9/1/19.

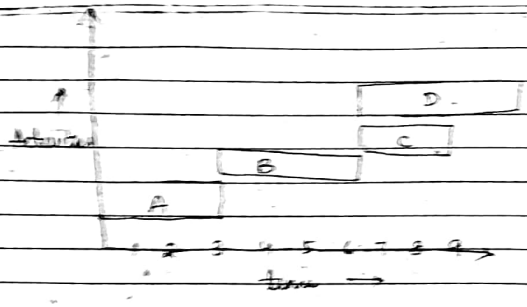
PAGE NO.
DATE / /

CPM – Critical path method
PERT – Program Evaluation and Review Technique

→ planning and scheduling of any type of project
→ Project are divided into small parts → the no:- of small parts depends upon the planner.
→ Division of project is done to estimate how much time is required to complete the project. Just looking at the entire project we can't estimate the time.
→ After division, plan see the interlation b/w small tasks and then decide the arrangement of the tasks (which task should come first, and then which will follow).
→ The small tasks are known as activities.
→ If there is relation that, B will start only after A completes and it take 3 days.
→ If there are two tasks C and D and both are started after completion of B and will start simultaneously.

Project → Small works (activities) → Interration among actuvies is determined → activities are then representated on a graph with time as x-axis (bar project chart)

Bar chart.
This is the simplest ~~implementation~~ representation of the plan (still used widely).



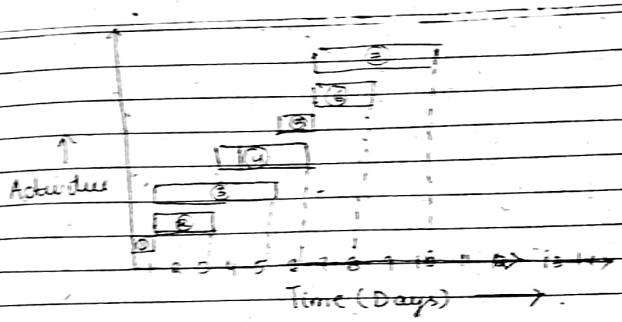
→ There are some limitations in the bar chart, which is overcome by CPM & Pert

For routine work → we use CPM
R&D work → we use PERT
For day to day activity → Bar chart

Q. Activity 2 and 3 can be done concurrently
→ Both must follow activity 1

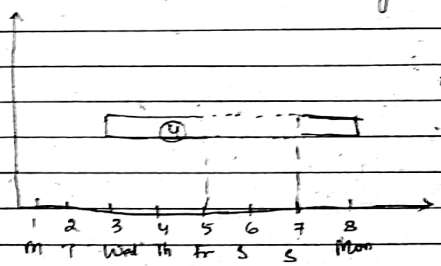
Activities	Days
1	1
2	2
3	4
4	3
5	1
6	2
7	4

→ Activity 2 must precede activity 4.
→ Activity 5 cannot begin until both 2 and 3 are complete.
→ Activity 6 can be started only after 4 and 5 are completed.
→ 7 is the last activity and which can be started only after completion of (5)



Total Days required without planning = 17
" " with planning = 10

If we follow calendar dates, (having 5 days week)



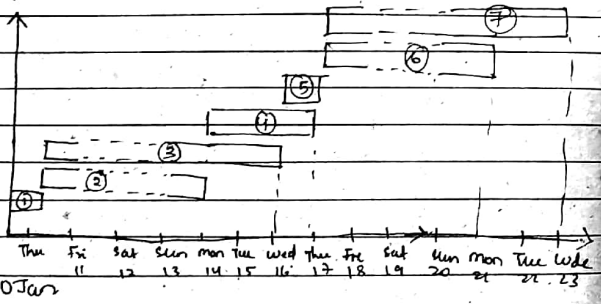
As Sat and Sun is holiday, 1 more day is covered on Monday

10/1/19.

Bar chart is a 2D representation of activities on one side and time on the other side.

Project — Manageable units (Activities) (no: of units, logic and duration of units → depends on the planner)

Q Same ques.
Start → 10th Jan (Thu)
5-day week.

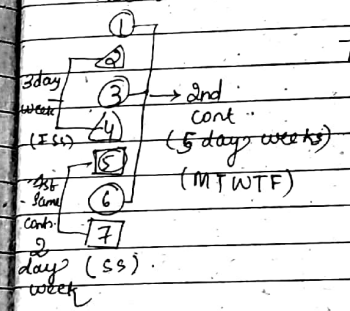


Work will be finished on 23 January

→ Putting things on time frame is known as Scheduling.

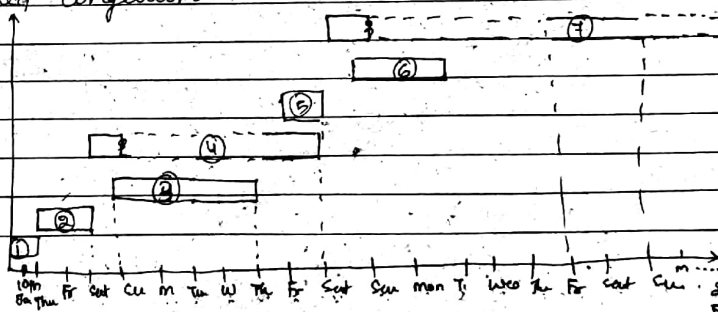
→ Single calendar date scheduling :-
Every one is using 5 day working.
(If there are more contractor for a project then they all have the same days week).
→ If they have different days week then it is multiple calendar date scheduling.

Activities



To avoid congestion, there have to some co-ordination b/w different department.
Let say 2nd conts. works from Monday to Friday)
Then 3rd cont. is working on Fri sat & Sun.
Then 1st conts. is working on sat & Sun.

Thus, by dividing the days of the weeks we have avoided congestion.



05/1/19

Shortcomings of Bar Charts

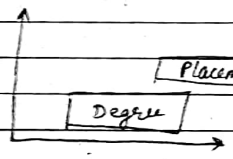
1) Degree of Detail.

→ No. of division increases then the bar chart will be difficult to make.

Degree of detail :- whether the work is large or small we have to represent all its details only in max. to 10-20 division.

→ We try to reduce the no:- to 10-20 division.
We try to enclose all the works in one activities.
↳ Drawback

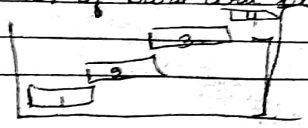
Suppose.



In Degree (B Tech). all the four degrees are included. So it is not clear that at what year placement will start.

So instead of having one single activity we will divide into 4 years.

But here no:- of bars will be increased.



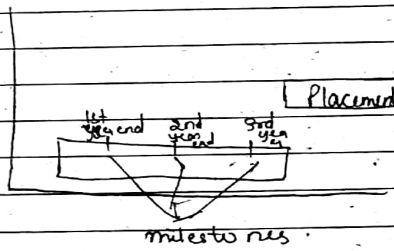
Another solution;

We will have some marks (milestone) to each bar. so they are representing events which shows
↳ Milestone beginning or end of something.
(Eg:- starting of one event or ending of one event).

Another type of bar chart on which milestones are marked on the bars is known as Milestone Chart.

Milestone are beginning or ending of a particular event.

→ Activities take time or resources but events do not take time (as it is just a point of time).



Milestone chart.

→ Bar chart also known as gantt chart.

→ To overcome this limitation we have milestones (which is some event) and chart is known as Milestone chart

2) Work progress

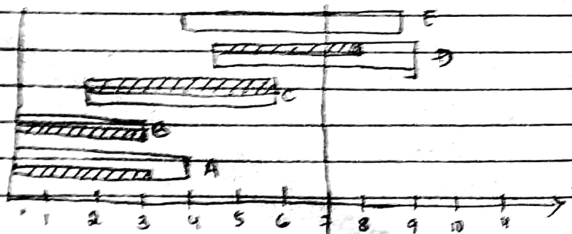
→ How much work have been completed and how much not.

→ Work progress may not be same for all people.
→ Take the eg of CGPA (For some students who are sincere will have increasing CGPA).
→ The amount of work done in a day is not uniform. (~~Some activ~~

→ We have a plan - we are comparing the actual work on site. We have three cases
  → Some may be on schedule
  → Some may be behind the schedule.
  → Some " " ahead " "
The above 3 cases may happen for any activity.

Drawback :- Work progress at site is not reflected in the bar chart

Overcome :- Hatching by some pattern or colour.

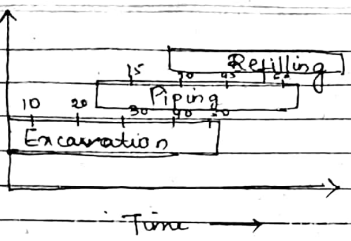


Some parts have been hatched → i.e. that portion have been finished

→ Suppose I am on 7th day (i.e. observing progress at the 7th day).
From the hatched bar chart, we have seen that A is behind the schedule, even on the 7th day.
As E depends on A, as A have not yet finished so E have not yet started.
  → C ~~and D~~ ~~are~~ is on schedule till 7th day.
  → D is ahead of schedule as on the 7th day D has completed the 8th day work.

→ Once we have ~~be~~ done hatching then we have to see the controlling factors.
→ so it is known as controlling tools.
1 → As D have got more resources (as ahead) so this is the controlling factor - we have to modify the controlling factors / resources such that A will be finished and E will get started.

3) Inter-relationship
Eg:- Overhead Electrical line has to be underground
Act 1 - Excavation
Act 2 Putting the pipe
Act 3 Refilling again.



→ We know that 1st excavation will take place, then piping will start after some time & then refilling will start after some time.
But this things are not been shown by the bar chart.
ie, Bar chart is unable to clearly reflect the inter-relationship b/w activities.

We can overcome this drawback by putting milestones.

So here we have put milestones that after 20m excavation we will start piping. As piping is a faster process so division of piping will be larger and after 30m piping Refilling will start (which is not for 2nd)

By putting milestone or giving some division this problem is overcome.

→ So if excavation will be late then piping will be late and further Refilling will be late. So we are unable to tell from the bar-chart without division that how much delay will happen for piping & delay of Excavation.

4) Time Uncertainty

→ Time estimate should be accurate.
→ We cannot used bar chart for R&D type.
→ Times are of fair degree of accuracy in routine work. so bar chart are good for routine work.
→ If time is not certain, then bar chart cannot be used.
→ Avoided for R&D type (not good for R&D type)
→ This can only be overcomed if the Planner is well experienced and good knowledge of the outcome of the project

5) Planning and Scheduling together

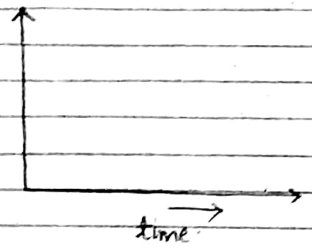
Planning → duration, interrelationship, etc are planning.
Scheduling → Giving or Assigning time.

If this happen together, we cannot give enough time to planning. So this is one of the drawback of bar-chart.

16/1/19

Tutorial - 1

Q3

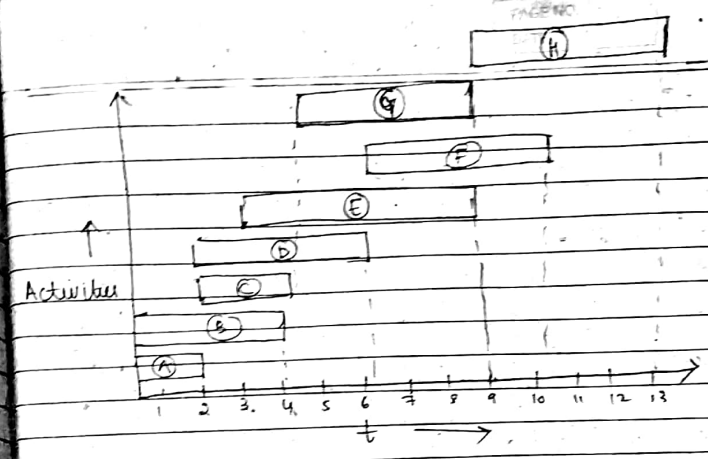


Project consist of 8 activities: A B C D E F G H

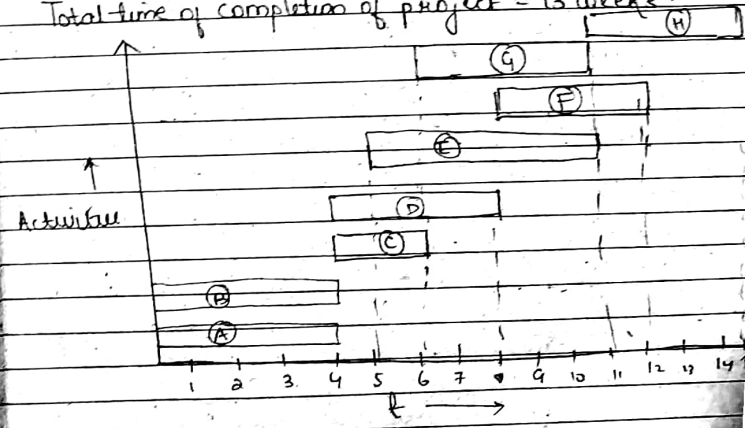
A	2 weeks	
B	4 weeks	→ A & B can be performed in parallel.
C	3 weeks	→ C and D cannot start until A is complete
D	4 weeks	
E	6 weeks	→ E cannot start until half of the work of activity C is complete
F	4 "	→ F can start only after activity D is complete.
G	5 "	→ G succeeds C. It is the last activity which should succeed E.
H	4 "	

Draw the bar chart, what is the total time of the completion of project.

If there is increase of 2 weeks in time completion of activity A. What will be corresponding increase in the total time of completion of project.



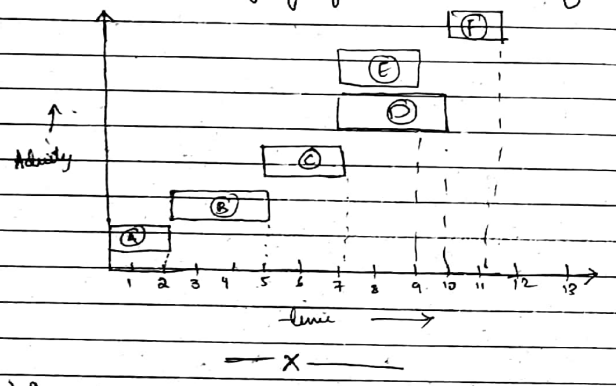
Total time of completion of project = 13 weeks.



Total time of completion of project = 15 weeks.

Increase in time = 15 - 13
= 2 weeks.

Eg: 1st activity = Foundation → 2 weeks.
2nd " = Casting Beam with → 3 weeks.
3rd " = Casting columns → 2 weeks.
4th " = Non-load bearing walls → 3 weeks
5th " = Top beam → 2 weeks
6th " = Laying of slab → 1 week.

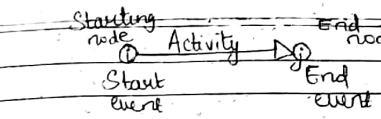


17/4/19

Critical Path Method (CPM)

↳ Here instead of bar we use arrow to represent → ▷

↳ Projects
↓
Small managable units
↓
Duration
↓
Relationship (Dep)



→ Events are point of time.
→ Activity is the actual piece of work (duration, not point of time)
→ In general, length of the arrows has nothing to do with time.

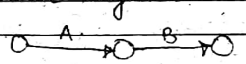
(This is known as Network)

→ There has to be arrow direction always.
→ In both the technique CPM & PERT we use arrow to represent piece of work.

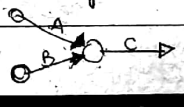
aij = Name of activity
D = duration.

→ How to represent relations?

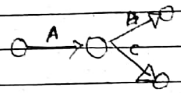
Eg:- ① B is controlled by A.
B cannot begin until A is complete.



② C is controlled by A and B.
C cannot begin until A and B are complete

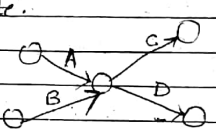


(3) B and C are controlled by A.
B and C cannot start unless A is complete.



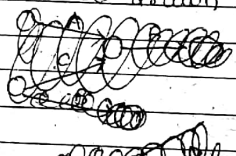
{ Always write activity on arrow
↳ in our course.

(4) C and D are controlled by A and B.
C and D cannot start until A and B are complete.

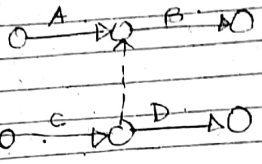


(5) Activity B is controlled by A and C.
" D is controlled by C. only.

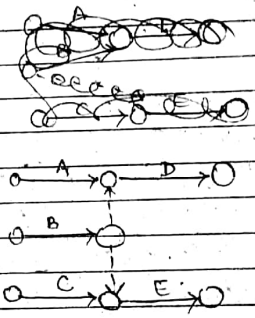
→ This cannot be drawn simply, as some or the other relationship will arise.



→ So we will show a dummy arrow.
We use this just to ↓ maintain relationship

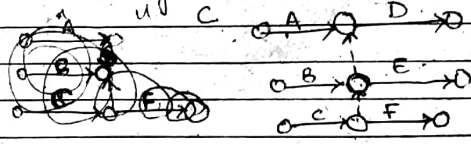


→ The no. of solid arrows will be equal to no. of activity
(6) D is controlled by A and B.
E is " " B and C.

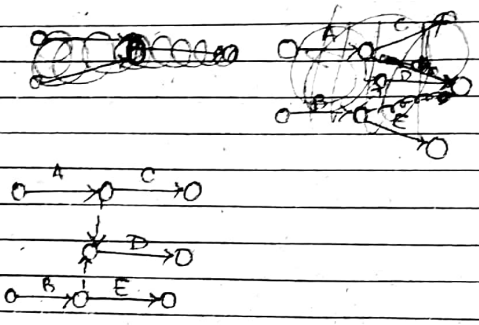


8/1/19

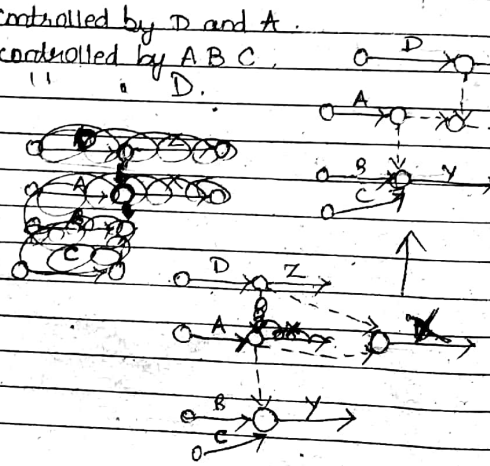
(7) D is controlled by A, B and C.
E is controlled by B, C
F " " C.



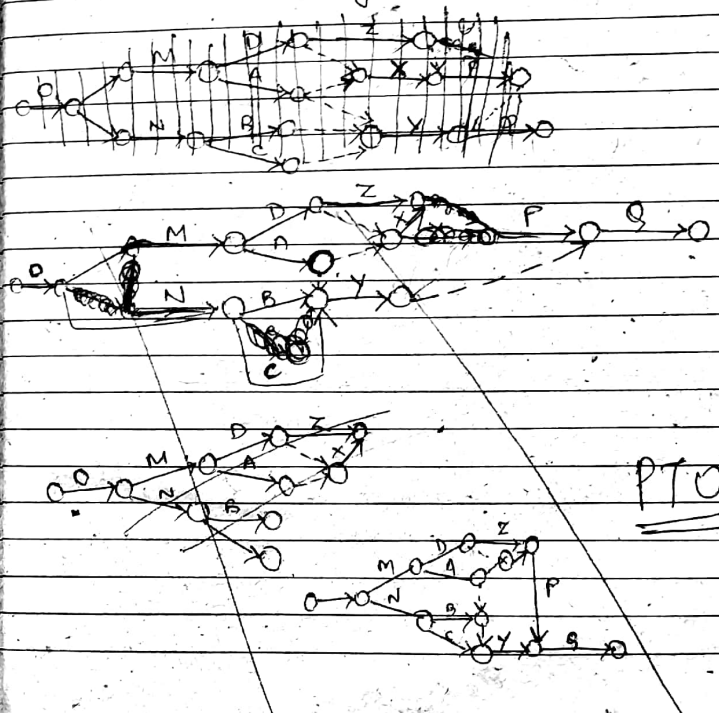
Q A controls C and D.
B " D, E.
D is controlled by A and B.



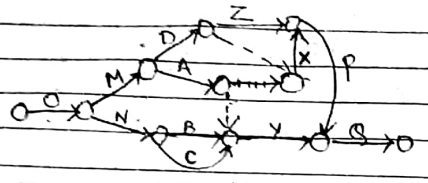
Q X is controlled by D and A.
Y is controlled by A B C.
Z " " D.



Q D and A succeeds M ✓
B and C succeeds N ✓
M and N " O ✓
Y is controlled by ABC ✓
P succeeds Z, X ✓
Z is controlled by D ✓
Q succeeds P ✓
X is controlled by DA ✓



PTO



23/4/19

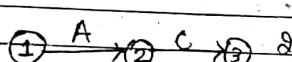
Tutorial - 2.

① Install a machine → Activity.

② The pump has been installed → event.

Event → We do not need time or resources allocation.

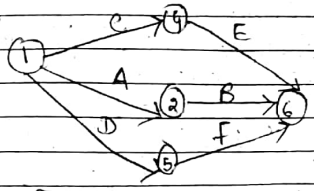
Tail event & Head event.



2 - Head event.
1 - Tail event.

If total project is starting from that event then we call it as initial event of the project.

③ is the head event of activity C and is also known as end event.

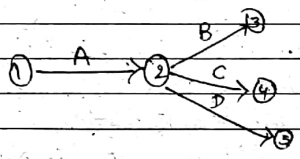


④, ②, ⑤ and ⑥ are successors of event ①.

But ④ ② ⑤ are immediate successors of ①.

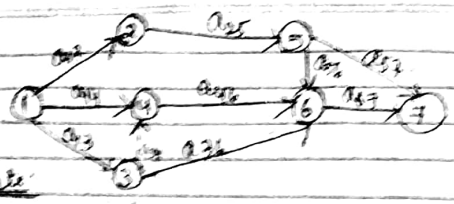
④, ② and ⑤ are immediate predecessor of event ⑥.

Immediate successor of activity A is B.
" " B " C
" " C " E
" " D " F



B, C and D are immediate successor of activity A.

Q Prepare a table showing immediate predecessor activities and events and predecessor and then immediate successor & successor.



① Events

Predecessor and immediate predecessor and successor.

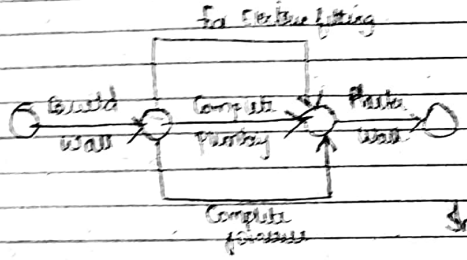
Event	Predecessor	Imm Pred	Successor	Imm Succ
1	–	–	2, 4, 3, 5, 6, 7	2, 4, 3
2	1	1	5, 6, 7	5
3	1	1	4, 6, 7	4, 6
4	1, 3	1, 3	6, 7	6
5	1, 2	2	6, 7	6, 7
6	1, 3, 4, 2, 5	5, 4, 3	7	7
7	1, 2, 3, 4, 5, 6	5, 6	–	–

② Activities

Activities	Pred	Imm Pred	Successor	Imm Succ
a_{12}	–	–	a_{25}, a_{57}, a_{27}	a_{25}
a_{14}	–	7	a_{46}, a_{47}	a_{46}
a_{13}	–	–	a_{34}, a_{36}, a_{37}	a_{34}, a_{36}
a_{25}	a_{12}	a_{12}	a_{57}, a_{67}, a_{47}	a_{57}, a_{67}
a_{46}	a_{14}, a_{13}, a_{34}, a_{12}	a_{14}, a_{34}, a_{13}	a_{67}	a_{67}
a_{34}	a_{13}	a_{13}	a_{46}, a_{36}, a_{67}	a_{46}, a_{36}
a_{36}	a_{13}	a_{13}	a_{67}	a_{67}

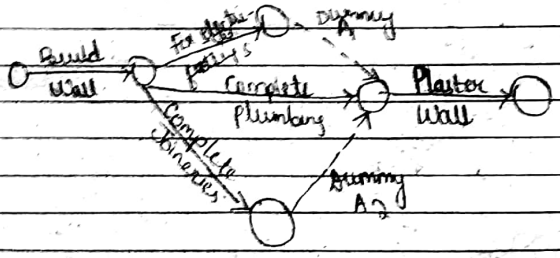
	Pred	Imm Pred	Succ	Imm Succ
a_{25}	a_{12}	a_{12}	–	–
a_{57}	a_{12}, a_{25}	a_{25}	a_{67}	a_{67}
a_{67}	All	a_{46}, a_{36},	–	–
	except	a_{34}		
	a_{67}			

2.



Insert dummy activity.

In the above fig, 3 activities start from one common node and end at some other common node. This gives ambiguous representation, and is grammatically incorrect. So dummies have to be introduced.



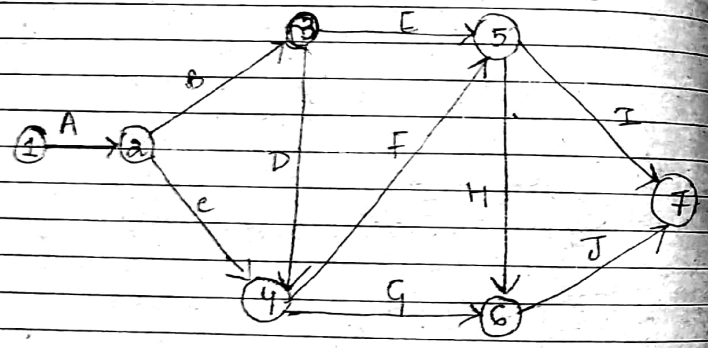
04/1/19

Network : (How to represent logic in the form of network)

→ Whenever we develop some computer program to tell how the flow is we number activities.

→ But if we do manually then it is not required

→ We no. events in a N/W in such a way that head event gets higher number than the tail. This numbering from lower to higher is known as Fulkerson's Rule for event numbering



→ Purpose of fulkerson's rule is just to number events.

① Identify a node or event in the N/W from which all arrows are going out (initial node)

② Number it 1

③ Forget about arrow. Few more events will generated from where arrow are going out (no inflow is there) Give it the next number

Repeat step ③

Activity	i (from)	j (to)
A	1	2
B	2	3
C	2	4
D	3	4
E	3	5
F	4	5
G	4	6
H	5	6
I	5	7
J	6	7

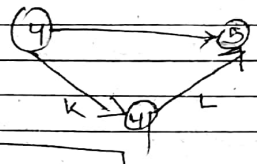
Here we can see that i is always less than j

This fulkerson's rule is only required in computer programming.

For manual purpose, we can write numbers in any manner (not specific).

Suppose we want to add more nodes in the existing N/W, then we have to number it all again. Then we have arrived at a solution known as Skip numbering.

So in same N/W we represent a node like

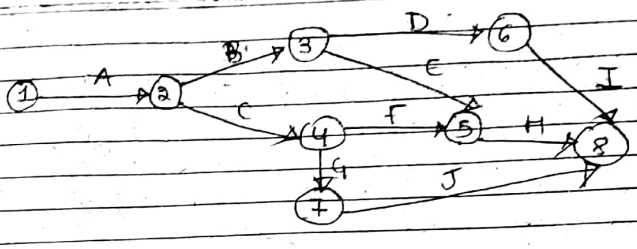


so the skip numbering one will be like

Act.	i	j
A	10	20
B	20	30
C	20	40
D	30	40
E	30	50
F	40	50
G	40	60
H	50	60
I	30	70
J	60	70
K	40	41
L	41	50

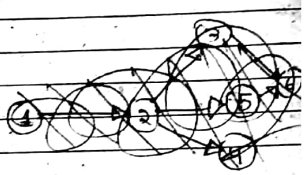
here we skip numbering has been used.

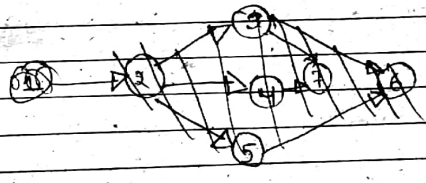
Q A — 1, 2
B — 2, 3
C — 2, 4
D — 3, 6
E — 3, 5
F — 4, 5
G — 4, 7
H — 5, 8
I — 6, 8
J — 7, 8

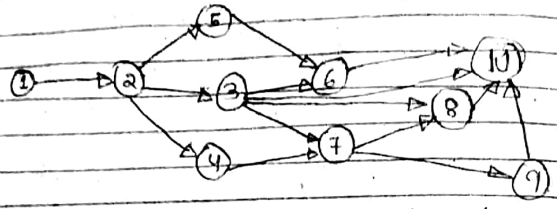


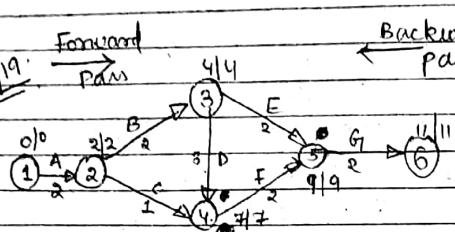
Q

Event	Immediate pred.
1	—
2	1
3	2
4	2
5	2
6	3,5
7	3,4
8	3,7
9	4
10	3,6,8,9









28/1/19

Number represents → duration

② is the starting node of B and C.

B and C will start after 2 day of start of event.

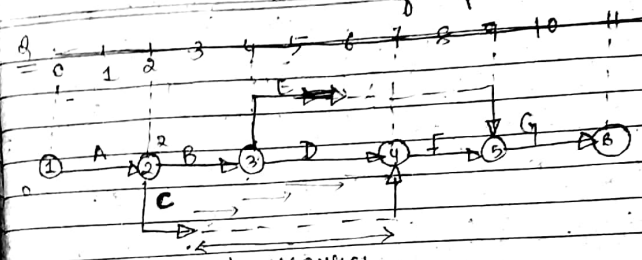
→ F will start only when C and D will be over.

So, F will start after 7.

→ So the project will take 11 days, for its completion.

Length of arrow will be time taken.

→ (Representation of the previous N/W)



No resource required (as C will be completed in one day).

↓

time, man, money, etc.

For the previous ques,

i	j	Activity	Duration
1	2	A	2
2	3	B	2
2	4	C	1
3	4	D	3
3	5	E	2
4	5	F	2
5	6	G	2

EST For this ques.

EST	i	j	Activity	Duration
0	1	2	A	2
2	2	3	B	2
2	2	4	C	1
4	3	4	D	3
4	3	5	E	2
7	4	5	F	2
9	5	6	G	2

In this question, C is starting as earliest as possible (otherwise C can be the time 3-4, 4-5, 5-6, 6-

→ EST (Earliest Start time) → Activities will start as soon as possible.

If activities are starting earliest possible, then it will end earliest possible.

Earliest Finish Time :- (EFT)

Activity	EST	EFT	LST	LFT
A	0	2	0	2
B	2	4	2	4
C	2	3	6	7
D	4	7	4	7
E	4	6	7	9
F	7	9	7	9
G	9	11	9	11

If the network grows, then managing network in this manner will be difficult. so EST and EFT, (without time scale) it can be directly calculated from the N/W

EST ⇒ we will get from Network
EFT ⇒ EST + Duration

⇒ Time scale we have drawn, just to understand the concept.

Late start time :- Activities are starting as late as possible.
In our time scale, For C 6 - 7
for E 7 - 9.
{ And for all other it is same as EST }

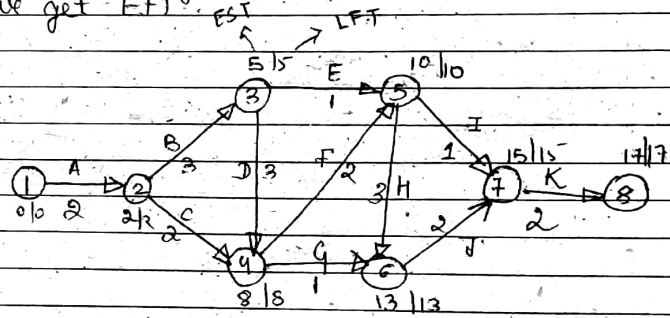
Late finish time :-
If an activity will start as late as possible, then it will finish as late as possible.

Forward pass :- we took (we took max) earliest start time
Backward pass :- We get late finish time (it will take min) (it will come on the arrow head)

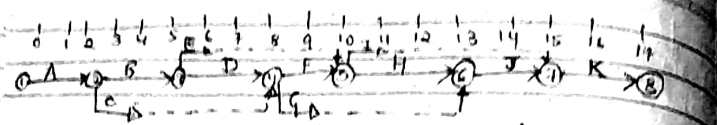
Forward Pass → along arrow.
Backward Pass → against arrow.

→ If we know LFT from backward pass, then subtracting duration from LFT (LFT - duration) we will get LST.

→ If we know EST from forward pass, then adding duration to EST (EST + du) we get EFT.



→ Best way to draw the time-scale is stretch the longest path.



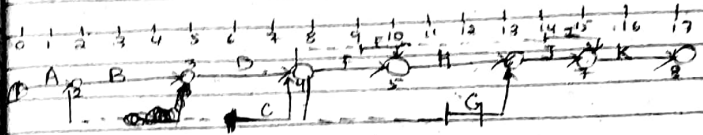
By time-scale

i	j	Activity	EST	EFT	LST	LFT	LST-EST OR LFT-EFT
1	2	A	0	2	0	2	0
2	3	B	2	5	2	5	0
2	4	C	2	4	6	8	4
3	4	D	5	8	5	8	0
3	5	E	5	6	9	10	4
4	5	F	8	10	8	10	0
4	6	G	8	9	12	13	4
5	6	H	10	13	10	13	0
5	7	I	10	11	14	15	4
6	7	J	13	15	13	15	0
7	8	K	15	17	15	17	0

By Network

i	j	Activity	EST	(EST+D) EFT	LST	(LFT-D) LFT
1	2	A	0	2	0	2
2	3	B	2	5	2	5
2	4	C	2	4	6	8
3	4	D	5	8	5	8
3	5	E	5	6	9	10
4	5	F	8	10	8	10
4	6	G	8	9	12	13
5	6	H	10	13	10	13
5	7	I	10	11	14	15
6	7	J	13	15	13	15
7	8	K	15	17	15	17

Time scale with late start time



Critical path:

→ On this Buried path, this technique is known as Critical Path Method (CPM).

→ It is the longest path in the network which go on till the project duration.

Why critical?

Because any activities lies on this path, cannot move forward or backward they do not carry flexibility. Because any shifting will affect or delay the project duration.

→ Any activities that are on the critical path are critical activities.

→ Any activity that are not on the critical path are non-critical activity.

In our previous prob, critical path is

A → B → D → F → H → J → K

Critical activities
= A, B, D, F, H, J, K.

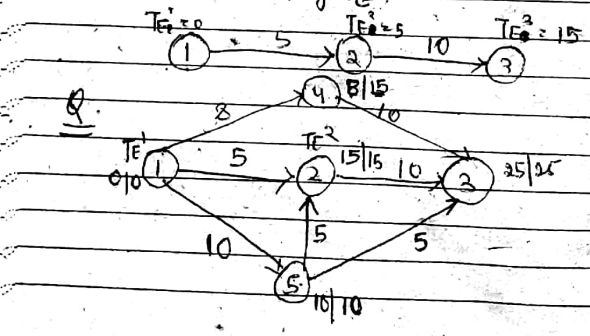
non-critical activities
C, E, I, G.

In critical path method, if for an activity LST - EST or LFT - EFT = 0 then these activities are known as critical activities (and are not flexible) else they are known as non-critical activities (they are flexible)

— x —

30/1/19 Tutorial - 3

→ Earliest event time or earliest occurence time.
→ It is denoted by T_E.



Q.

$T_E^2 = \max(T_E^5 + t_{5,2}, T_E^2)$

$= \max(10+5, 5)$

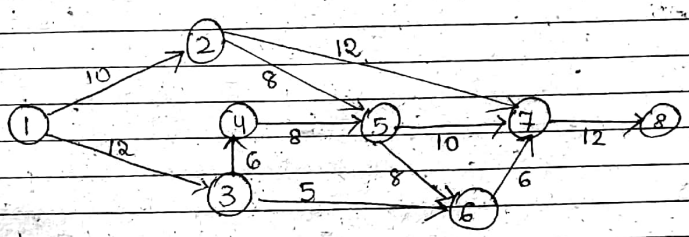
$= 15.$

Event	EET	LET
1	0	0
2	15	15
3	25	25
4	8	15
5	10	10

→ latest allowable occurence time.

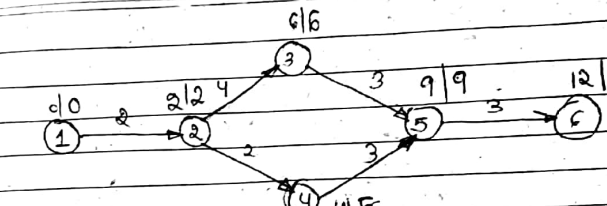
Latest occurence time is the minimum time during backward pass.

Q

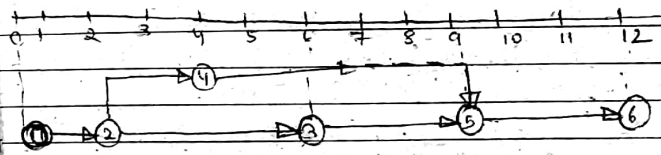


Event	Predecessor	Activity	EET	Successor	Activity	LET
1	–	–	0	2	10	8
				3	12	6
2	1	$t_{12}=10$	10	5	$t_{25}=8$	18
				7	$t_{27}=12$	28
						18
3	1	$t_{13}=12$	12	6	$t_{36}=5$	29
				4	$t_{34}=6$	12
						12
4	3	$t_{34}=18$	18	5	$t_{45}=8$	18
5	2	$t_{25}=8$	18	6	$t_{56}=8$	26
	4	$t_{45}=8$	=26	7	$t_{57}=10$	30
			26			26
6	3	$t_{36}=5$	17	7	$t_{67}=6$	34
	5	$t_{56}=8$	=34			
			34			
7	2	$t_{27}=12$	32, 36, 40	8	t_{78}	40
	5	$t_{57}=10$	36			
	6	$t_{67}=6$	=40			
			40			
8	7	$t_{78}=12$	52	–	–	52

31/1/19



Activity	Duration	EST	EFT	EST	EFT	LST	LFT	Total float
1-2	2	0	2	0	2	0	0	0
2-3	4	2	6	2	6	2	6	0
2-4	2	2	4	2	4	4	6	2
3-5	3	6	9	6	9	6	9	0
4-5	3	4	7	4	7	6	9	2
5-6	3	9	12	9	12	9	12	0



Critical path 1-2-3-5-6

Critical activity = 1-2, 2-3, 3-5, 5-6

Non-critical activity = 2-4 & 4-5.

float means flexibility.

Total float or path float are same.

There are 2 paths from 2

2-4-5 = slack-path (non-critical)
and 2-3-5 = critical path.

It is called path float because all the activities that lie on the slack-path share the same flexibility or float.

TF = LST - EST

Lets say 2-4 is carried out by one contractor i.e., A and 4-5 is carried out by another contractor - B,
But if B is rigid that he want to start after 4th day, then A have no flexibility and 2-4 is a critical path as A is not free to use this float.
Only B is free to use this float.

Free float :- That float is owned by that activity.
here B is free to use but A is not free to use

Internationally, free float is also known as activity float because that float is associated with activity not path.

	TF	Free Float	I F
2-4	2	0	2
4-5	2	2	0

$$EST_{jk} - EFT_{ij} = FF_{ij}$$

$EST_{4-5} = EST_{5-6} - EFT_{4-5}$
$= 9 - 7 = 2$

$EST_{2-4} = EST_{4-5} - EFT_{2-4}$
$= 4 - 4$
$= 0$

Interfering float :-

If activity use its float, then how much interference will create for start time of succeeding activity

Here contractor A will create interfere for the activity of contractor B.

Interference float ≠ TF − FT

04/02/19

Critical Path Method (CPM)

Project Duration :- The total time taken by the project to be completed.

→ Sum of the activities along that path is equal to the project duration is known as critical path or the longest path.

→ Activities which lies on critical path are known as critical activities. There is no flexibility. It is essential to keep the project on time.

→ Non-critical activities :- which carry some flexibility / float.

→ Earliest start time → how early an activity start.
In that if we add duration then it is earliest finish time.

→ Latest start time :- how late can an activity start (i.e, activity start as late as possible).

→ EST and LST are same for critical activity and also EFT and LFT.

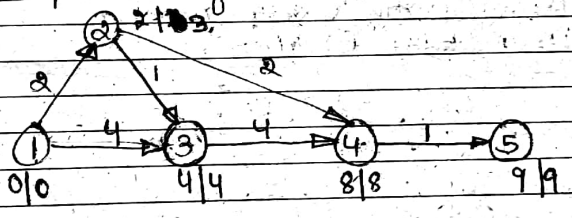
→ Total float / Path float :- flexibility associated with activity on stack path

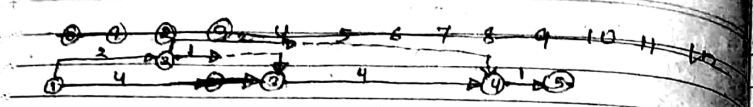
→ Stack path → have some flexibility associated with it.

→ Free float / Activity float :- whether activity is free to use this float or not.

→ Interfering float :- If activity use this float then how much it affect the start or end time of other activity.

Independent float :-





Activity	Duration	EST	EFT	LST	LFT	TF	Free	Independent
12	2	0	2	1	3	1	0	
13	4	0	4	0	4	0	0	0
23	1	2	3	3	4	1		
24	2	2	4	6	8	4		3
34	4	4	8	4	8	0		0
45	1	8	9	8	9	0		0

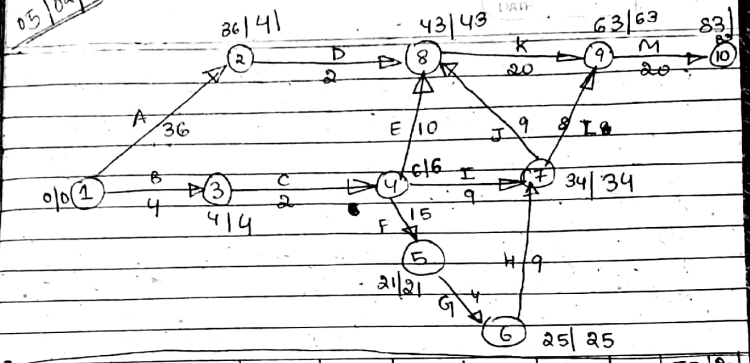
Independent float

→ Activity is independent to use the float.
- No other activity can take this independent float of the activity under consideration.

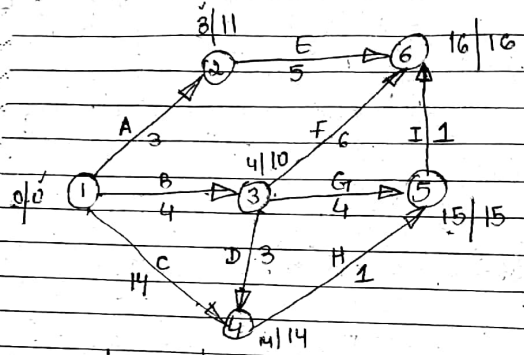
→ Succuor start as early as possible and predecessor finish as late as possible.
then the diff of this is how much less than of activity duration.

Eg 2-4. Pred 1-2 LFT = 3.
Succ. 4-5 EST = 8.
diff = 8-3 = 5.
Activity duration = 2.
5-2 = 3.

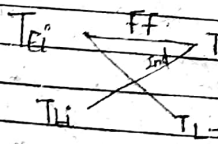
05/08/19



Activity	Duration	EST	EFT	LST	LFT	TF	FF	IF	Ind
A	36	0	36	5	41	5	0	5	0
B	4	0	4	0	4	0	0	0	0
C	2	4	6	4	6	0	0	0	0
D	2	36	38	41	43	5	5	0	0
E	10	6	16	33	43	27	27	0	27
F	15	6	21	6	21	0	0	0	0
G	4	21	25	21	25	0	0	0	0
H	9	25	34	25	34	0	0	0	0
I	9	6	15	25	34	19	19	0	19
J	9	34	43	34	43	0	0	0	0
K	20	43	63	43	63	0	0	0	0
L	8	34	42	55	63	21	21	0	21
M	20	63	83	63	83	0	0	0	0



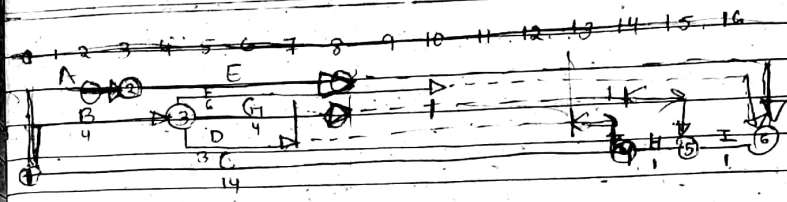
Activities	Duration	EST	EFT	LST	LFT	TF	FF	Dinkar	Indep
A	3	0	3	8	11	8	0	8	0
B	4	0	4	6	10	6	0	6	0
C	14	0	14	0	14	0	0	0	0
D	3	4	7	11	14	7	7	0	0
E	5	3	8	11	16	8	8	0	0
F	6	4	10	10	16	6	6	0	0
G	4	4	8	11	15	7	7	0	0
H	1	14	15	14	15	0	0	0	0
I	1	15	16	15	16	0	0	0	0



FF = TEJ − TEi − D

Ind F = TEJ − TLi − D

TF = TLJ − TEi − D



12/02/19

⇒ Progress is how much work per unit time.

⇒ Some activities are :-

→ As per schedule (Resources are available)

→ Behind the schedule (No adequate resources or

→ Ahead of schedule (occurs due to extra resources)

Master schedule :- On this basis of schedule, everything is planned

→ If things are allowed to happen as such, then things go out of plan.

→ After execution of some part of plan, they (planner) gain some experience and he think that some schedule need to be revised. That is called updating

→ Updating means to revise or update the plan or network after gaining some experience at site

→ Vision is required after some time (may be weekly, monthly, etc). After a regular interval,

updating is required to keep the project on plan or schedule.

→ Updating is the vision of the initial plan.

→ Different situations we come across:-

① Progress in some activities according to schedule.
② Some activities are ahead of schedule.
③ " " " behind the schedule.

Based upon progress at site, project network has to be redrawn, this process is called updating.

After execution of some part of a project, it may be possible that:-

① Estimated time may appear more or less after field knowledge.
② Planner feels after some time that there is a need to update the project.
③ ~~Data~~

Data required for updating

① Original network calculations, hence network itself.
② Stage at which updating is to be done (time/date).
③ Actual execution of work at that stage.
④ New information/knowledge which will affect the time duration of project.

Steps in updating:-

① Decide point of time at which updating is to be done.

Activity	whether completed or not		if in progress	Time required for activity yet to begin
	Yes/NO	if yes then time taken	add. time required for completion	
①	②	③	④	⑤

All this should be revised time, not the actual time.

② Record what happened actually till the updating point in tabular form.

③ Assign time of update when we have drawn.

④ Assign time of update as E1 for the start event of the project.

⑤ Allot zero time duration to all the activities which are complete.

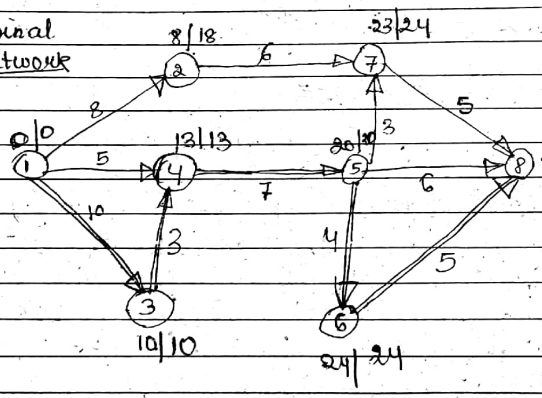
⑥ Enter revised remaining ~~revised~~ duration to those activities which are in progress.

⑦ Change duration on the basis of new knowledge of the activities which are still to be commenced.

⑧ Perform network calculation.

13/2/19 Tutorial

Original Network



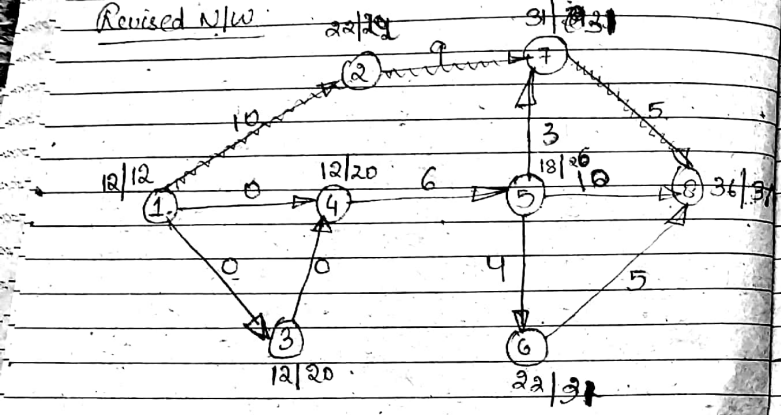
The project is to be updated at the end of 18th day.

Activity	Completed or not		Additional time required for activities in prog	Revised completion time required for activities yet to start
	Yes/No	If yes time duration		
1-2	No	—	10	
1-3	Yes	8		
1-4	Yes	5		
2-7				9
4-5	No	—	6	
5-6				4
5-7				3
5-8				10
6-8				5
7-8				5
3-4	Yes	3		

→ 1-4 was completed as originally planned.
→ 1-3 was executed more rapidly than originally schedule. It took 8 days for its completion.
→ 3-4 commenced following the completion of 1-3 as was finished at the end of 11th day
→ Activity 4-5 was commenced following the completion of activity 3-4 and require 6 more days for its completion.
→ Completion of activity 1-2 was delayed drastically and it still required 10 more days for its completion.
→ Activity 2-7 will commence following the completion of activity 1-2 & will require 9 days for its completion instead of 6 days.

→ Time required to perform activity 5-8 has been revised. It require 10 days instead of 6.
→ No other activity have been started and the original time estimate for these activity still appear to be accurate.

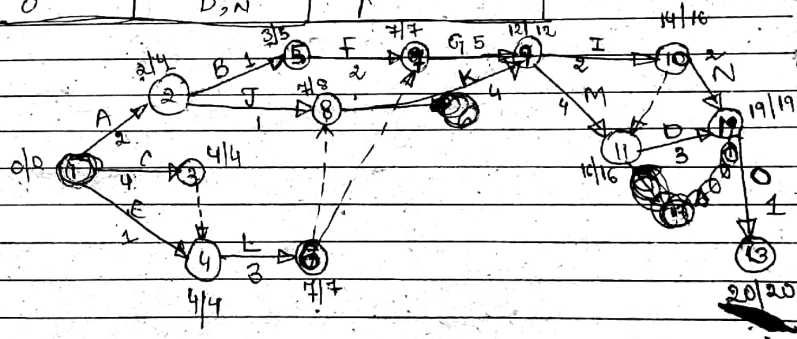
Revised N/W



→ critical path.

11/2/19

Activity	Precedent	Duration
A	—	2
B	A	1
C	—	4
D	I, M	3
E	—	1
F	B	2
G	F, L	5
I	G, K	2
J	A	1
~~I~~	~~J, H~~	~~8~~
~~J~~	~~C, E~~	
K	~~G~~ J, L	4
L	~~D~~ C, E	3
M	G, K	4
N	I	2
O	D, N	1



Activity	Duration	EST	EFT	LST	LFT	TF	FF	Inter	Indepen dent
1-2	2	0	2	2	4	2	0	2	0
1-3	4	0	4	0	4	0	0	0	0
1-4	1	0	1	3	4	3	3	0	3
2-5	1	2	3	7	5	2	0	2	0
~~2-3~~	1	2	3	~~7~~	8	5	4	1	2
~~3-4~~									
4-6	3	4	7	4	7	0	0	0	0
5-7	2	3	5	5	7	2	2	0	0
~~6-7~~									
~~6-8~~									
7-9	5	7	12	7	12	0	0	0	0
8-9	4	7	11	8	12	1	1	0	0
9-10	2	12	14	14	16	2	0	2	0
9-11	4	12	16	12	16	0	0	0	0
~~10-11~~									
10-12	2	14	16	17	19	3	3	0	1
11-12	3	16	19	16	19	0	0	0	0
12-13	1	19	20	19	20	0	0	0	0

21/02/19

Difference between CPM and PERT

CPM → Critical path method
PERT → Programme Evaluation & Review Technique

CPM	PERT
① It is activity based. (calculations)	① Event based.
② EST, EFT, LST, LFT	② T_E, T_L (Early and late occurence of an event)
③ It is used when time estimate are with fair degree of accuracy. (OR) Accurate time estimates. Deterministic time	③ When time estimates are not with fair degree of accuracy (OR). Probabilistic time estimates.
④ Here we have only 1 time, D.	④ Here we give 3 times (t_{max}, t_{min}, $t_{general}$)
⑤ Widely used technique for routine work.	⑤ Widely used for R&D type work.
⑥ Flexibility is represented in terms of float (TF, FF, IndF, IntefF).	⑥ Flexibility is represented in terms of slack. ($T_E - T_L$)
⑦ In CPM, this linear relationship b/w cost & duration doesn't exist.	⑦ In PERT, we assume that cost of project is $\propto$ to duration