

## **Unit III: Project Management using Network Analysis**

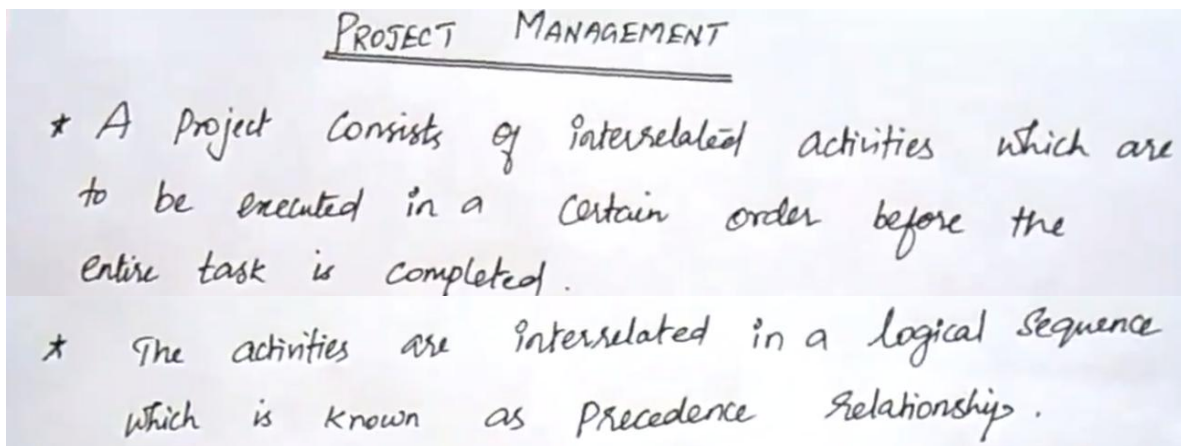
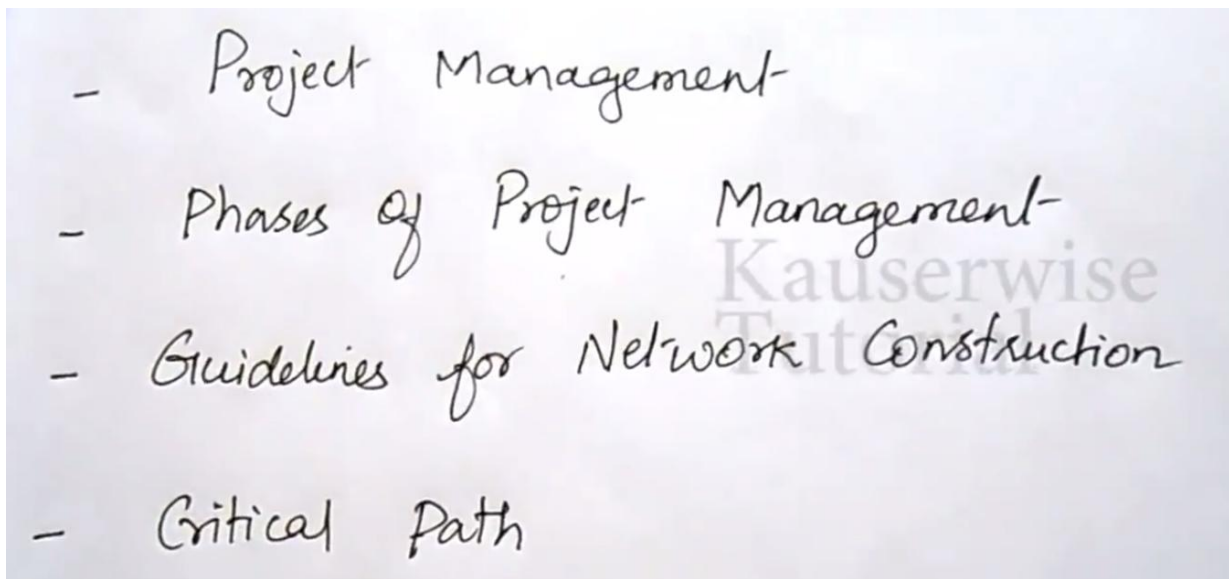
- A **project** is a temporary endeavor designed to produce a unique product, service or result with a defined beginning and end (usually time-constrained, and often constrained by funding or staffing) undertaken to meet unique goals and objectives, typically to bring about beneficial change or added value.
- **Project management** is the practice of initiating, planning, executing, controlling, and closing the work of a team to achieve specific goals and meet specific success criteria at the specified time.
- The **primary challenge** of project management is to achieve all of the project goals within the given constraints. This information is usually described in project documentation, created at the beginning of the development process.
- The primary constraints are **scope, time, quality and budget**.
- The secondary & more ambitious challenge is to **optimize** the allocation of necessary inputs and apply them to meet pre-defined objectives.
- **Successful projects** are completed on schedule, within budget, and according to previously agreed quality standards
- A 2017 study suggested that the success of any project depends on how well four key aspects are aligned with the contextual dynamics affecting the project, these are referred to as the four P's:
  1. **Plan:** The planning and forecasting activities.
  2. **Process:** The overall approach to all activities and project governance.
  3. **People:** Including dynamics of how they collaborate and communicate.
  4. **Power:** Lines of authority, decision-makers, organograms, policies for implementation and the like.

## Techniques used:

- Critical Path Method (CPM)
- Project Evaluation and Review Technique (PERT)

## Critical Path Method (CPM)

- Construction of CPM network
- Finding critical path and project completion time
- Computation of free floats and total floats for non critical activities



\* Project is represented in the form of a network for the purpose of analytical treatment to get solutions for scheduling and controlling its activities.

### Techniques

I CPM - Critical path method

II PERT - Project Evaluation and Review technique

### PHASES OF PROJECT MANAGEMENT :-

#### 1) Planning :-

- Dividing the project into distinct activities.
- Estimating time requirement for each activity.
- Establishing Precedence Relationships among the activities.
- Construction of the arrow diagram (network)

#### 2) Scheduling :-

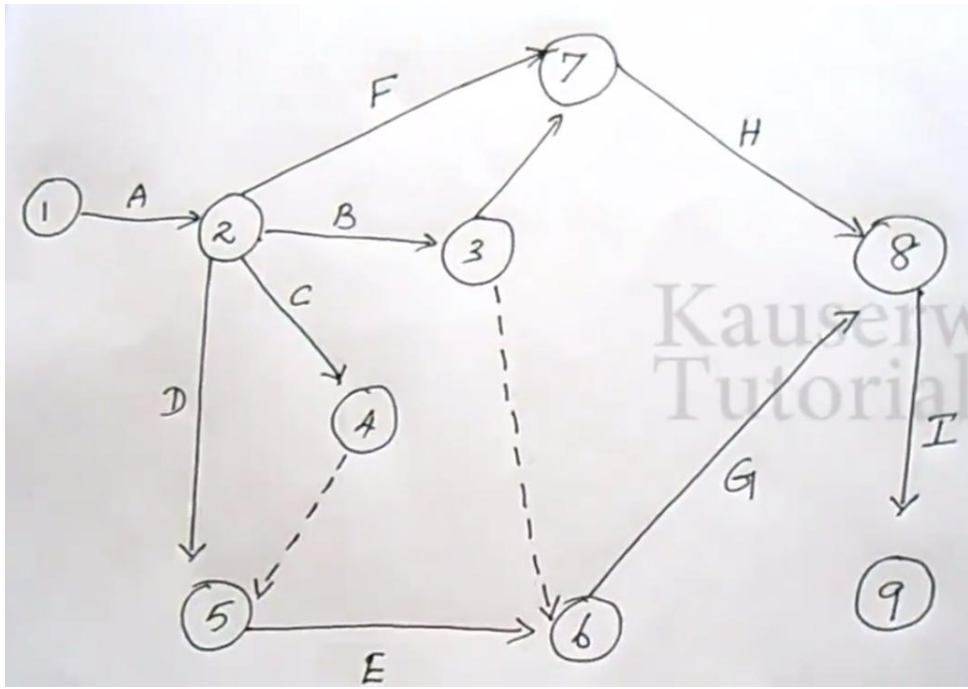
- determines the start and end time of each and every activity.

### 3) Controlling :-

- Uses the arrow diagram and time chart for continuous monitoring and progress reporting.

### GUIDELINES FOR NETWORK CONSTRUCTION :-

1. The starting event and ending event of an activity are called tail event and head event, respectively.
2. The network should have a unique starting node (tail event)
3. The network should have a unique completion node (head event)
4. No activity should be represented by more than one arc in the network
5. No two activities should have the same starting node and the same ending node.
6. Dummy activity is an imaginary activity indicating precedence relationship only. Duration of a dummy activity is zero.

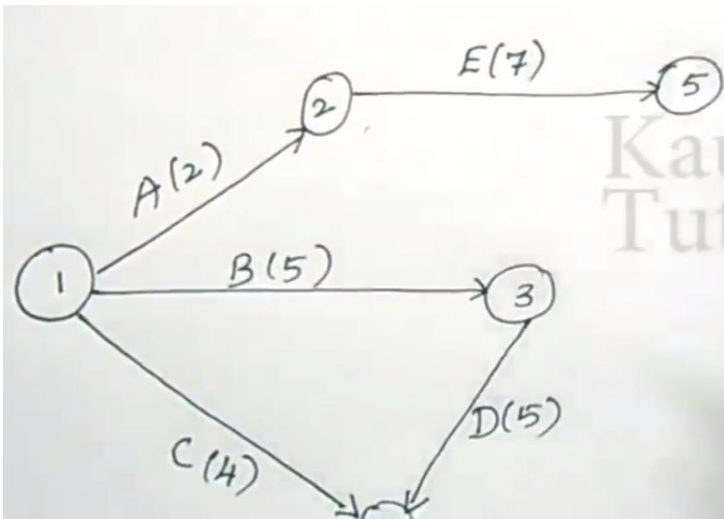
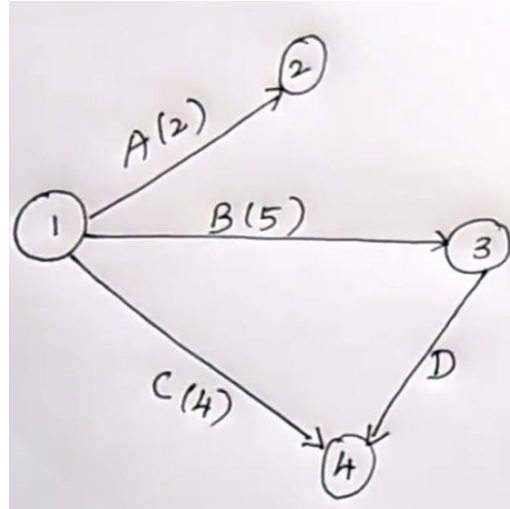
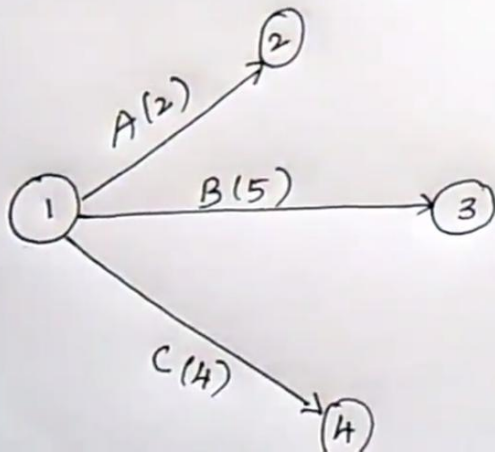


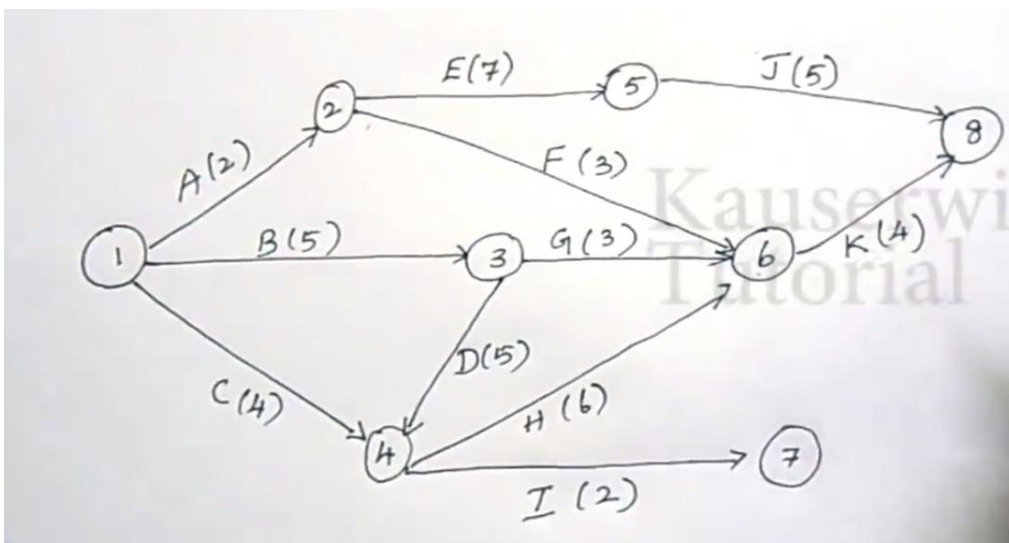
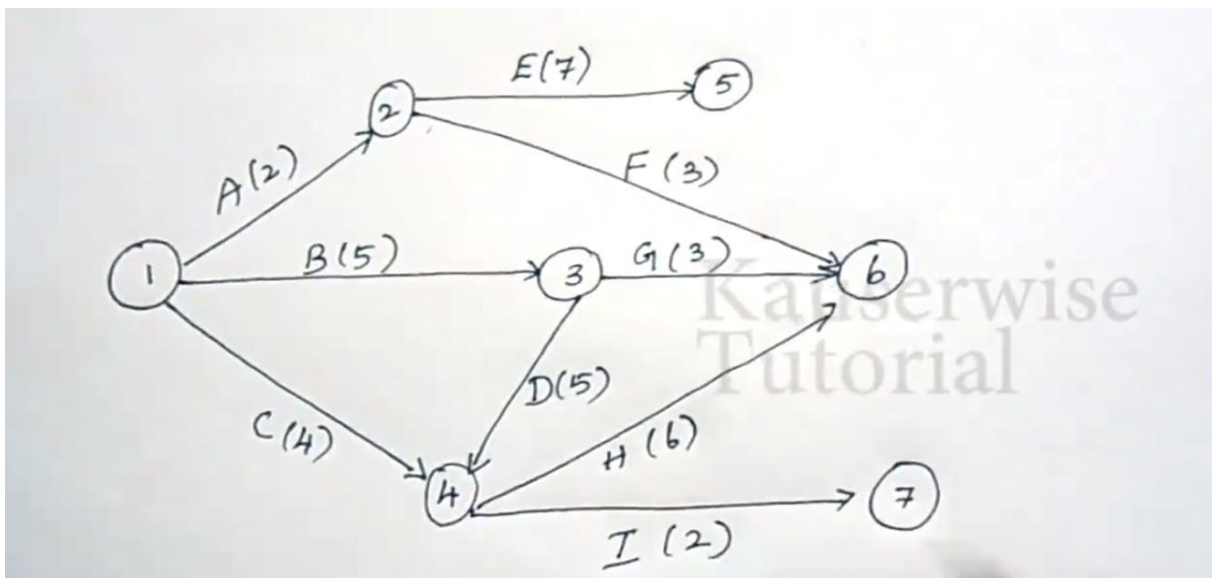
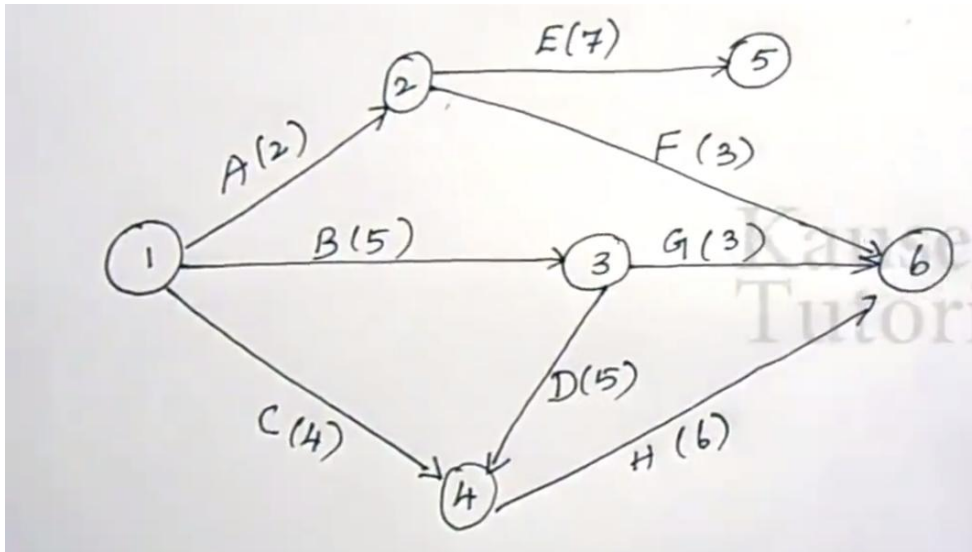
Consider the details of a project as shown in the table.

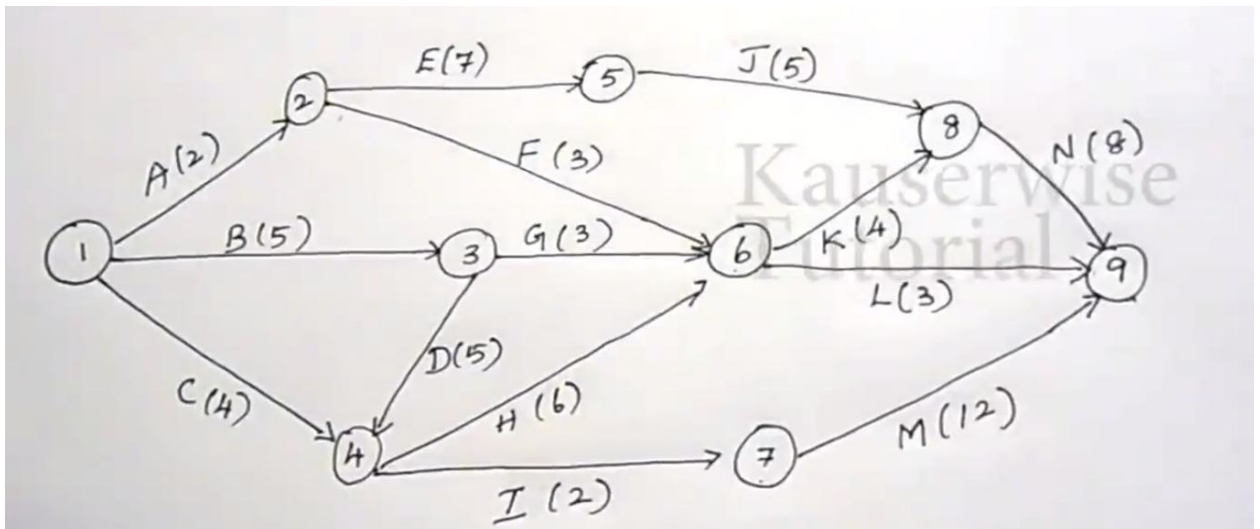
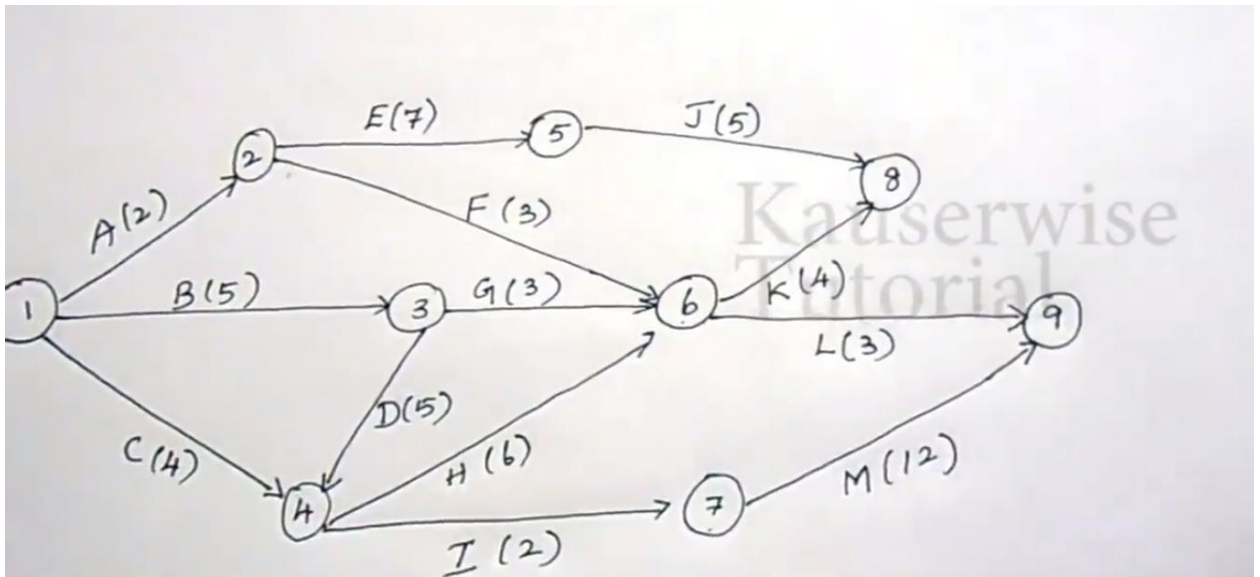
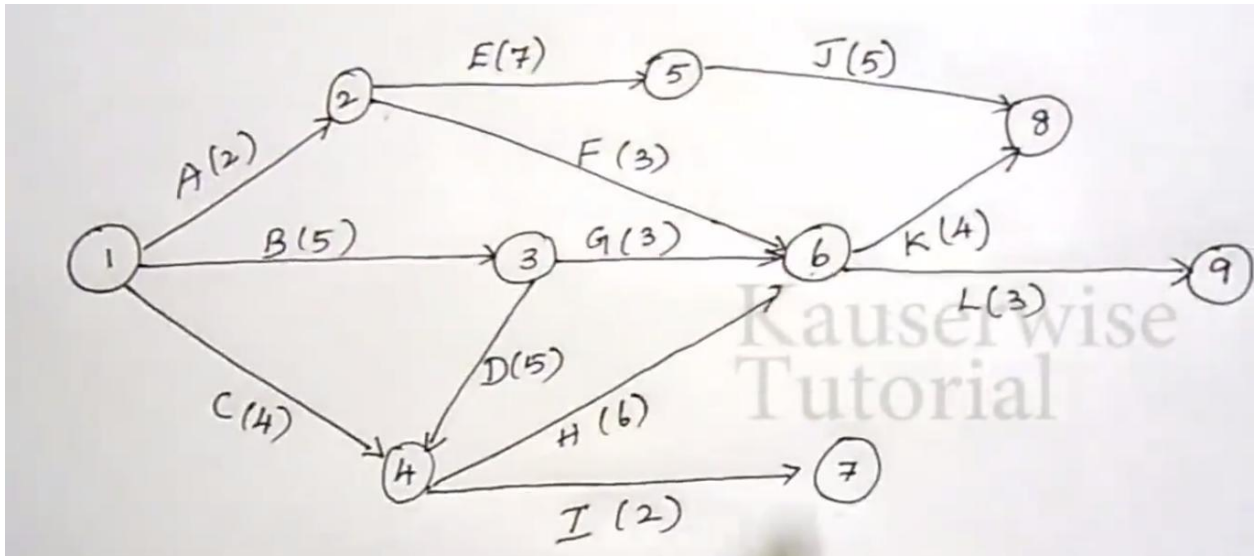
Activity	Immediate Predecessor(s)	Duration (Months)
A	-	2
B	-	5
C	-	4
D	B	5
E	A	7
F	A	3
G	B	3
H	C, D	6
I	C, D	2
J	E	5
K	F, G, H	4
L	F, G, H	3
M	I	3
N	J, K	12

- Construct the CPM network.
- Determine the Critical path and Project Completion time.
- Compute total floats and free floats for non-critical activities.

a) The CPM network







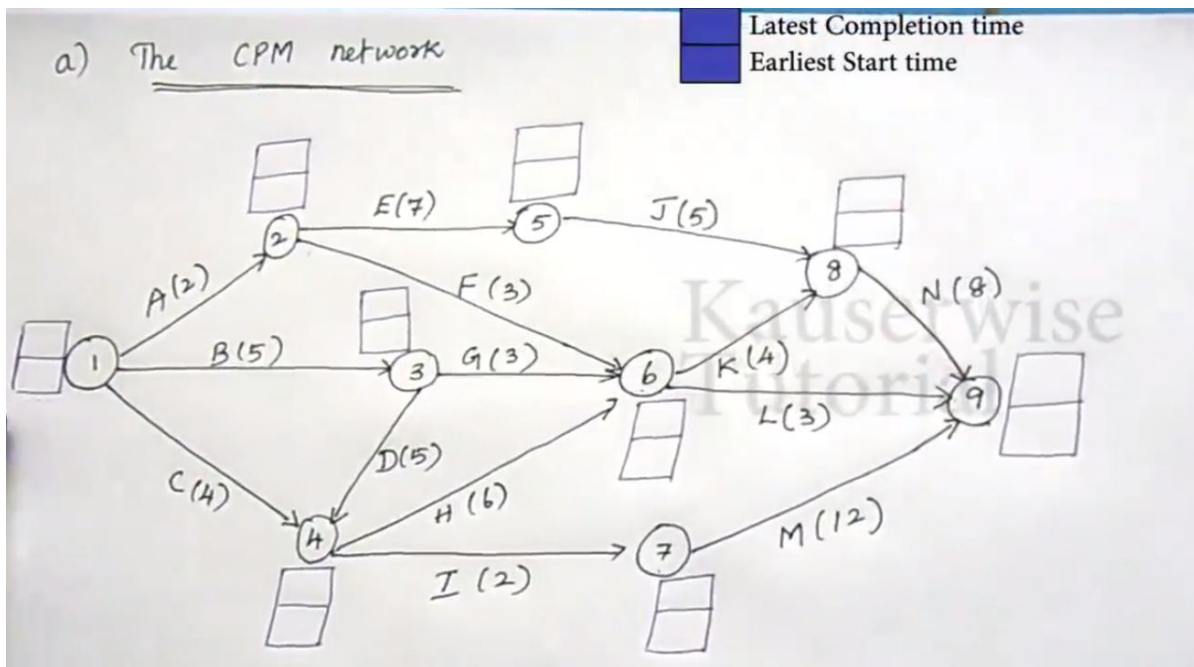
## CRITICAL PATH

The Critical Path of a project network is the longest path in the network.

This can be identified by simply listing out all the possible paths from the Start node of the project to the end node of the project and then selecting the path with the maximum sum of activity times on that path.

Two Phases :

- i) Determines earliest start times (ES) of all the nodes. This is called forward pass.
- ii) Determines latest completion times (LC) of various nodes. This is called backward pass.



Determination of earliest start times ( $ES_j$ )

i = Starting Activity  
j = Ending Activity

$$ES_j = \text{Max}_i (ES_i + D_{ij})$$

For Node 1  $ES_1 = 0$

Node 2  $0 + 2 = 2$

Node 3  $0 + 5 = 5$

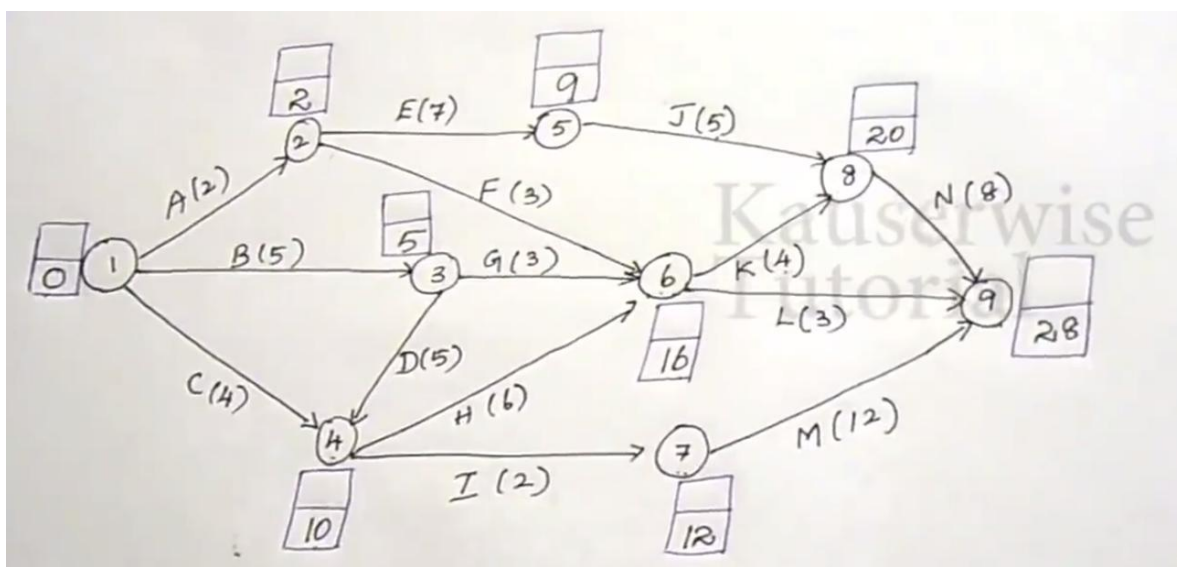
Node 6

$$2 + 3 = 5$$

$$5 + 3 = 8$$

$$10 + 6 = 16 \checkmark$$

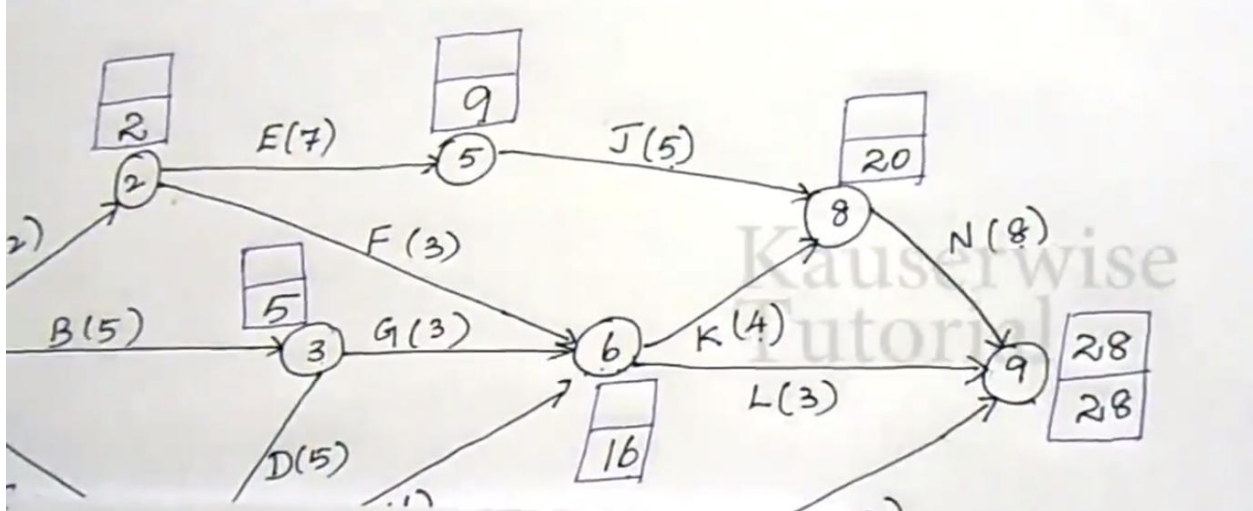
Earliest Start Times



## Determination of Latest Completion times ( $LC_i$ )

$$LC_i = \min_j (LC_j - D_{ij})$$

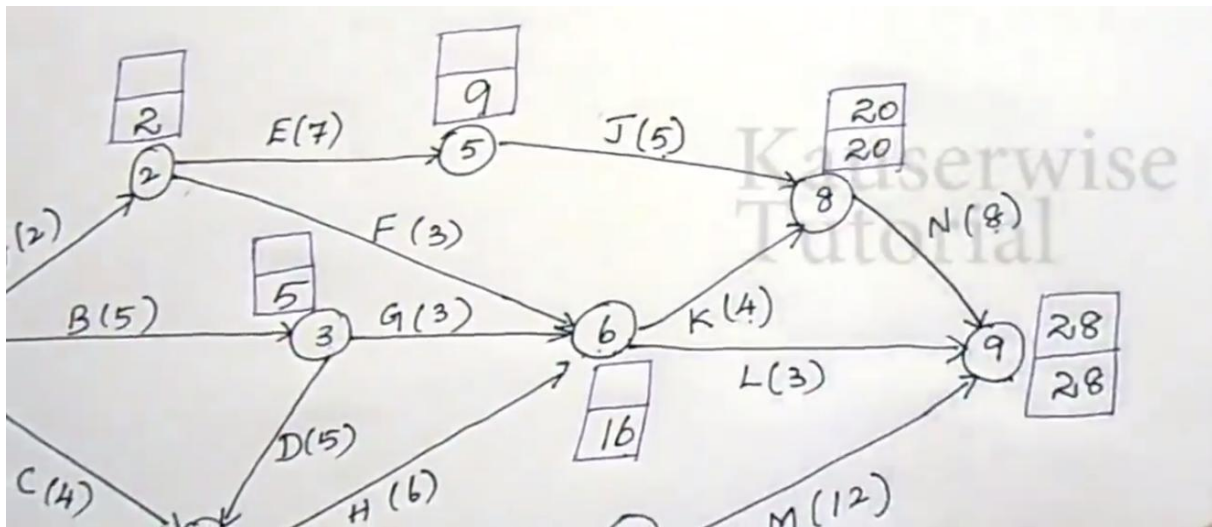
Latest Completion Time for the last node is always the earliest start time

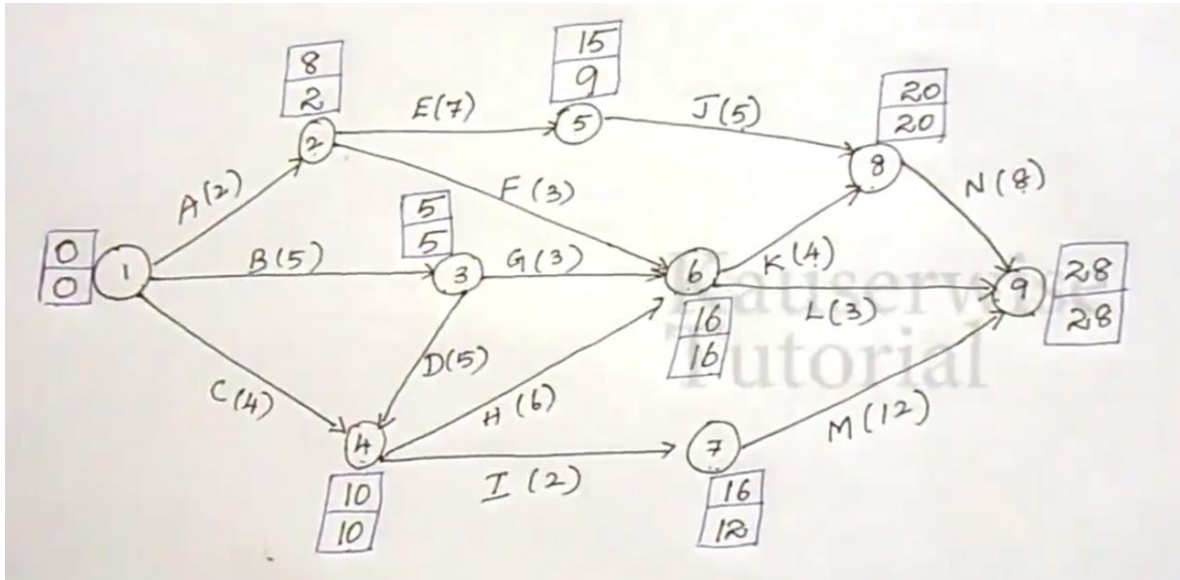


$$LC_i = \min_j (LC_j - D_{ij})$$

$$\text{Node 8} = LC_9 - D_{8,9}$$

$$= 28 - 8 = 20$$





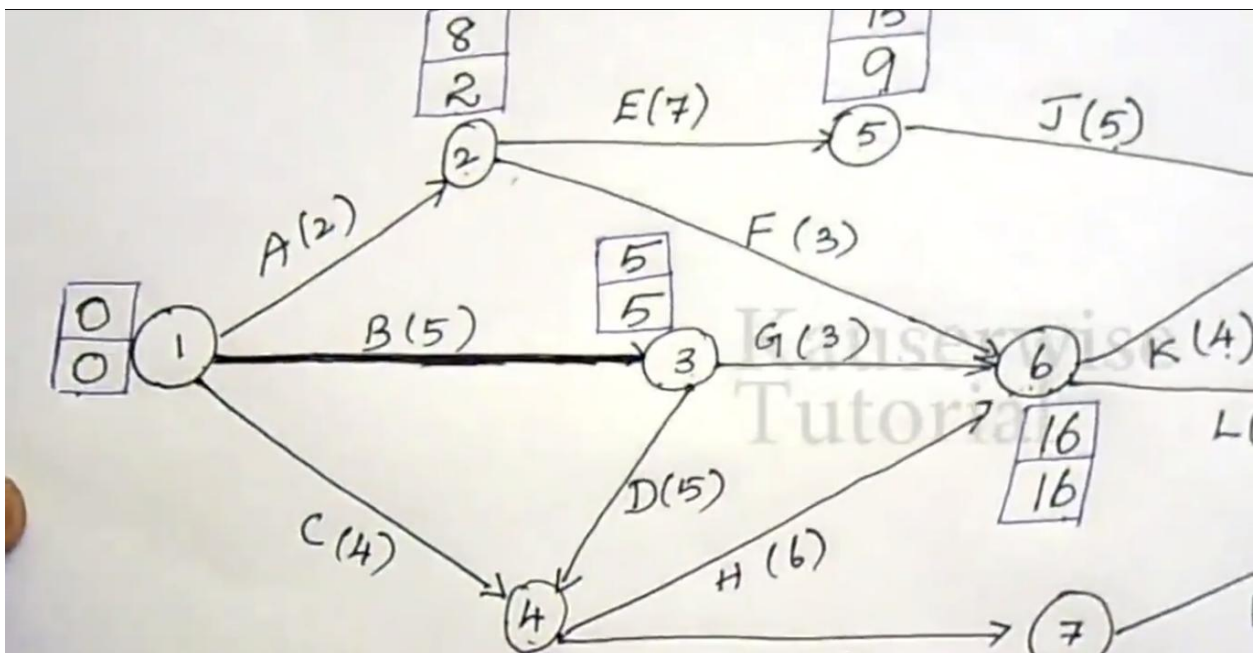
Conditions for Critical Path :-

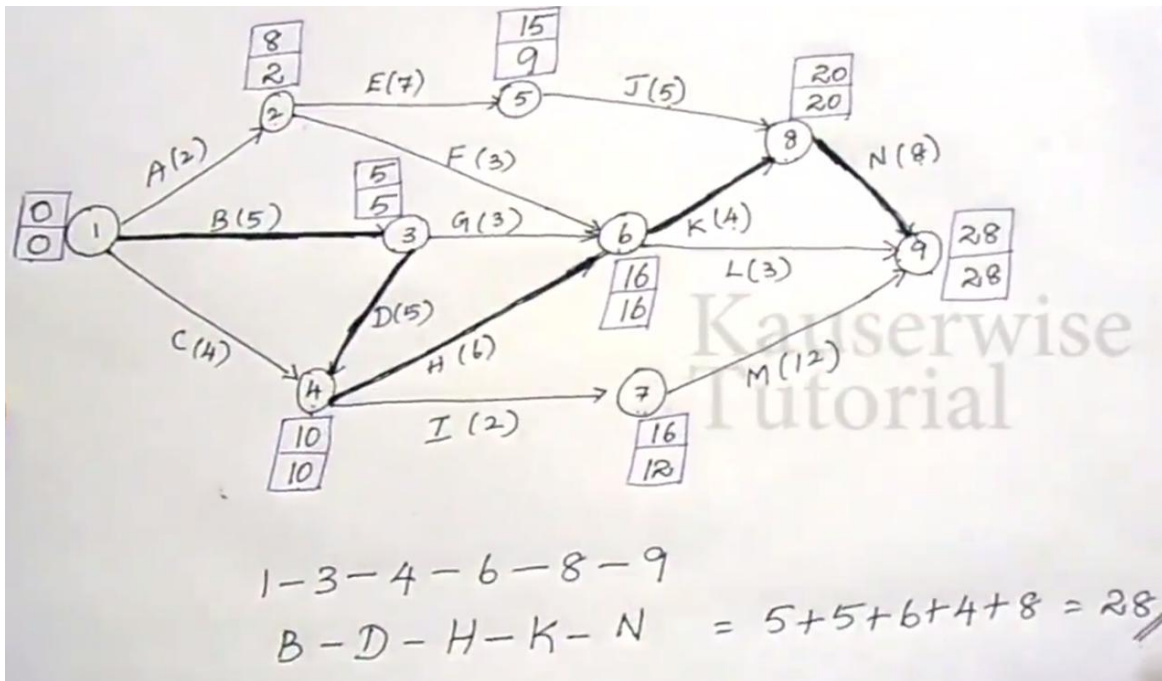
$$ES_i = LC_i$$

$$ES_j = LC_j$$

$$ES_j - ES_i = LC_j - LC_i = D_{ij}$$

Kauserwi  
Tutorial





Total Floats :

It is the amount of time that the completion time of an activity can be delayed without affecting the project completion time.

$$TF_{ij} = LC_j - ES_i - D_{ij}$$

Total float

$$LC_j - ES_i - D_{ij}$$

$$A \quad 1-2 \Rightarrow 8 - 0 - 2 = 6$$

$$B \quad 1-3 \Rightarrow 5 - 0 - 5 = 0$$

### Free floats :-

It is the amount of time that the activity completion time can be delayed without affecting the earliest start time of immediate successor activities in the network.

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

$$A \ 1-2 \Rightarrow 2 - 0 - 2 = 0$$

$$B \ 1-3 \Rightarrow 5 - 0 - 5 = 0$$

### Summary of Total Floats and Free Floats

Activity (i,j)	Duration (D <sub>ij</sub> )	Total float (TF <sub>ij</sub> )	Free floats (FF <sub>ij</sub> )
A 1-2	2	6	0
B 1-3	5	0	0
C 1-4	4	6	6
D 3-4	5	0	0
E 2-5	7	6	0
F 2-6	3	11	11
G 3-6	3	8	8
H 4-6	6	0	0

I	4-7	2	4	0
J	5-8	5	6	6
K	6-8	4	0	0
L	6-9	3	9	9
M	7-9	12	4	4
N	8-9	8	0	0

Any critical activity will have Zero total float and Zero free float, based on this property we can determine critical activities.

Critical Activities

B-D-H-K-N

