Q1) Minimum Spanning tree is subset of edges of connected edge weighted undirected graph that connects all the vertices together without any cycles & with the minimum possible total edge weighted.

Applications -

(i) Consider n stations are to be linked using a communication network & laying of communication link b/w any two stations involves cost. The ideal solⁿ would be to extract a subgraph termed as minimum cost spanning tree.

(ii) Suppose you want to construct highway or railroad spanning several cities then we can use concept of minimum spanning tree.

(iii) Designing LAN

(iv) Laying Pipelines connecting offshore drilling sites, refineries & consumer markets.

(v) Suppose you meant to apply a set of houses with →

→ Electric power → Water → Telephone lines → Sewage lines

Q2) Prim's Algorithm →

Time Complexity : $O(|E| \log |V|)$

Space Complexity : $O(|V|)$

Kruskal's Algorithm →

Time Complexity - $O(|E| \log |V|)$

Space Complexity - $O(|V|)$

Dijkstra's Algorithm -

Time Complexity - $O(V^3)$

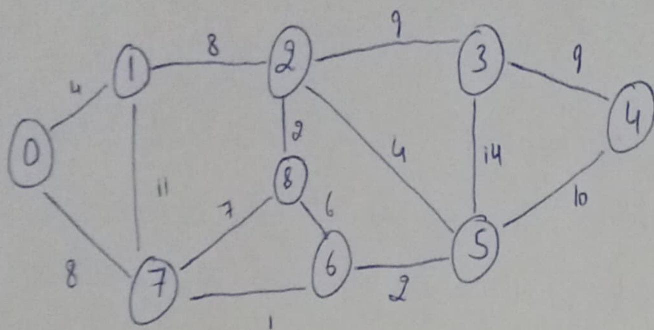
Space Complexity - $O(V^2)$

Bellman Ford's Algorithm -

Time Complexity - $O(VE)$

Space Complexity - $O(E)$

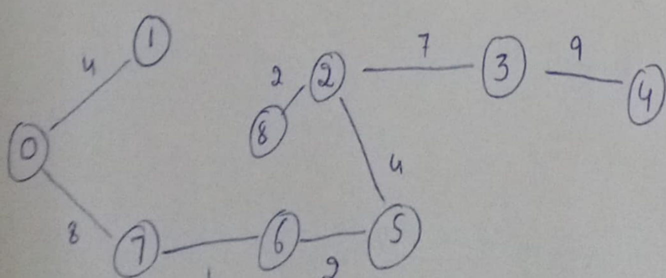
Q3.)



Kruskal's Algorithm -

O	V	W	
6	7	1	/
5	6	2	/
2	8	2	/
0	1	4	/
2	5	4	/
6	8	6	x
2	3	7	/

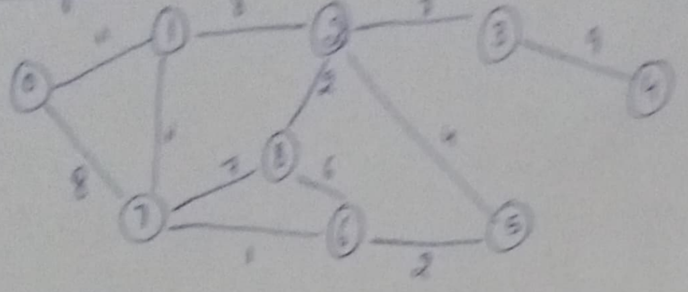
O	V	W	
7	8	7	x
0	7	8	/
1	2	8	x
4	3	9	/
4	5	10	x
1	7	11	x
3	5	14	x



Weight - $1+2+2+4+4+7+8+9$

$= 37$

Prim's Algorithm. ③

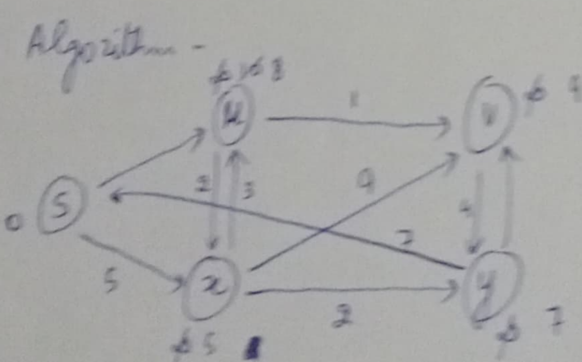


Weight - 4+8+2+4+2+9+7+1 = 37

Q4) ii) The shortest path may change. The reason is there may be different number of edges in different paths from 's' to 't'. For eg. let shortest path be of weights 15 & has edges 5 edges. Let there be another path with 2 edges & total weight 25. The weight of shortest path is increased by 5*10 and becomes 15+50. weight of other path is increased by 2*10 & becomes 25+20. So the shortest path changes to other path with weight 45.

iii) If we multiply all edges weight by 10, the shortest path doesn't change. The reason is simple, weights of all paths from 's' to 't' get multiplied by same amount. The number of edges on a path doesn't matter. It is like changing units of weights.

Q5) Dijkstra Algorithm -



Node	Shortest Distance From source node
u	8
v	9
x	5
y	7

Bellman Ford Algorithm.

1st → S^{0} $u^{\cancel{\infty}\,10}$ v^{∞} $x^{\cancel{\infty}\,5}$ y^{∞}

2nd → S^{0} u^{10} $v^{\cancel{\infty}\,11}$ x^{5} y^{∞}

3rd → S^{0} $u^{\cancel{10}\,8}$ $v^{\cancel{11}\,9}$ x^{5} $y^{\cancel{\infty}\,7}$

4th → S^{0} u^{8} v^{9} x^{5} y^{7}

Graph doesn't have -ve cycle.

Final Graph.