

1

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Program: BS (SE)

Section: (A)

Subject: Operation Research

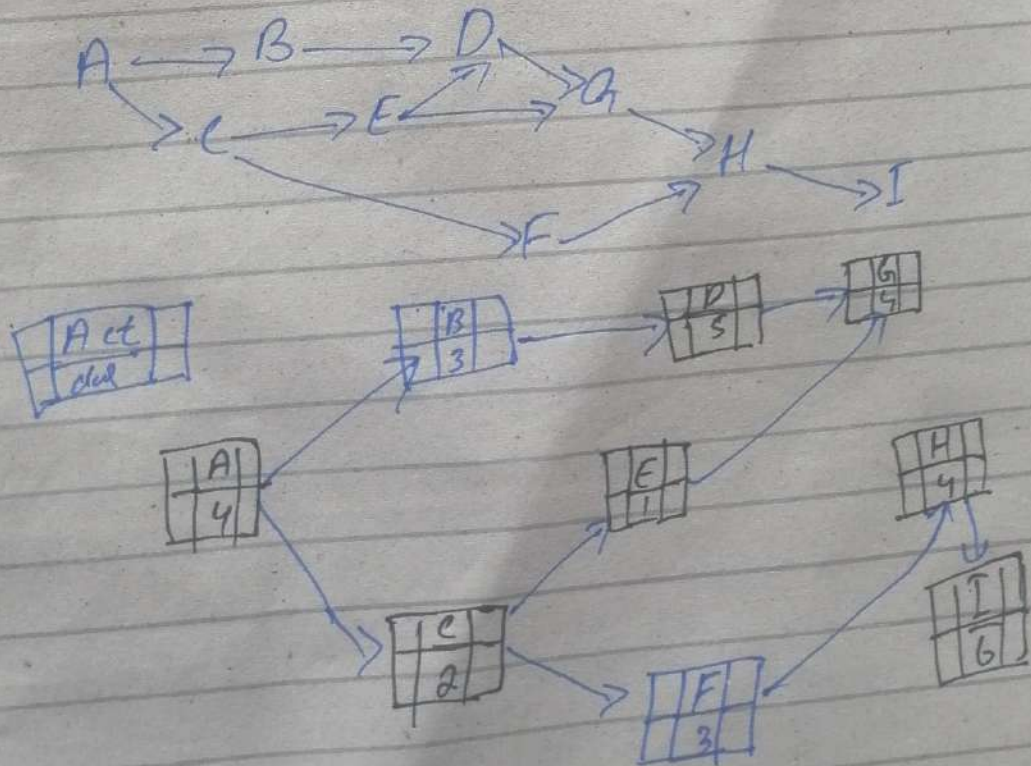
Instructor: Saifullah Jan

(2)

Question No 1
Part A

(a) Calculate the CPM Network.

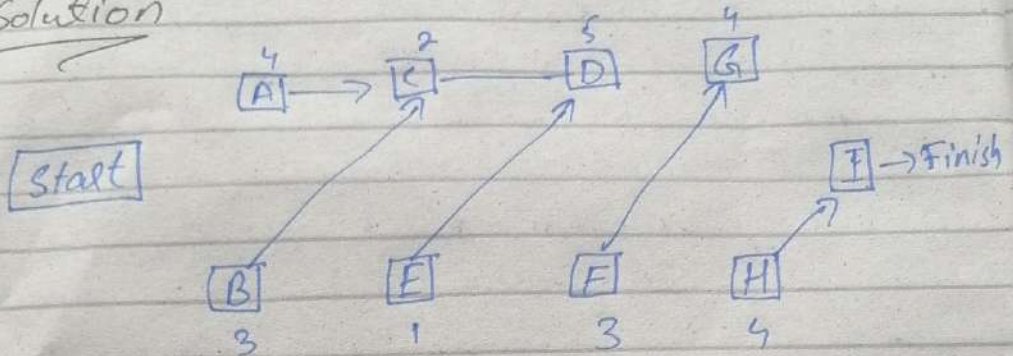
Activity	predecessor	time
A	-	4
B	A	3
C	A	2
D	B	5
E	B, C	1
F	C	3
G	D, E, F	4
H	D, E	4
I	H, G	6



(3)

Q 1 Part B.

Solution



Q 1 (C)

Solution

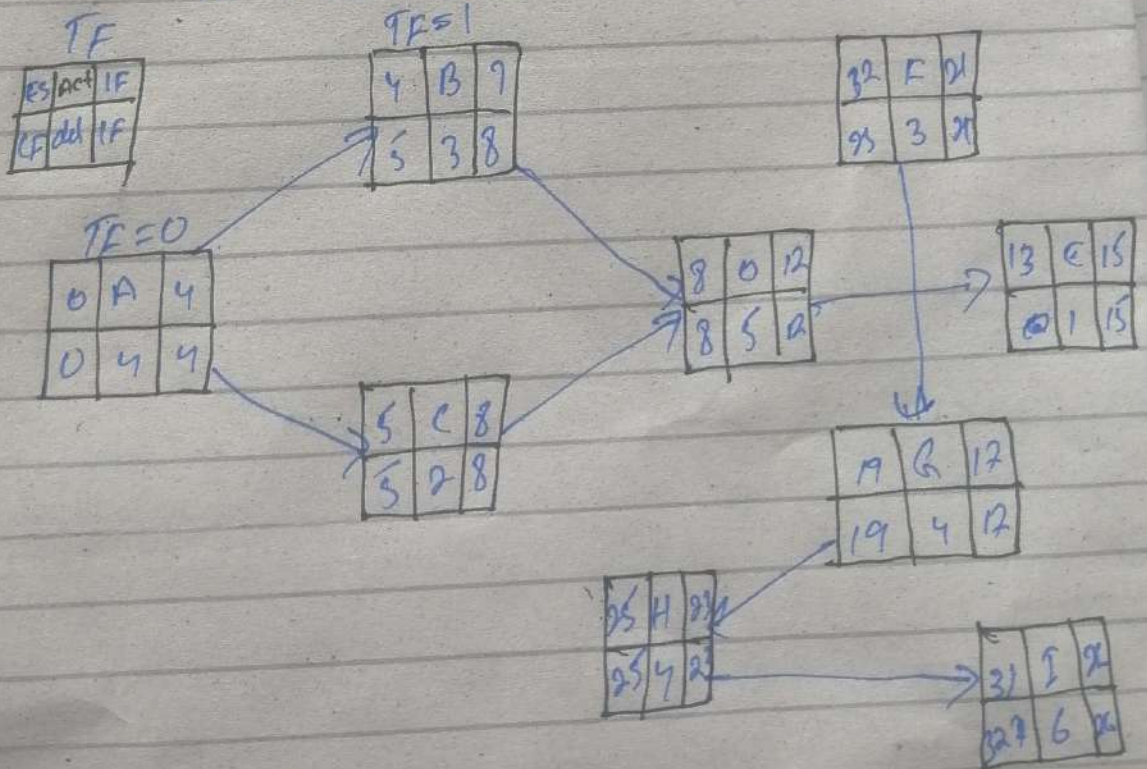
total float = TF1

$$TF = LF - EF$$

Finish float

$$TF = LS - ES$$

"start float"



3(B)

Question # 2.

variance
6
3
10
6
4
4
3
8

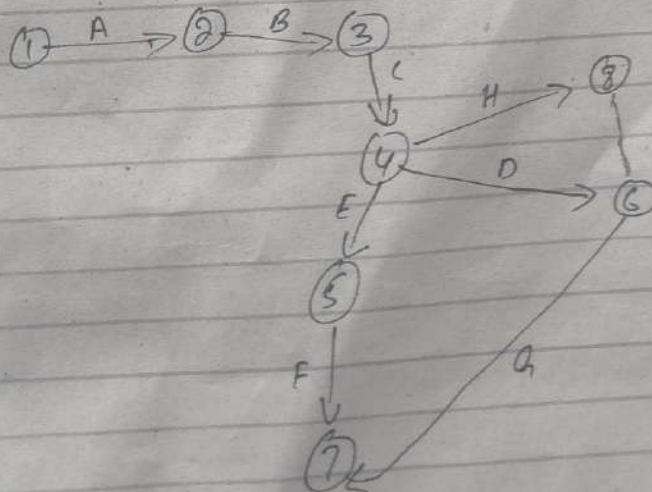
Activity	Predecessors	optimistic time (o)	most likely time (m)	Pessimistic time (p)
A	-	4	5	12
B	A	2	3	4
C	B	6	8	22
D	C	4	6	8
E	C	3	4	5
F	E	2	4	6
G	D, F	2	3	4
H	C	5	7	15

Q 2 Part A

AY

Solution.

(a) Construct the project Network



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Q 2. B

Activity	Predecessors	O	M	P	mean expected duration	variance
A	-	4	5	12	6	1.77
B	A	2	3	4	3	0.11
C	B	6	8	22	10	7.09
d	C	4	6	8	6	0.44
e	C	3	4	5	4	0.11
f	E	2	4	6	4	0.44
g	D, F	2	3	4	3	0.11
h	C	5	7	15	8	2.76

by formula.

$$\text{(mean) } te = \frac{to + 4tm + tp}{6}$$

$$= \frac{4 + 4(5) + 12}{6} = \frac{4 + 20 + 12}{6} = 6$$

$$te_2 = \frac{2 + 4(3) + 4}{6} = \frac{2 + 12 + 4}{6} = 3$$

$$te_3 = \frac{6 + 4(8) + 22}{6} = \frac{6 + 32 + 22}{6} = 10$$

$$te_4 = \frac{4 + 4(6) + 8}{6} = \frac{4 + 24 + 8}{6} = 6$$

$$te_5 = \frac{3 + 4(4) + 5}{6} = \frac{3 + 16 + 5}{6} = 4$$

$$te_6 = \frac{2 + 4(4) + 6}{6} = \frac{2 + 16 + 6}{6} = 4$$

Q 2
Activity

A

B

C

D

E

F

G

H

Q 2

A4
→

(a)

5

$$te_7 = \frac{2+4(3)+4}{6} = \frac{2+12+4}{6} = 3$$

$$te_8 = \frac{5+4(7)+15}{6} = \frac{5+28+15}{6} = 8$$

Variance (σ^2): - by formula

$$\sigma^2 = \frac{(tp - te)^2}{6}$$

$$\sigma_1^2 = \frac{(12-4)^2}{6} = \left(\frac{8}{6}\right)^2 = (1.33)^2$$

$$\sigma_2^2 = \frac{(4-2)^2}{6} = \left(\frac{2}{6}\right)^2 = 1.77$$

$$\sigma_3^2 = \frac{(22-6)^2}{6} = \left(\frac{16}{6}\right)^2 = 7.09$$

$$\sigma_4^2 = \frac{(8-4)^2}{6} = \left(\frac{4}{6}\right)^2 = 0.44$$

$$\sigma_5^2 = \frac{(5-3)^2}{6} = \left(\frac{2}{6}\right)^2 = 0.11$$

$$\sigma_6^2 = \frac{(6-2)^2}{6} = \left(\frac{4}{6}\right)^2 = 0.44$$

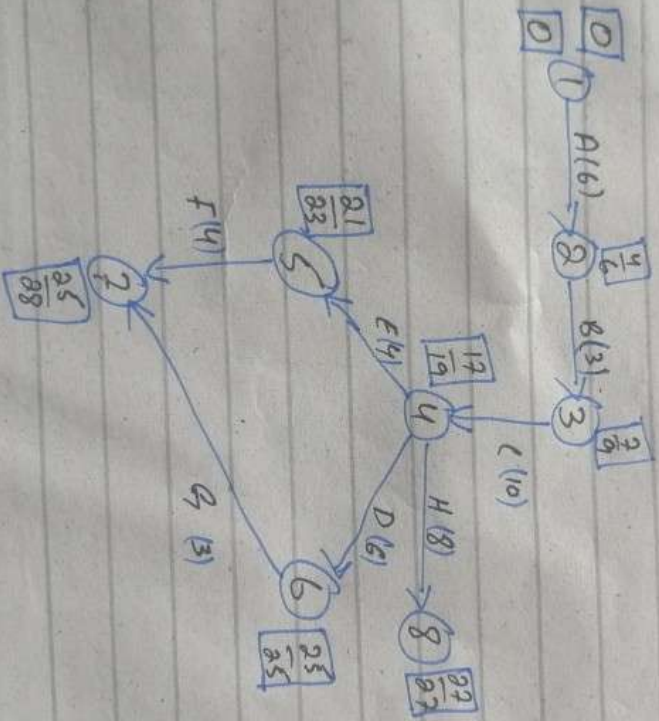
$$\sigma_7^2 = \frac{(4-2)^2}{6} = \left(\frac{2}{6}\right)^2 = 0.11$$

$$\sigma_8^2 = \frac{(15-5)^2}{6} = \left(\frac{10}{6}\right)^2 = 2.76$$

6

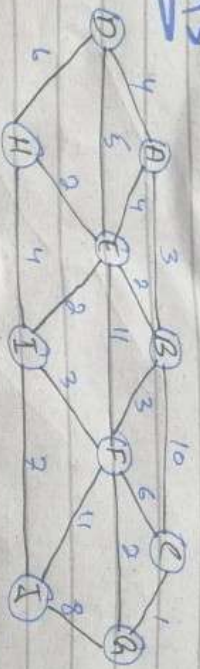
(c) Find the critical path and expected project completion time.

critical path.



Question (3)

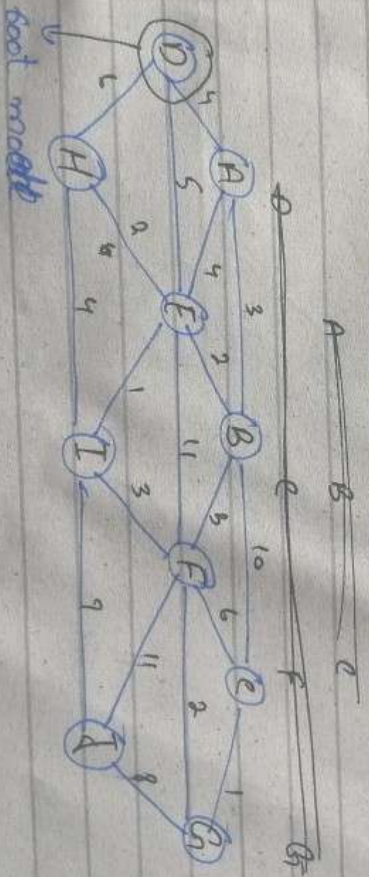
ANS



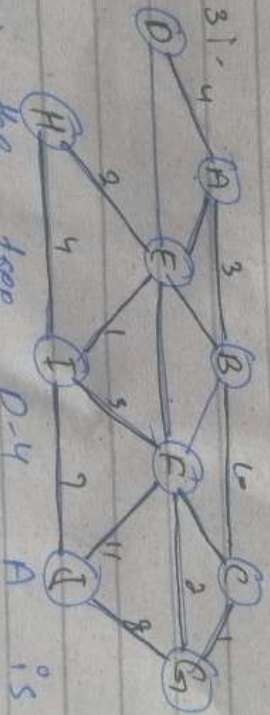
Step 1:-

Removing all loops and parallel edges.

Step 2:- Choosing arbitrary node as root node.



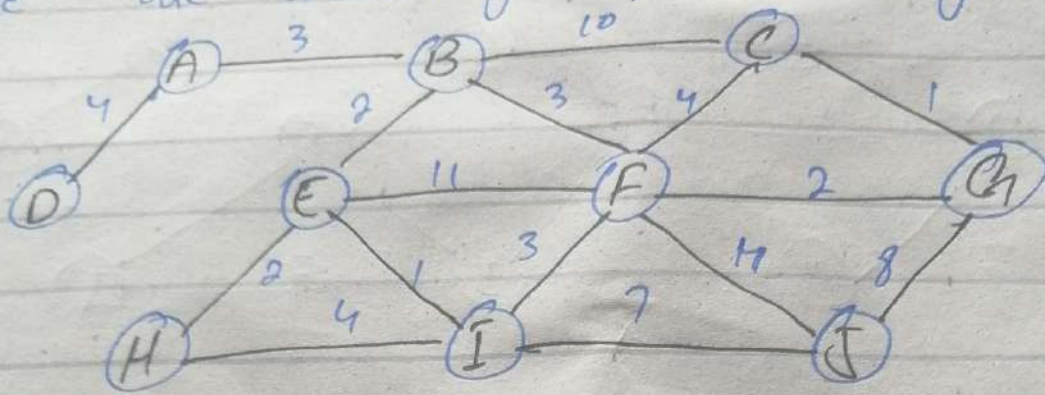
Step 3:-



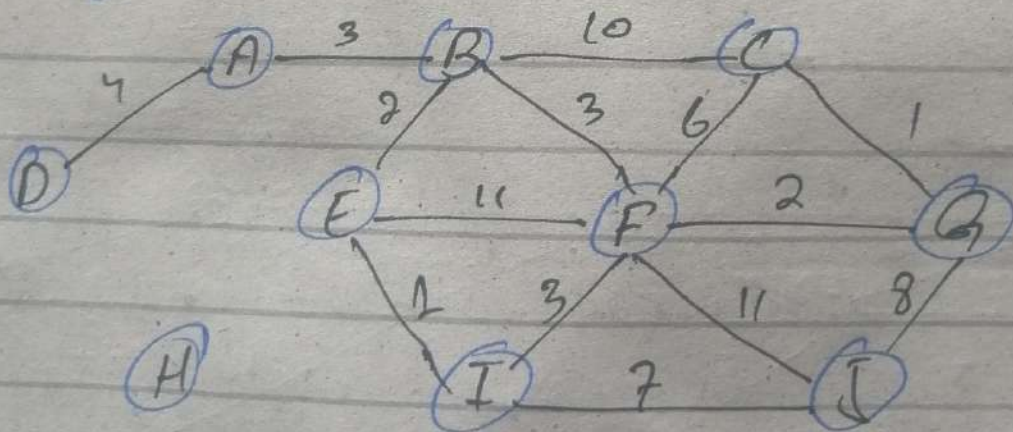
Now the tree D-H-A is

8

is treated as one node and we are checking for all edges-



after this step D-7-A-3 tree is formed Now we will again traverse it as a node and will check the edges again.

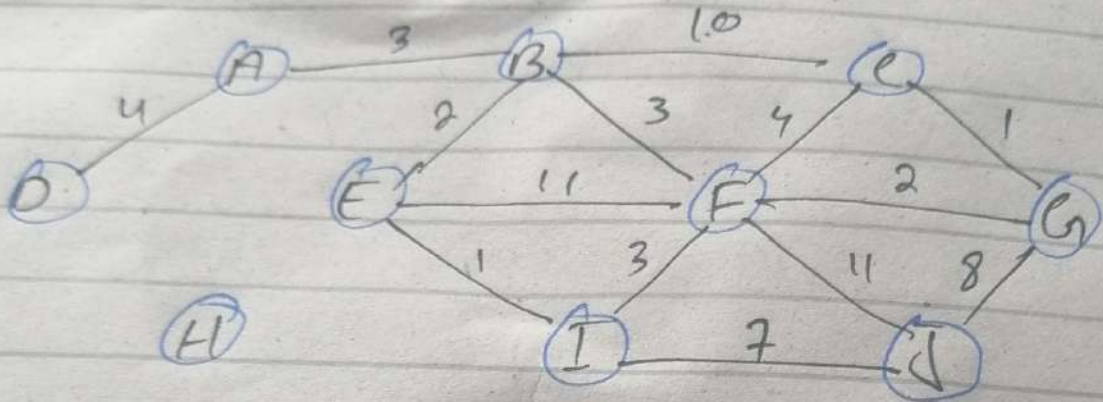


after adding Node E

D-4-A-3-B-2

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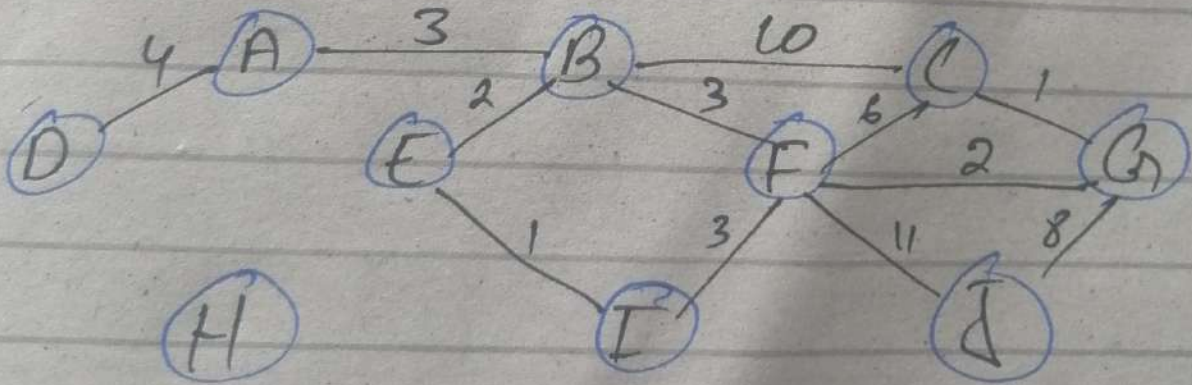
Now



after adding root (I)

D-4-A-3-E-2-I-1

Now.

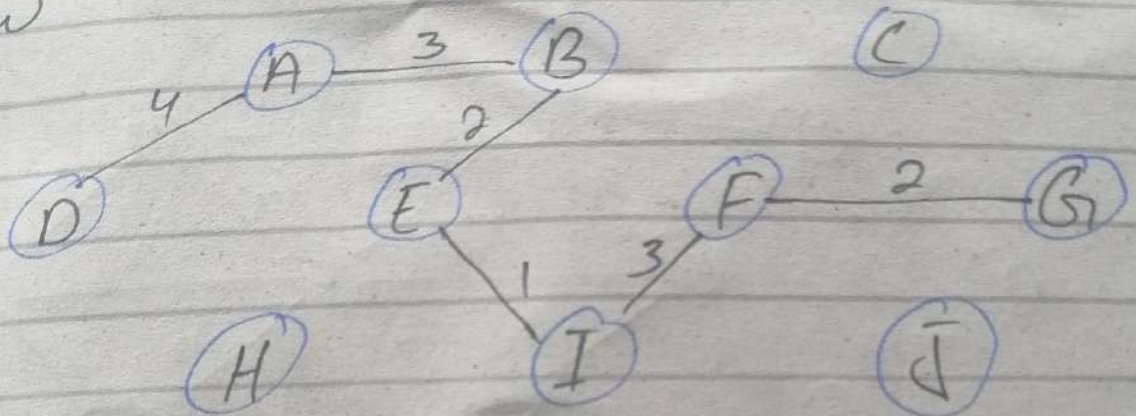


Now after adding root (F)

D-4-A-3-E-2-I-1-F-3

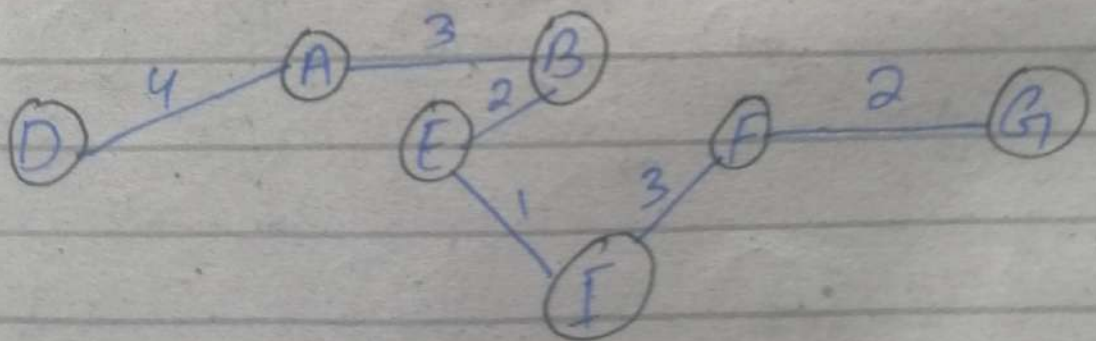
10

Now



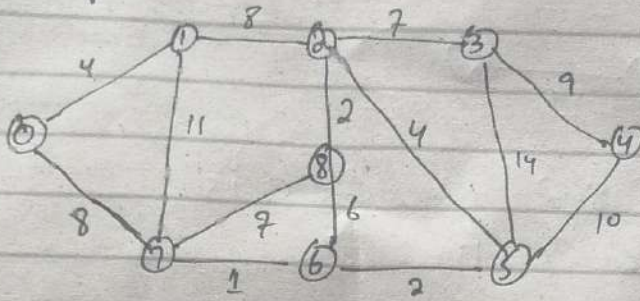
Now we find that the output spanning tree of the graph using two different algorithms.

$$4 + 3 + 2 + 1 + 3 + 2 = 15$$



Q # No 4:

For the following graph, find the minimum spanning tree using Kruskal's algorithm?



Ans

The graph contains 9 vertices and 14 edges. So, the minimum spanning tree formed will be having $(9-1) = 8$ edges.

After sorting:

weight	src	Dest
1	7	6
2	8	2
2	6	5
4	0	1
4	2	5
6	8	6
7	2	3
7	7	8
8	0	7
8	1	2
9	3	4
10	5	4
11	1	7
14	3	5

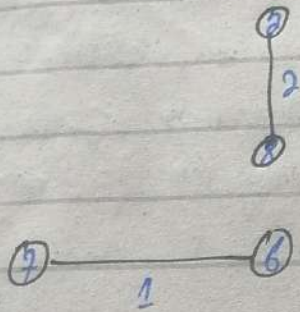
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Now pick all edges one by one from sorted list of edges.

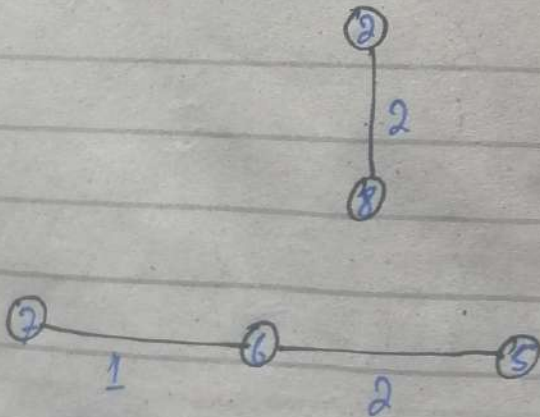
(1) Pick edge 7-6: No cycle is formed include it.



(2) Pick edge 8-2: No cycle is formed include it.

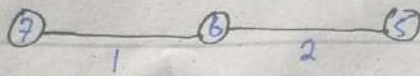
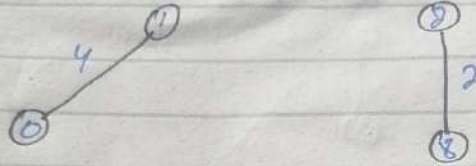


(3) Pick edge 6-5: No cycle is formed include it.



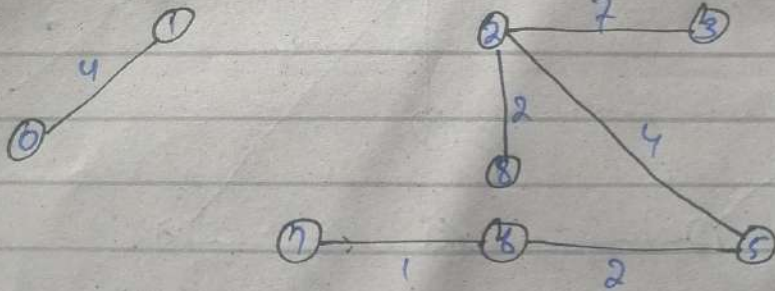
13

(4) Pick edge 0-1: No cycle is formed include it.



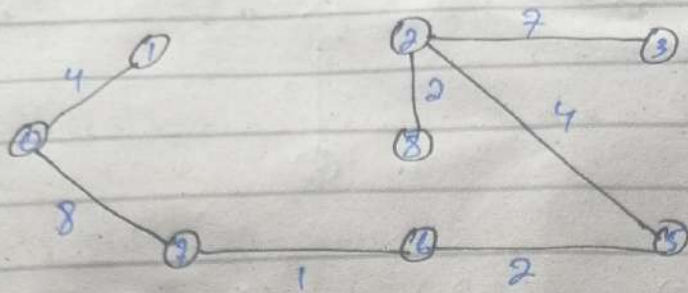
(6) Pick edge 8-0: Since including this edge result in cycle, discard it.

(7) Pick edge 2-3: No cycle is formed include it.



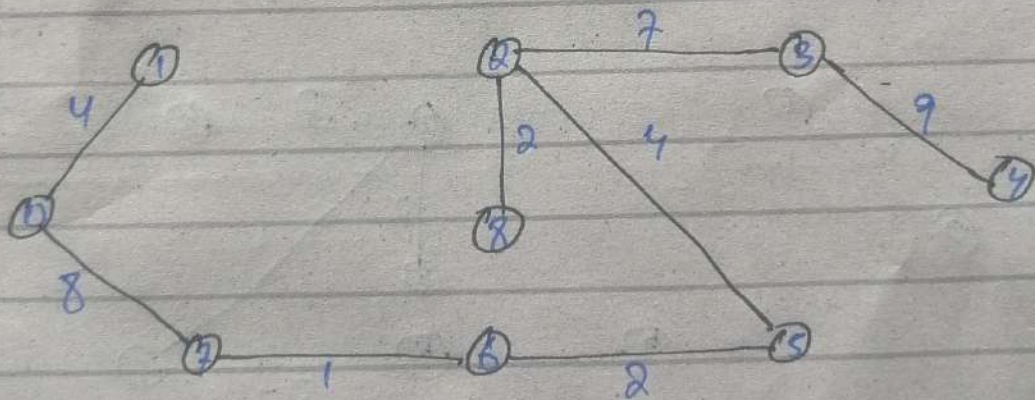
(8) Pick edge 7-8: Since including this edge result in cycle, discard it.

- (9) Pick edge 0-7: No cycle is formed, include it.



- (10) Pick edge 1-2: Since including this edge result in cycle, discard it

- (11) Pick edge 3-4: No cycle is formed include it.



Since the number of edges included equals $(v-1)$ the algorithm stop here.

Q No 5

ANSWER:

Operation research (OR) is an analytical method of problem solving and decision making that is useful in the management of organizations. In operation research, problems are broken down into basic components and then solved in defined steps by mathematical analysis.

The concept of operation research arose during world war II by military planners. After the war, the techniques used in their operations research were applied to addressing problems in business, the government and society.

Characteristics of operation research.

- 1) Optimization
- 2) Simulation
- 3) Probability.

Importance of operation research.

The field of operation research provides a more powerful approach to decision making than ordinary software and data.

analytical tools employing operation research professionals can help companies achieve more complete datasets. Consider all available options. predict all possible outcomes and estimate risk. Additionally operation research can be tailored to specific business processes or use cases determine which techniques are most appropriate to solve the problem.

Uses of Operation Research.

- * Scheduling and time management
- * Urban and agricultural planning
- * Enterprise resource planning and supply chain management.
- * Inventory management.
- * Network optimization and engineering.
- * Packet routing optimization
- * Risk management.