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Subject: Operations Research
Teacher: Saifullah
Class: BS-SE-A - 4th Sem
date: 23rd June, 2020

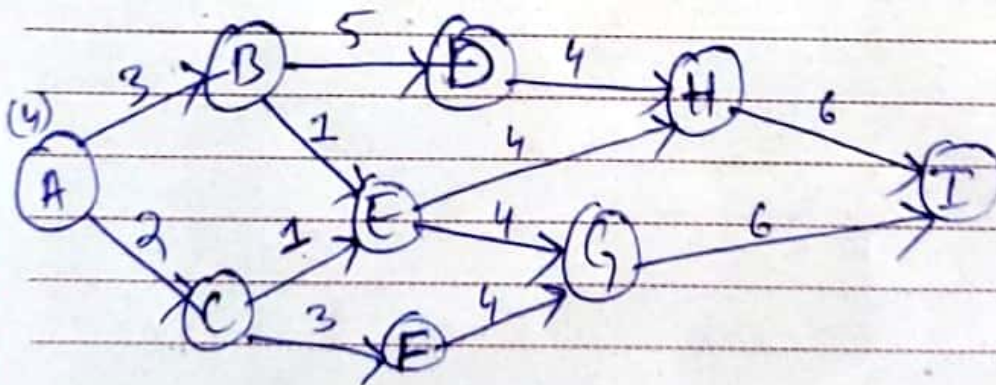
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Question NO1

ACTIVITY	PREDECESSOR	TIME
A	-	4
B	A	3
C	A	2
D	B	5
E	B, C	1
F	C	3
G	E, F	4
H	D, E	4
I	H, G	6

(a) CPM Network:

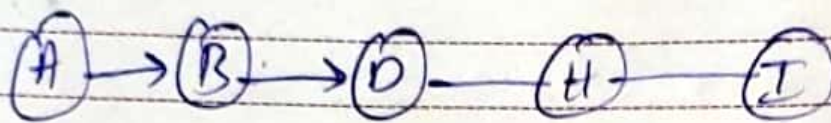


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(B) Critical path:

The critical path is the longest path in a network, the critical path in case in hand,



Total duration:

$$4 + 3 + 5 + 4 + 6 = 22$$

(C) Compute total floats and free floats for non-critical activities:

Formulas used are,

$$TF_{ij} = LF_{ij} - ES_{ij} - D_{ij}$$

$$FF_{ij} = ES_{ij} - ES_i - D_{ij}$$

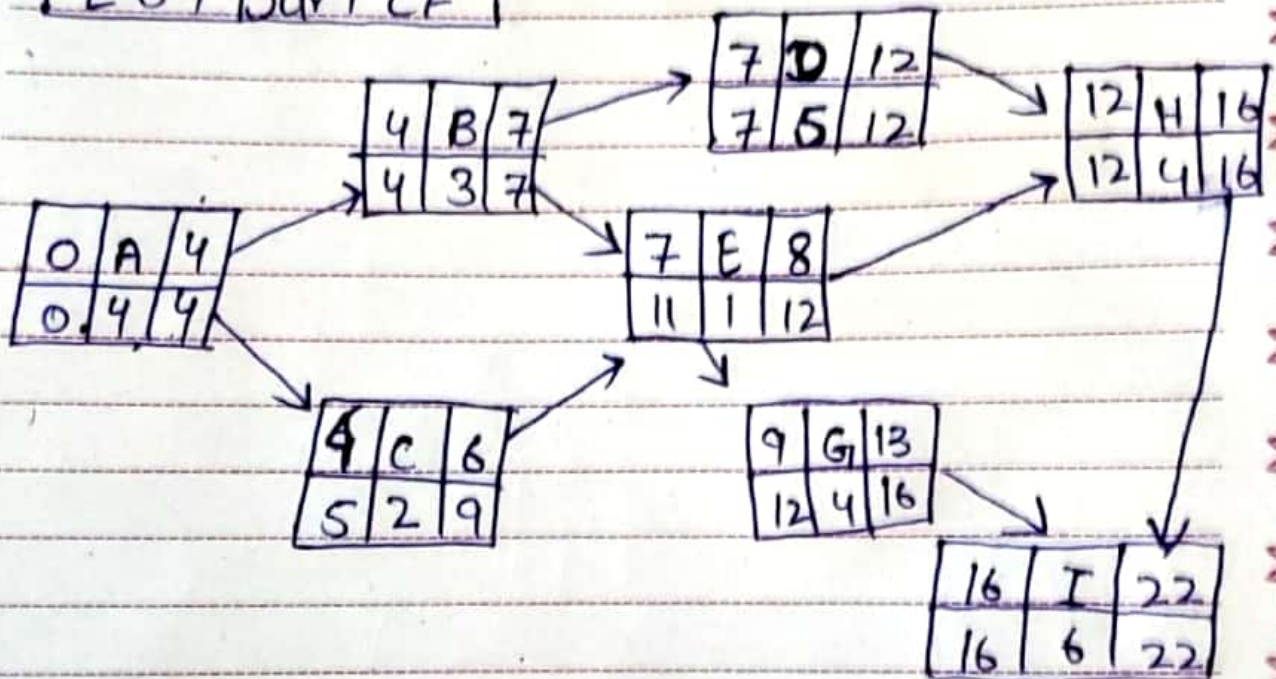
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First calculating Early start and late finish

ES	Act	EF
LS	Dur	LF



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NOTE BOOKS

2.

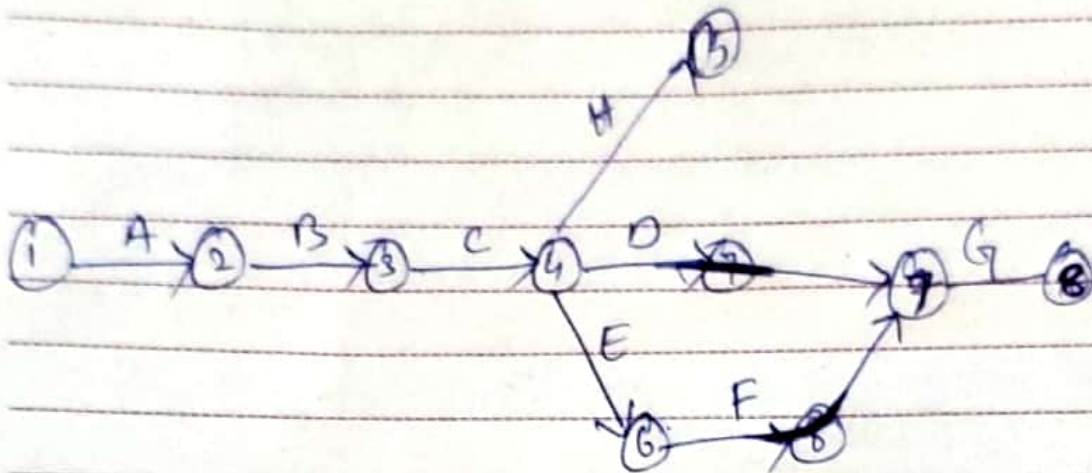
Total Float and Free Floats

Activity (i,j)	Duration D_{ij}	ES_i	ES_j	LF_j	TF_{ij}	FF_{ij}
A	4	0	4	4	0	0
B	3	4	7	7	0	0
C	2	4	6	9	3	0
D	5	7	12	12	0	0
E	1	7	8	12	4	0
F	3	6	9	12	3	0
G	4	9	13	16	3	0
H	4	12	16	16	0	0
I	6	16	22	22	0	0

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Question NO. _____ :

(a) Project Network:



(b) Formula used:

$$\text{expected duration} = \text{mean} = \frac{t_a + 4t_m + t_b}{6}$$

$$\text{Variance} = V = \sigma^2 = \left[\frac{t_b - t_a}{6} \right]^2$$

t_a : optimistic time

t_m : Most Probable time

t_b : Most Pessimistic time.

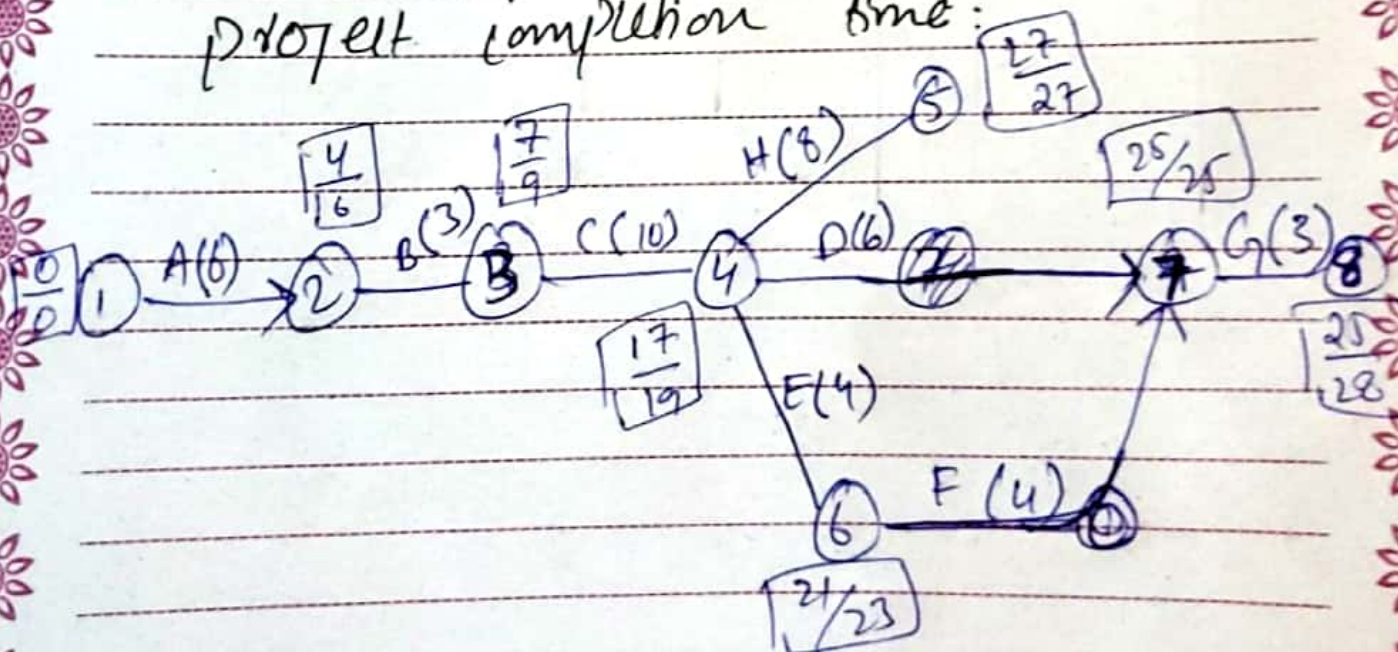
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Activity	Predecessor	t_a	t_m	t_b	Expected duration	Variance
A	-	4	5	12	6	1.777
B	A	2	3	4	3	0.111
C	B	6	8	22	10	7.111
D	C	4	6	8	6	0.444
E	C	3	4	5	4	0.111
F	E	2	4	6	4	0.444
G	D, F	2	3	4	3	0.111
H	C	5	7	15	8	2.777

(c) Critical path and Expected project completion time:



Critical path is the longest path
and is given by

$A \rightarrow B \rightarrow C \rightarrow E \rightarrow F \rightarrow G$

Completion time:

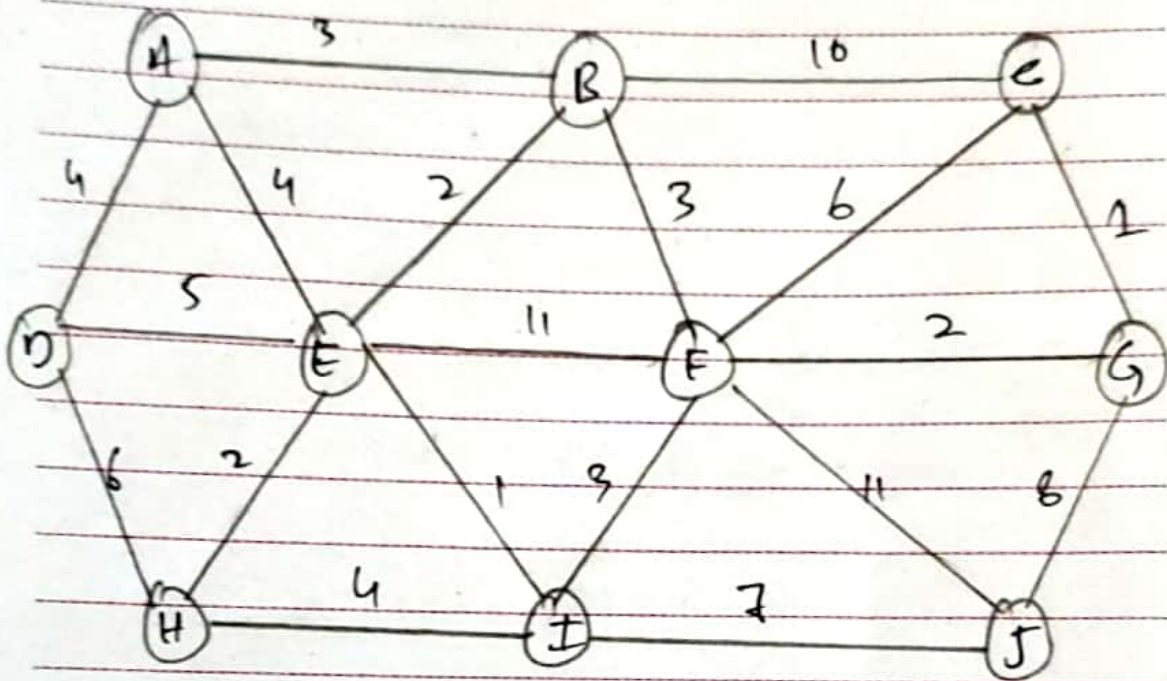
$$6 + 3 + 10 + 4 + 4 + 3 = 30$$

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Question no 3:

For the following graph
Minimum Spanning Tree.



Answer:

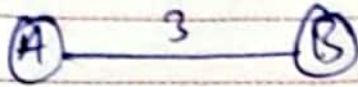
Step 1: As no loops, no parallel edges.

Selecting the node "A" as a root node.

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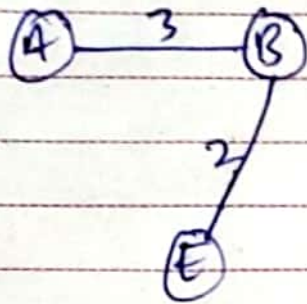
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Step 2: Choosing edge A and B



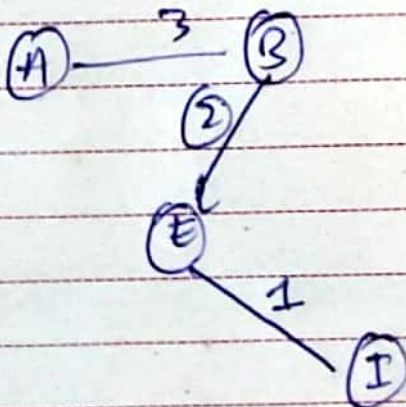
Tree: A-3-B

Step 3: Selecting edge B and E



Tree: A-3-B-2-E

Step 4: Selecting edge E-I



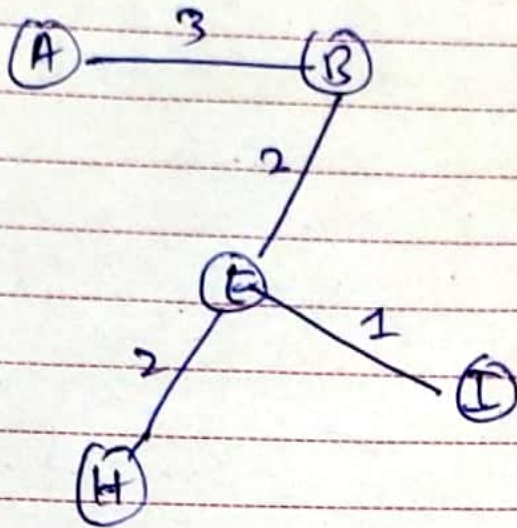
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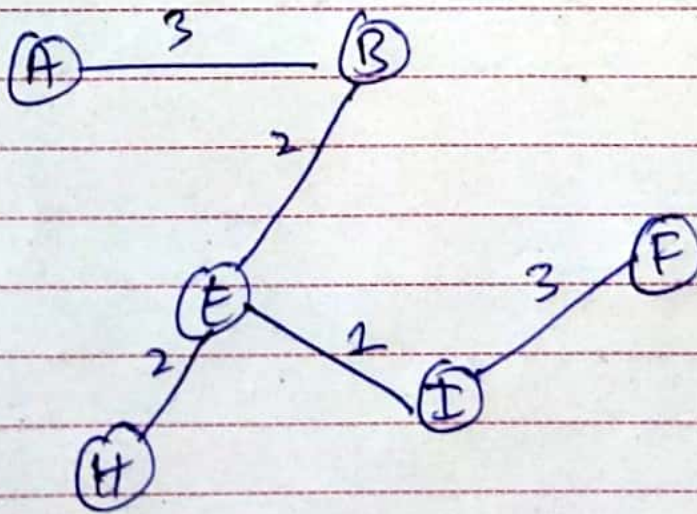
Step 5:

Selecting edge $E-H$ as it is the minimum weight edge of all



Tree: A-3-B-2-E-1-I-E-2-H

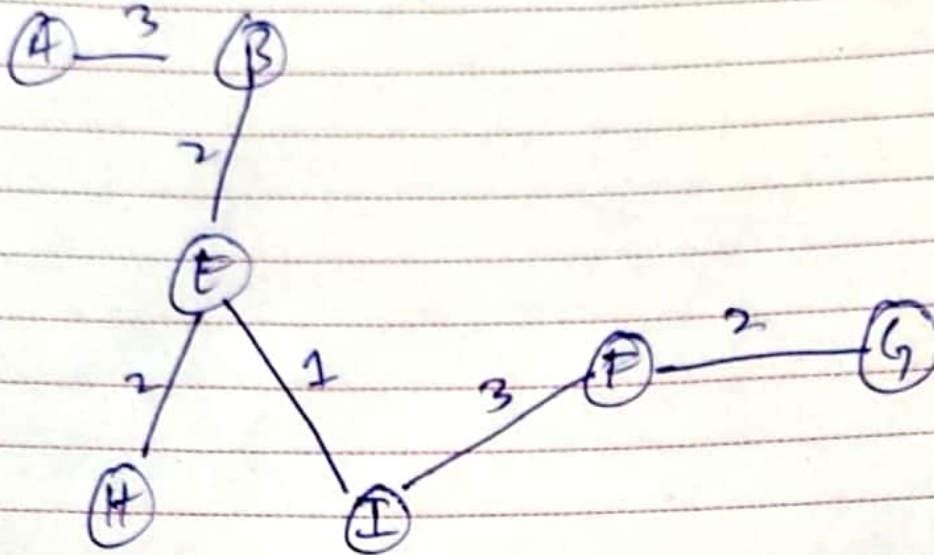
Step 6: Selecting edge $I-F$



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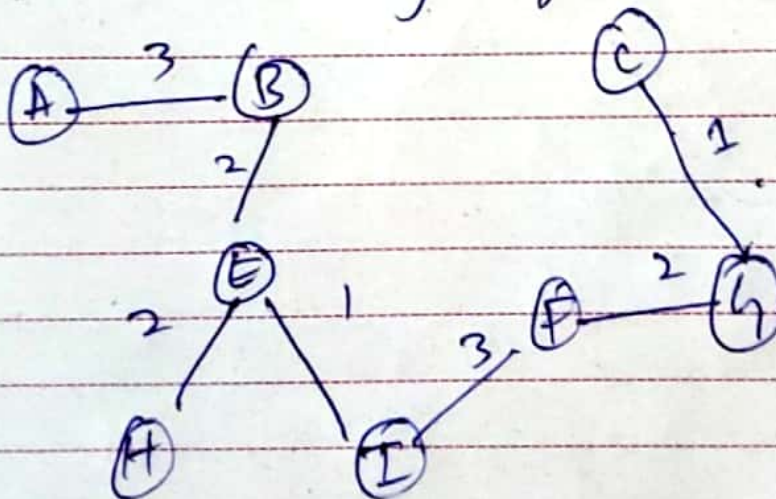
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Step 7: Selecting edge F-G



Step 8:

Selecting edge G-C



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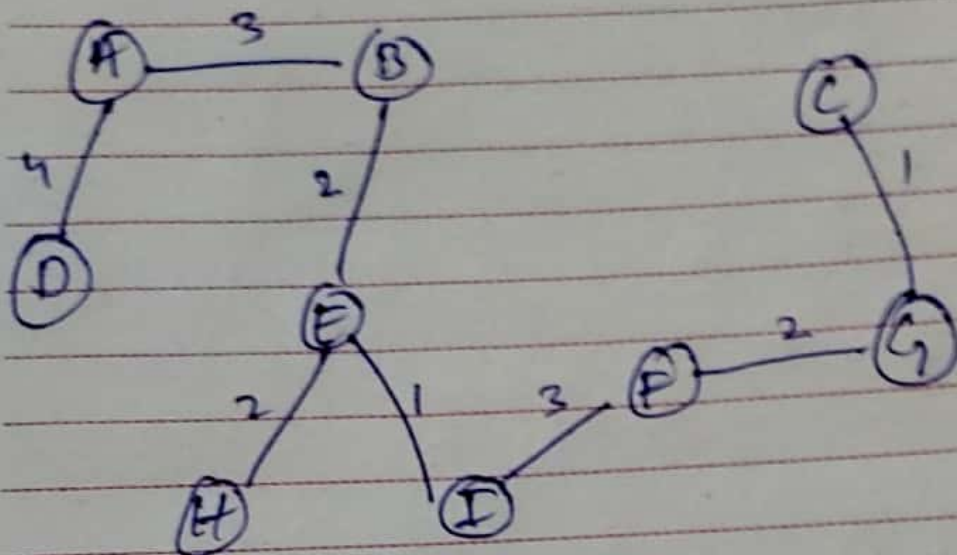
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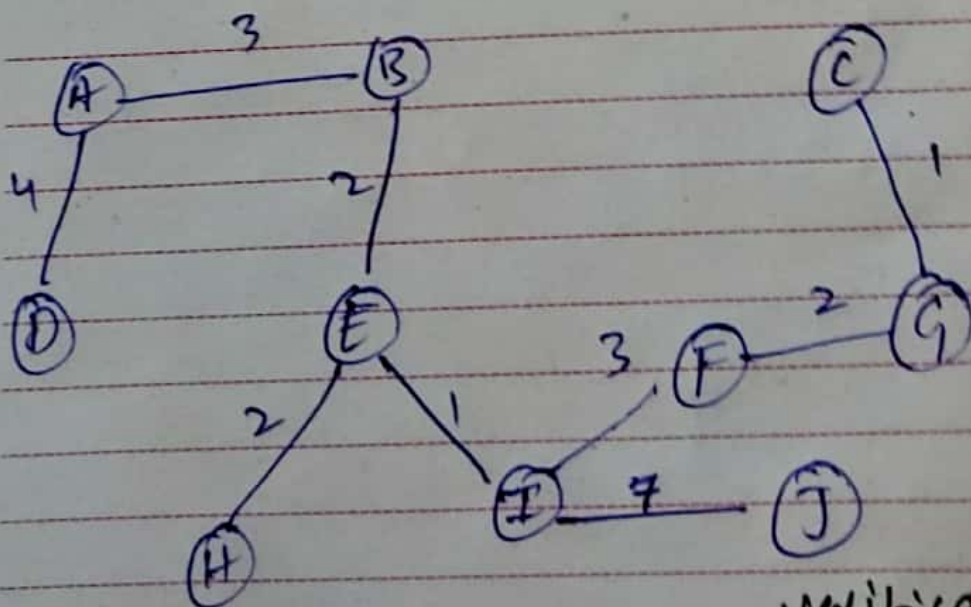
Step 9:

Selecting edge A-D



Step 10:

Selecting edge I-J



Verification:

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$$E' = 10 = E$$

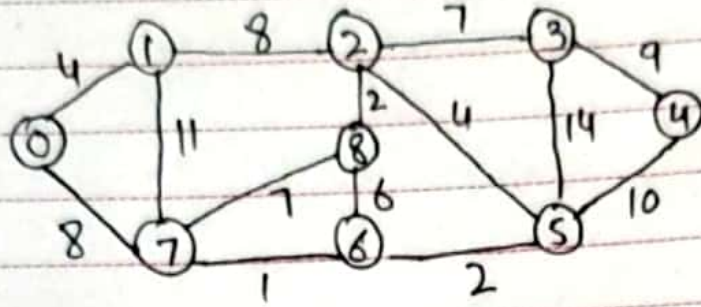
$$V' = V - 1 = 10 - 1 = 9$$

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Question no 4:

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



ANSWER#04

Step 1: NO edges and NO loops

Step 2: Arranging edges in increasing order of weight

EDG

7,6 1	8,2 2	6,5 2	0,1 4	2,5 4	8,6 6
2,3 7	7,8 7	0,7 8	1,2 8	3,4 9	5,4 10
1,7 11	3,5 14				

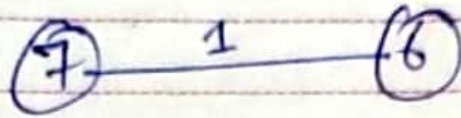
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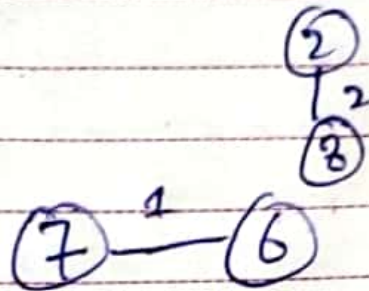
Step 3:

Choosing edge 7,6 (NO circuit formation)

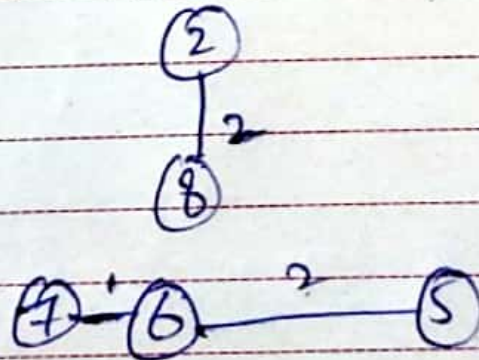


Step 4:

select edge 8,2



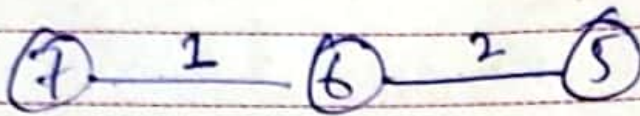
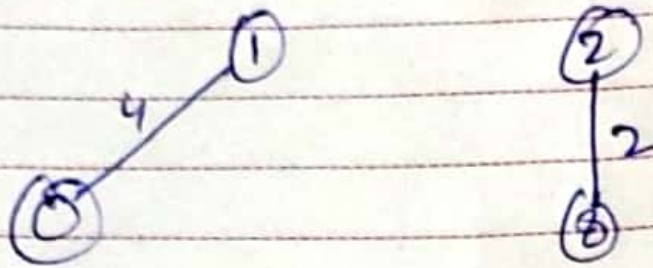
Step 5: selecting edge 6,5 (NO circuit again)



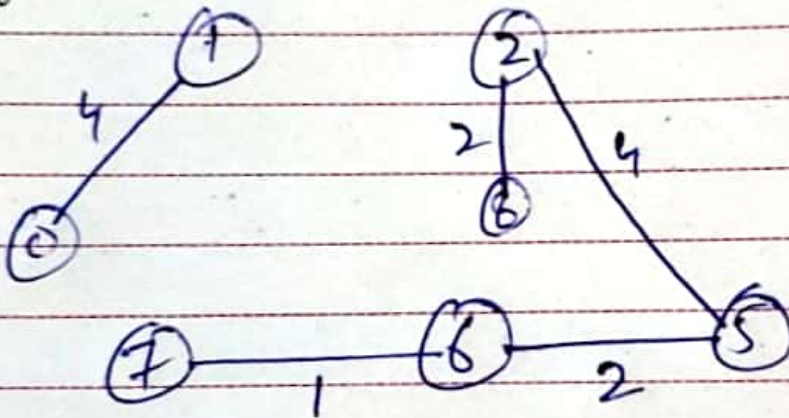
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Step 6: Select edge 0,1



Step 7: Select edge 2,5

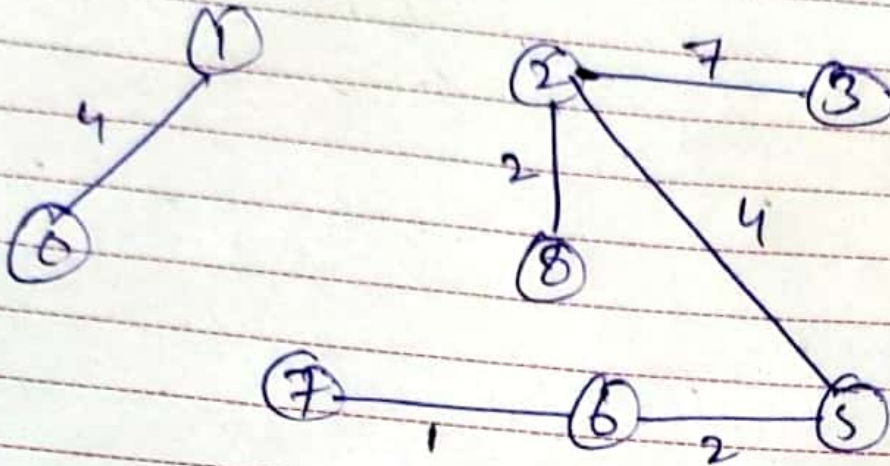


Step 8: Discarding edge 6,6
as it forms circuit

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Step 9: Selecting edge 2,3

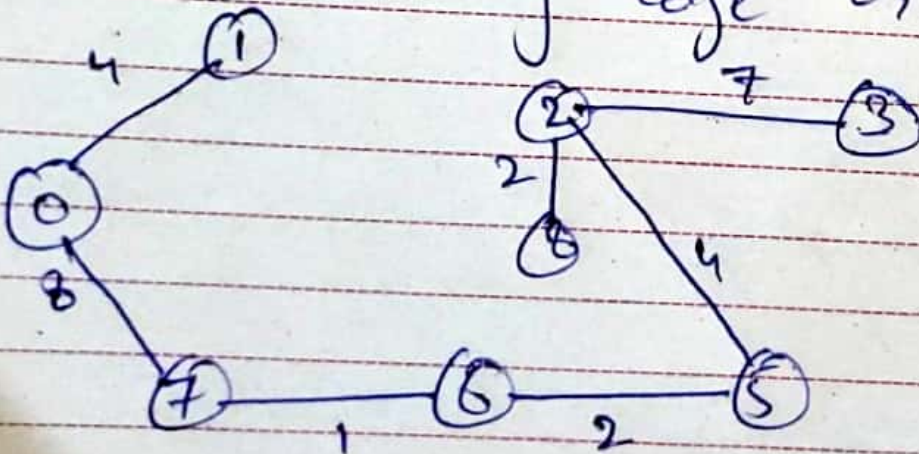


Step 10:

Discarding edge 7,8
as it forms circuit

Step 11;

Selecting edge 0,7



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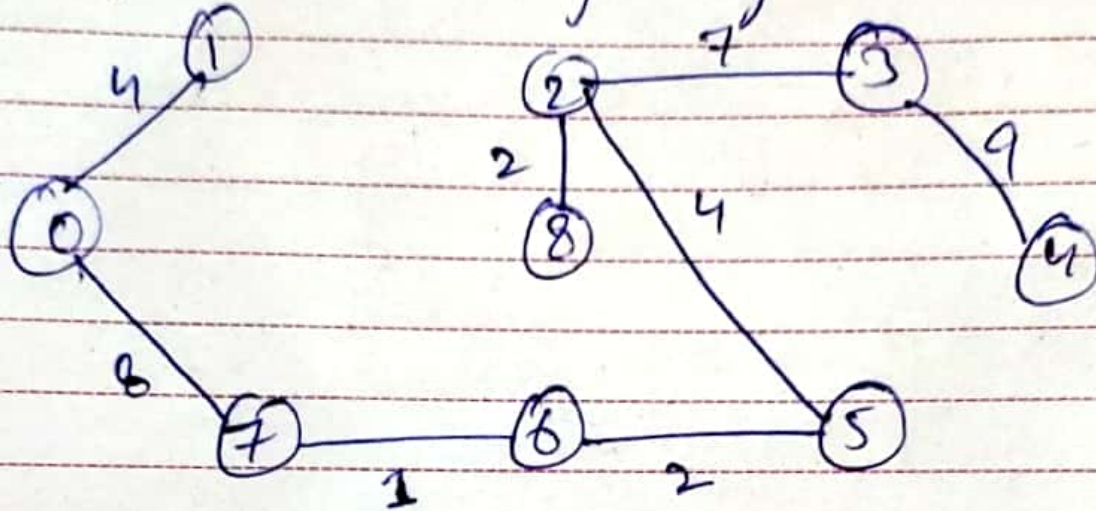
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Step 12 :

pick edge $1, 2$ but discard as it forms circuit

Step 13 :

Selecting edge $3, 4$



Step 14 : Neglecting $(5, 4)$, $(1, 7)$

and $(3, 5)$ as they form circuits.

Verification:

$$\text{Vertices} = V = 9$$

$$\text{edges} = V - 1 = 9 - 1 = 8$$

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Question no 5 :

Write a detailed note on how this course (Operations Research) will help you in your professional life?

Answer: An Engineer should have a very good decision making skill and should be able to select the alternative that yields more profit at less investment. As operations Research is the study of applying mathematics to business questions and problems are broken down into basic components and then solved in defined steps by mathematical analysis this helps the Engineer to decide among many alternatives.

I, as an Engineer, will help my company to achieve more datasets

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consider all available options, predict all possible outcomes and estimate risk.

Apart from that, I will also use Operations research techniques for scheduling and time management. I can use the concepts in Urban and agricultural planning. Most

Importantly in supply chain Management and Inventory management of the company, problems dealing with production process etc.

Lastly, I can also use the rules and tools of operations research to Risk management and can eventually save my company from sturdy loss. For further expansion in product, I can also use (OR) in Research and Development.

Hence, Operations Research will help me in dealing with many problems that will arise in business organization.