6 & 4 & 0 \end{bmatrix}$$

$$D^5 = \begin{bmatrix} 0 & 2 & 3 & 1 & 4 \\ 6 & 0 & 3 & 2 & 5 \\ 10 & 12 & 0 & 4 & 7 \\ 6 & 8 & 2 & 0 & 3 \\ 3 & 5 & 6 & 4 & 0 \end{bmatrix}$$

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QUESTION NO 5 :-

Dijkstra Algorithm :-

→ Relaxation operation :-

Relax (U, V, W)

if $(d[v] > d[u] + w(u,v))$

$d[v] = d[u] + w(u,v)$

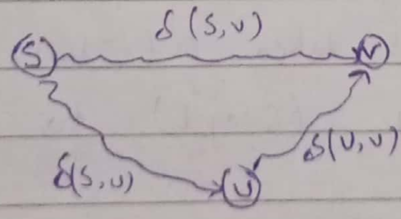
$\pi[v] = u$ → Update predecessor relationship.

Lemma / Logic :-

→ The relaxation operation maintains the invariant that $d[v] \geq \delta(s,v) \ \forall \ v \in V$.

Algorithm Proof :-

By induction on number of steps. By induction $d[u] \geq \delta(s,u)$. By Δ inequality $\delta(s,v) \leq \delta(s,u) + \delta(u,v)$



$\delta(s,v) \leq (d[u] + w(u,v) = d[v])$.

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QUESTION NO 7 :-

i) Adjacency Matrix :-

DFS :- $O(v^2)$ will be its time complexity as for each row we traverse each node which is adjacent to that node.

BFS :- $O(v^2)$ will be the time complexity of BFS. because for every node we have to traverce all column in that matrix,

Prims :- $O(v^2)$ because we need to search for the edge with a minimum weight from that vertex to explore other vertex.

Kruskal :- $O(E \log E + v^2)$
because it takes $O(v^2)$ to find the edge and $(E \log E)$ to sort the edges.

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ii) Adjacency List

DFS:- $O(|V| + |E|)$ because there will be an array of size V and each vertex of that array contain set of edges that connect that vertex to other.

so for selecting vertex ~~and~~ $O(V)$ time is required or for edges $O(E)$ is required.

BFS:- BFS time complexity is also $O(|V| + |E|)$.

Prims:- For adjacency list time complexity of Prim's algorithm is $O(E \log V)$

Kruskal: For kruskal algorithm time complexity is $O(E * \log(V))$.

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