GEPM 375

Project Planning and Construction Management

CPM Network

Application of CPM Network:

- Used/suitable for **repetitive** of project.

- For those projects for which **fairly accurate estimation of time for completion** of each activity can be made.

- For which **cost estimation** **can be made with fair degree of accuracy.**

- **Not suitable** for research and development project.

- Plays an **important role** in planning, scheduling and controlling of the projects.

Difference between CPM and PERT

- **Time estimation**:
  -**CMP**: with fair degree of accuracy.
  -**PERT**: Not so accurate and definite

- **Cost and Time**:
  -**CPM**: Cost is directly controlling factor.
  -**PERT**: Time is controlling factor.

CPM -**Optimization of cost** is given prime importance.
-**Time duration** for completion of the project depends on cost optimization.

PERT - Assumed that **cost varies with time**.
- Attention given so that **minimum cost results.**

Difference between CPM and PERT

Critical Path:

- **CPM**: Critical path is determined on **activity oriented float philosophy**.

F_T = **LST** – EST or **EFT** –LFT

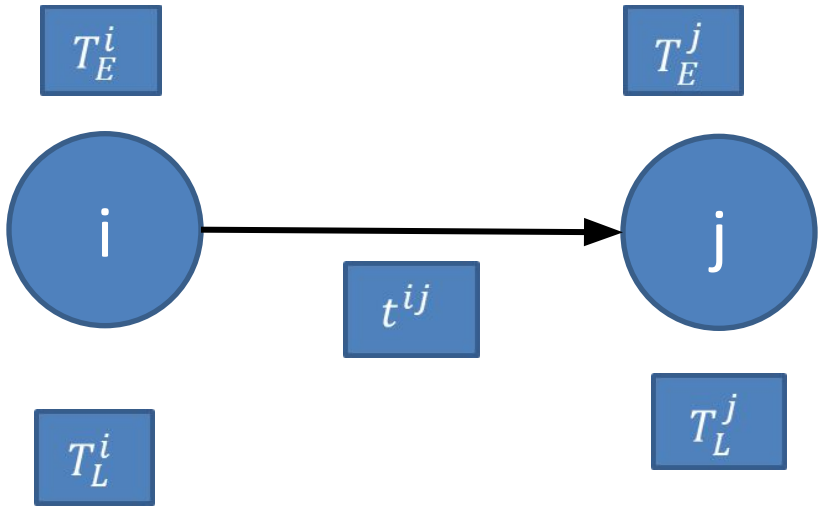
LST= Latest start time

$T_L^i = T_L^j - t^{ij}$ or $(T_L^j - t^{ij})_{min}$

EFT=Earliest Finish Time

$T_E^j = T_E^i + t^{ij}$ **or**

$= (T_E^i + t^{ij})_{max}$



Difference between CPM and PERT

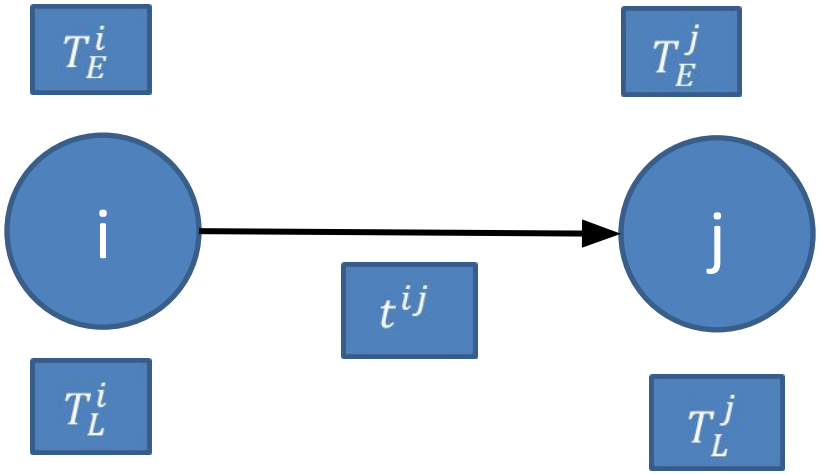
Critical Path:

- **CPM**: Critical path is determined on **activity oriented float philosophy**.

$$F_T = \text{LST} - \text{EST or EFT} - \text{LFT}$$

EST= Earliest start time=T_E^i

LFT=Latest Finish Time=T_L^j



Network

T_E^i=Earliest occurrence time for tail event.

T_E^j=Earliest occurrence time for Head event

$$T_E^j = T_E^i + t^{ij} \text{ or } = (T_E^i + t^{ij})_{max}$$

T_L^i=Latest Event Time for predecessor event

T_L^j=Latest Event Time for successor event

$$T_L^i = T_L^j - t^{ij} \text{ or } (T_L^j - t^{ij})_{min}$$

Float= $T_L^i - T_E^i$

- Difference between the **earliest event time** and **latest event occurrence time.**
- Range within which an activity start time or its finish time may fluctuate without affecting the completion of the project.

Difference between CPM and PERT

PERT: Critical path is determined on **event oriented slack philosophy.**

$$S = T_L - T_E$$

T_E=**Earliest Expected Time** –time when an event can expected to offer.

T_L = **Latest Allowable Occurrence Time** –Latest time by which an event must occur, to keep the project on schedule.

T_S=Completion time of the project/Scheduled completion /Contractual obligation time.

$T_S = T_L$, latest time of the last event

CPM Process

CPM process has several applications in project management:

- Planning,
- Scheduling and
- Controlling

Planning:

- **Logical sequence** in which the jobs/activities is **formalized**.
- Logic to **be reviewed** for corrections.
- Ascertain that **all activities** are shown.
- **Resources** required for performing each activity/jobs are applied.

CPM Process

Scheduling:

- **Mechanical process** of **formalizing the planned functions.**
- **Assigning the start and completion dates to each part** (or activity) of the project.
- So that project **proceeds in a logical sequence**, **in orderly** and **systematic manner.**

Controlling:

- Process in which the **differences or deviations between the plan and the actual performances are reviewed.**
- **Analysis and corrections form t**he basic aspects of controlling.
- **Re-planning and rescheduling** is done to compensate the deviations.

Steps of CPM process

- **Describe projects** in terms of **dependencies among activities**.

- **Determine** the **schedule** of the activities.

- **Predict** those **activities which control significant target dates** of the project.

- **Analyze** the **schedule developed**.

- **Re-plan** the project **if analyses so indicate.**

- **Allocate or make**: **resources to project** in an efficient manner for the schedule developed.
- Schedule changes are required **by resource limitations**.

- **Develop time-cost relationship** for activities and **optimize the total project cost by selecting suitable project duration**.

CMP Networks

What is CPM Networks?

- **Activity** oriented network.
- Arrows representing activities are **labeled with some description** of the activities.

Activities: Operations which **take time** to carryout and on which **resources are expended** to achieved the desirables.

Event: is a **point in time**, a milestone representing the **beginning or the completion of some activity** or group of activities.

- When project falls behind the schedule, it is the **critical activities** which need managerial attentions.

CPM Network

Process of Drawing CPM Network:

- **Listing the activities** of the projects.

- **Placement of activity arrows** with respect to other activities is done by answering **THREE questions**:

✔ What activity/activities **must immediately precede** this activity?
✔ What activity/activities **can not be started** until after completion of this activity?
✔ What activity/activities can be **performed concurrently** with this activity?

- **Drawing the network by answering these three questions.**

- **Interdependencie**s can be represented **by suitable use of dummies.**

CPM Network

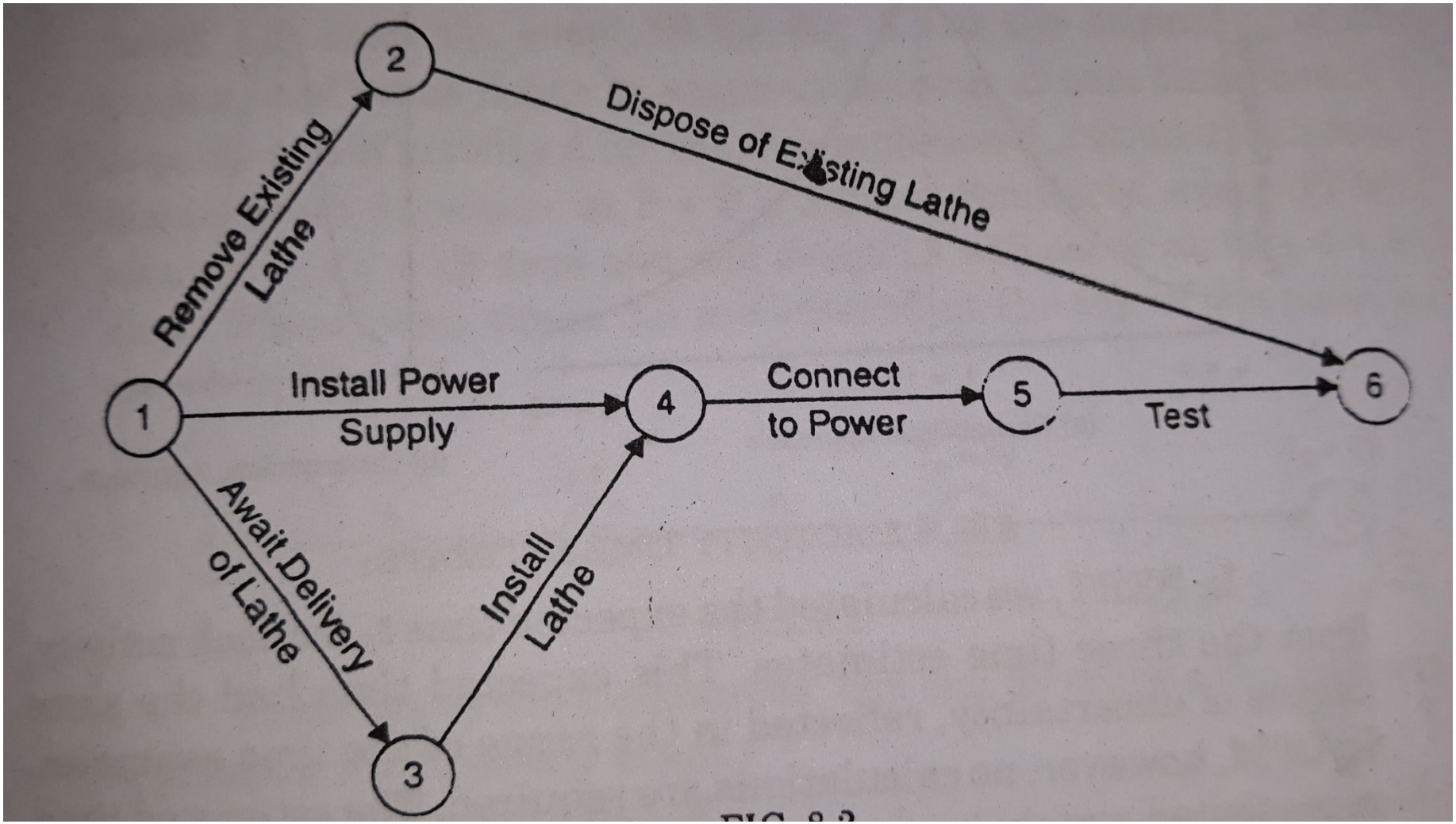
Example: Project of 'Purchasing a new heavy duty lathe and disposing the old lathe'.

Solution:

Project consists of following activities:

- Await delivery of lathe.
- Remove existing lathe.
- Install power supply.
- Install the new lathe.
- Connect power supply.
- Conduct test.
- Dispose of existing lathe.

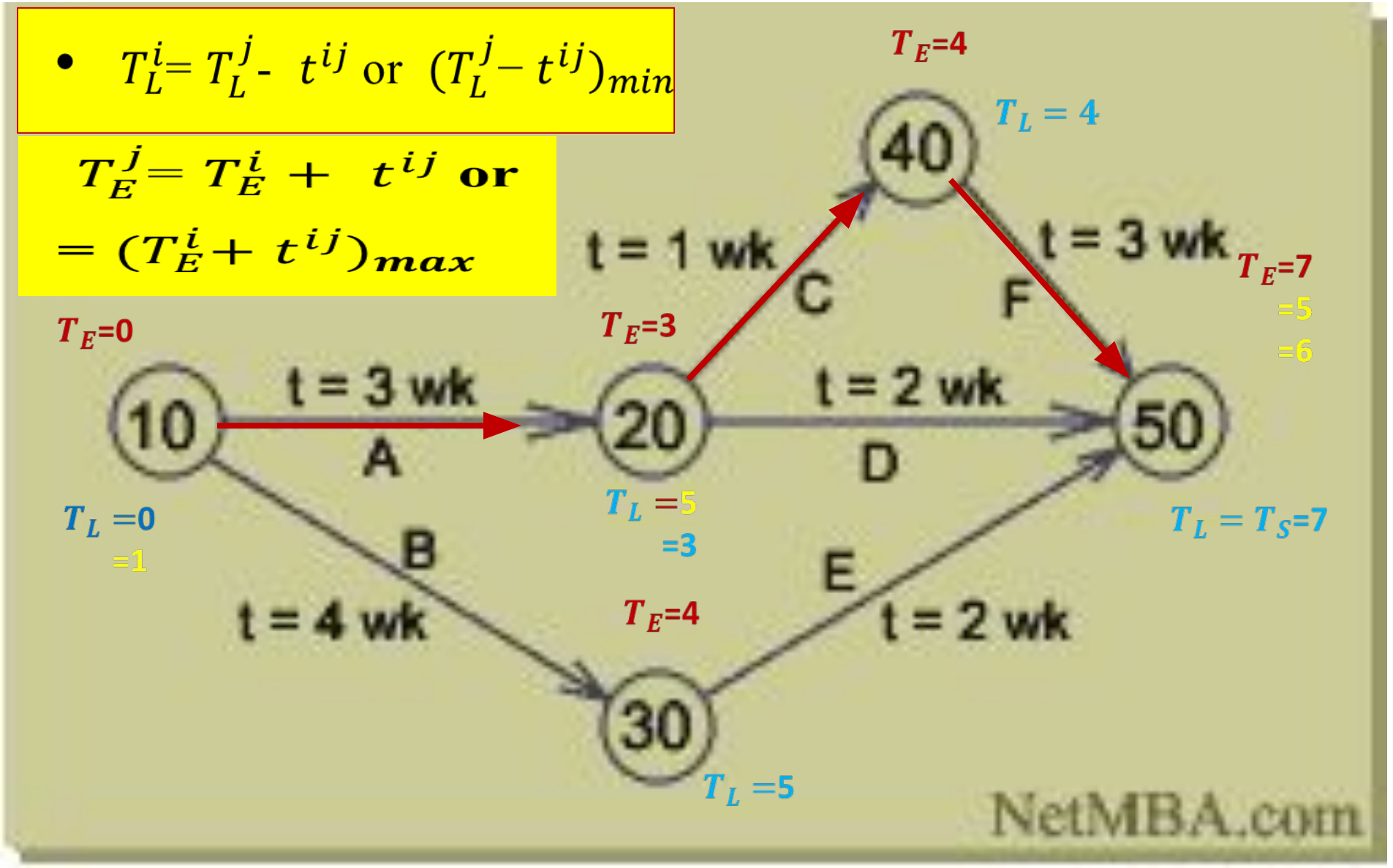
Network of the Project



- $T_L^i = T_L^j - t^{ij}$ or $(T_L^j - t^{ij})_{min}$

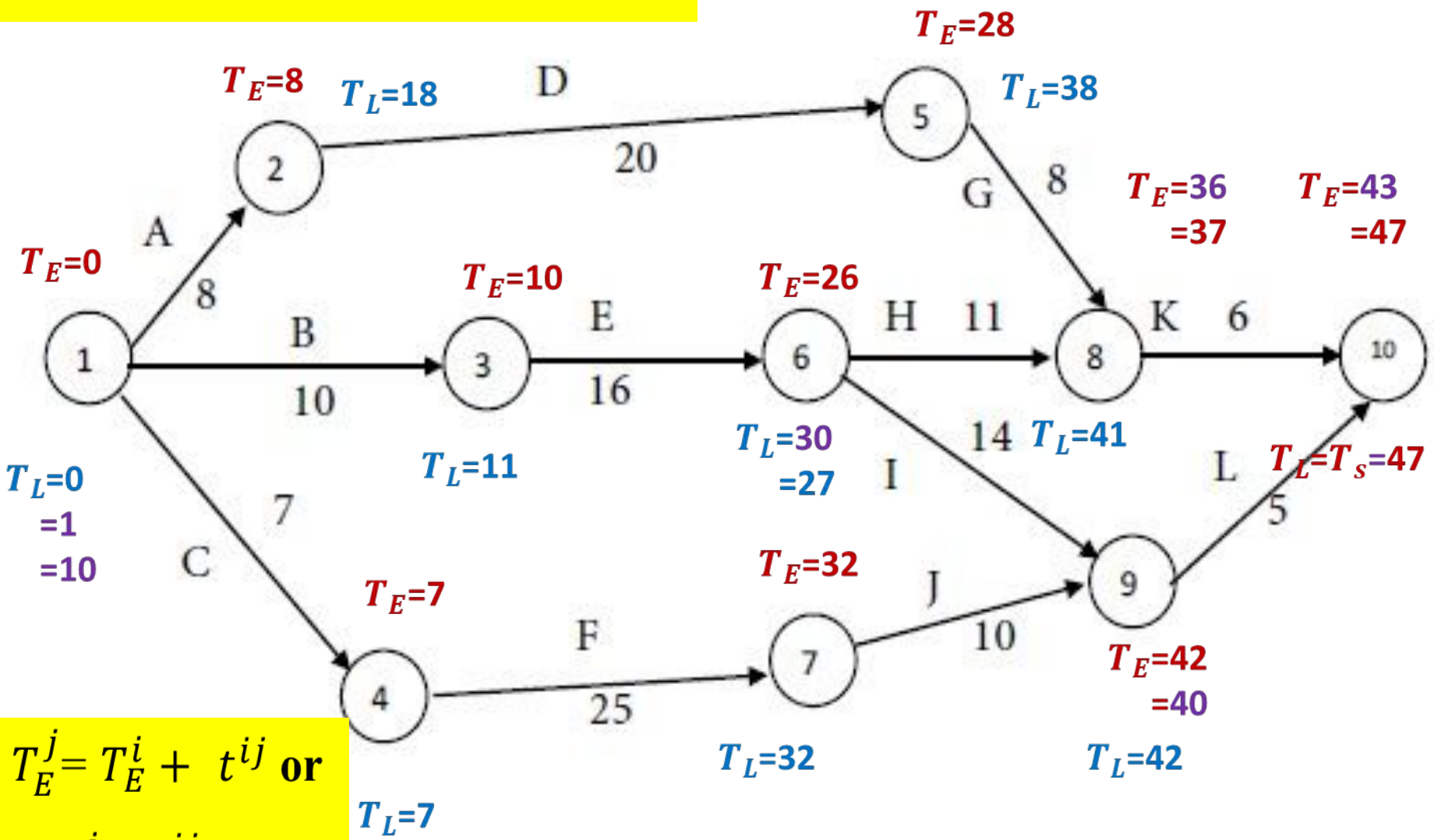
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CPM Network of the Project

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$= (T_E^i + t^{ij})_{max}$

CPM Network

Critical Activity and Critical Path:

Total float is the **difference** between maximum available time and the activity duration.

There are three possibilities:

- May have **Negative** value, if time availability is less than activity duration.
- May have **Zero value**, time availability is equal to the activity duration.
- May have a **Positive** value, availability exceeds the activity duration.

CPM Network

Degree of total float is very useful as regards the criticality of the activity:

- **Super critical Activity**: Float activity is –ve. Activity demands special attention and action.
- **Critical activity**: Float is zero. Activity demands above normal attention, with no freedom of action.
- **Sub Critical Activity**: Float is +ve. Demand normal attention, but allowing some freedom action.

CPM Network

Critical Path:

- The **longest path** through the network and **time along** this path gives the project duration.

- Joins **those activities** which are critical.

- Determined by the **total float** calculations.

- Activities on the critical path are those activities that have total float equal to zero.

- Activities that control the project duration are the ones that have zero total float; form the continuous chain or path starting at first node and ending with last node.

Thanks