

CPM calculation:-

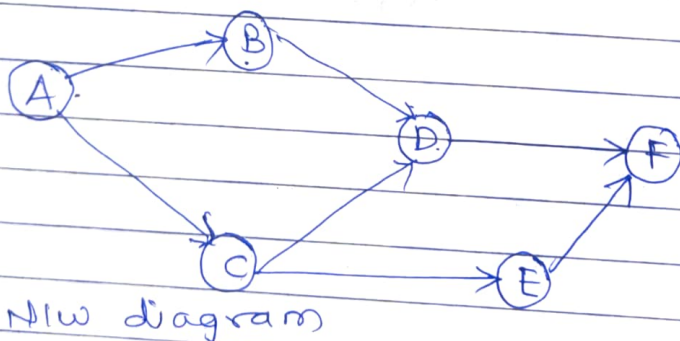
A project consists of:

Activity	Duration	Predecessors	Predecessor Duration
A	3	-	-
B	4	A	A
C	2	A	A
D	5	B, C	B, C
E	3	C	C
F	6	D, E	D, E

- Draw N/w Diagram
- Determine the Earliest start (ES), Earliest Finish (EF), Latest start (LS), Latest Finish (LF) for each activity
- Identify critical path & total project duration.

Ans:-

i) N/w diagram:-



ii)

- Earliest start = maximum EF of predecessors
- Node A: $ES(A) = 0$
- Earliest Finish = Earliest start + Duration of Act

Node A: $ES(A) = 0$ → It is zero bcz A is having no predecessor
 $EF(A) = ES(A) + \text{time durat}^n$
 $= 0 + 3 = 3$

Node B: $ES(B) = EF(A)$
 $= 3$

$EF(B) = ES(B) + \text{durat}^n$
 $= 3 + 4$
 $= 7$

Node C: $ES(C) = EF(A)$ → $EF(A)$ because A is predecessor of C
 $= 3$

$EF(C) = ES(C) + \text{time durat}^n$
 $= 3 + 2$
 $= 5$

Node D: Node D is having B & C as predecessors

$ES(D) = \max\{EF(B) \text{ or } EF(C)\}$
 $= \max\{7 \text{ or } 5\}$
 $= 7$

$EF(D) = ES(D) + \text{durat}^n$
 $= 7 + 5$
 $= 12$

Node E: ~~ES~~ $ES(E) = EF(C)$ → C is predecessor of E
 $ES(E) = 5$

$EF(E) = ES(E) + \text{durat}^n$
 $= 5 + 3$
 $= 8$

Node F: F is having D & E as predecessors

∴ $ES(F) = \max\{EF(D) \text{ or } EF(E)\}$
 $= \max\{12 \text{ or } 8\}$
 $= 12$

$EF(F) = 12 + 6$
 $= 18$

Forward Pass Table (Earliest start & Earliest Finish)

Activity	Duration (days)	Predecessors	ES	EF
A	3	-	0	3
B	4	A	3	7
C	2	A	3	5
D	5	B, C	7	12
E	3	C	5	8
F	6	D, E	12	18

* Latest Finish & Latest Start (Backward Pass):-

Latest Finish:- minimum LS of all successor activities

Latest start: $LF - \text{Duration}$

In Backward Pass we will start with last Node i.e. F.

Node 'F':- F is the final activity.

$$\text{So, } LF(F) = EF(F)$$

$$= 18$$

$$LS(F) = LF(F) - \text{duration}$$

$$= 18 - 6$$

$$= 12$$

Node 'E':- E is having F as successor.

$$\text{So, } LF(E) = LS(F)$$

$$= 12$$

$$LS(E) = LF(E) - \text{duration}$$

$$= 12 - 3 = 9$$

Node 'D': D is having F as successor

$$LF(D) = LS(F)$$

$$= 12$$

$$LS(D) = LF(D) - \text{duration}$$

$$= 12 - 5$$

$$= 7$$

Node 'c':- C is having D & E as successors

$$\therefore LF(C) = \min \{ LS(E) \text{ or } LS(D) \}$$

$$= \min \{ 9 \text{ or } 7 \}$$

$$= 7$$

$$LS(C) = 7 - 2$$

$$= 5$$

Node 'B':- B is having D as successor

$$\therefore LF(B) = LS(D)$$

$$= 7$$

$$LS(B) = LF(B) - \text{duration}$$

$$= 7 - 4$$

$$= 3$$

Node 'A':- A is having B & C as predecessors

$$LF(A) = \min \{ LS(B) \text{ or } LS(C) \}$$

$$= \min \{ 3 \text{ or } 5 \}$$

$$= 3$$

$$LS(A) = 3 - 3$$

$$= 0$$

Backward Pass Table

Activity	Duration (days)	Predecessor	ES LS	EF LF
A	3	-	0 3	3 7
B	4	A	3	7
C	2	A	5	7
D	5	B, C	7	12
E	3	C	9	12
F	6	D, E	12	18

iii) Critical Path Identification:-
Critical Path = Longest path in the NTW

Path 1:-

$A \rightarrow B \rightarrow D \rightarrow F$

$$3 + 4 + 5 + 6 = 18 \text{ days}$$

Path 2:-

$A \rightarrow C \rightarrow D \rightarrow F$

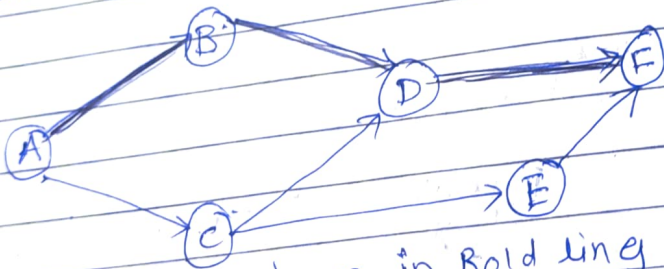
$$3 + 2 + 5 + 6 = 16 \text{ days}$$

Path 3:-

$A \rightarrow C \rightarrow E \rightarrow F$

$$3 + 2 + 3 + 6 = 12 \text{ days}$$

So, $A \rightarrow B \rightarrow D \rightarrow F$ is the critical path with possible duration of 18 days.



critical path shown in Bold line

Total Project Duration:- 18 days (Determined by critical path: $A \rightarrow B \rightarrow D \rightarrow F$)

Float calculation in CPM:
(Slack)

Float or slack is the amount of time by which activity gets delayed without affecting project time duration.

* ~~Gantt Chart~~:-

* ~~Float (Slack)~~ = $LF - EF$ or $LS - ES$

Activity	Total slack/float
A	0
B	0
C	2
D	0
E	4
F	0.

Activities A, B, D & F have 0 slack which means they are critical.

Activities C & E have float (slack) of 2 & 4 days, which means they can be delayed by up to 2 days or 4 days without affecting the total project duration.