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PERT & CPM

- (1) Project Management
- *** (2) Fundamental of Network
- *** (3) PERT and
- *** (4) CPM
- ** (5) Crashing
- (6) Resource allocation and Updating
- (7) Engineering Economy
- (8) Construction Equipment.
- (9) A-O-N Diagram.

weightage

ESE

Prelims → 7-8 questions.

Mains → 40 to 50 marks.

GATE → 2 to 3 marks.

① Project Management

Project ⇒ • Project is a temporary ~~hard~~ endeavour undertaken to provide a unique product, service or result. Any work which we do is termed as project. product

project → मीस अत मीस
like ४ टाई
like launch a new product

• A project involves a series of activities that which consume resources and time to achieve a specific goal. To execute the project, resources are required. ⇒ (1) manpower (2) machine (equipment), (3) Money (4) Material (5) Time.

Objective of Project ⇒ • Project should be completed in optimum amount of time.

- Project should use local resources and man power as far as possible.
- Project should finish without delay with minimum investment cost.

Project Management (PM) ⇒ • It is application of knowledge, skills, tools and techniques to meet the requirement of project.

- Measurement of risk impacts.
 - Risk identification, costs, levels and security.
 - Project WBS verification and the relevance.
- PM synchronize technology with the manpower.

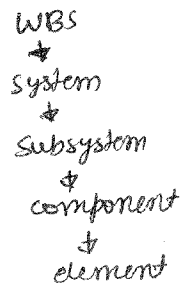
Elements of PM ⇒ (1) Planning ⇒ • It is most important technique of PM.

Planning
Scheduling
controlling

* Planning means defining objectives of project and to identify different task and resources required for timely completion of project.

• In planning phase, a plan is made along with work breakdown structure (WBS) and organisational breakdown structure (OBS).

- * OBS was given by F.W Taylor.
- WBS and OBS identifies activities to be done to achieve project goal as well as responsibilities of project management team.



⇒ Every project has three basic objective :

- Project should be completed in least time.
- " " " " cost.
- Project " " " by optimum use of resources that are available.

(2) Scheduling : \Rightarrow • It is the process of ^{arranging} fixing order of all the activities and allocation of resources to these activities.

* Scheduling gives clear idea regarding the requirement of resources at different stages of work (Planning & scheduling \rightarrow कर्म के फ़ील्ड में शामिल होना शुरू कर देना)

(3) Controlling : \Rightarrow • It is the process perform to observed project execution such that potential problems can be identified and necessary action can be taken if required.

✓ It involves execution of planning & scheduling.

Note : \Rightarrow • Planning and scheduling are done before the execution of project whereas controlling is done during the execution of project. If there is any deviation from plan, it also includes rescheduling.
[CPM & PERT \rightarrow tool of scheduling]

(4) Directing : \Rightarrow • It is function of project leader to give instructions to subordinates to supervise their work and to respond to reports of subordinates.

Higher authority \rightarrow directing
same level of authority \rightarrow co-ordinating

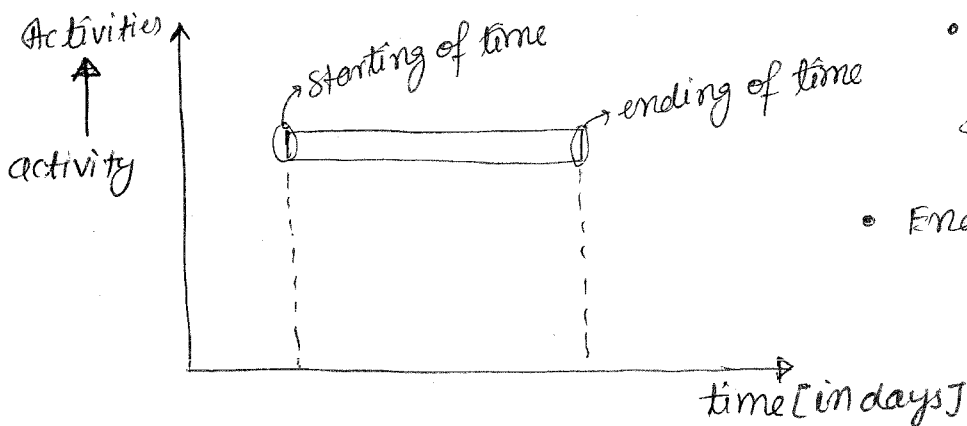
(5) Co-ordinating : \Rightarrow • It is process of interaction b/w various departments.

Methods of Scheduling : \Rightarrow (1) Bar chart : \Rightarrow • Bar chart was introduced by

* Henry Gantt around 1900 A.D. Hence it is also called as Gantt chart.

* It is a graphical representation b/w activity and time.

* Activities are shown with the help of bars.

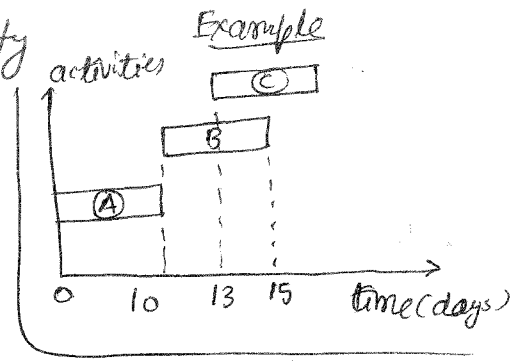


• Beginning of bar
 \downarrow
starting time of that activity.

• Ending of bar \rightarrow finishing time of that activity.

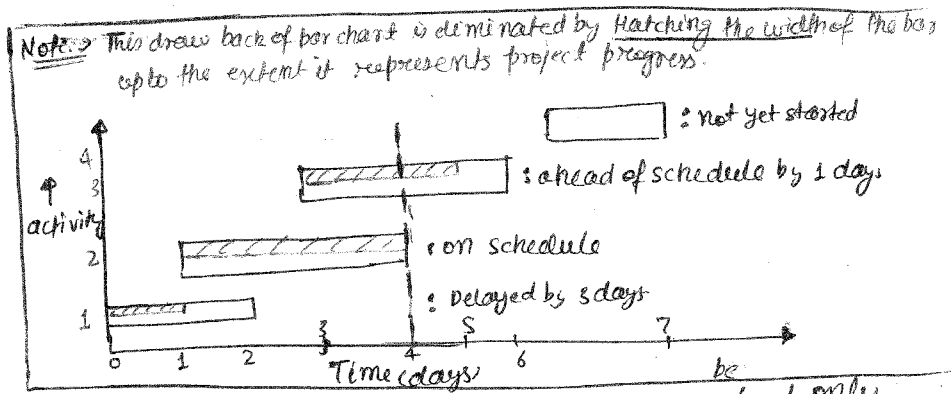
• length of bar \rightarrow duration of that activity

Ques For a certain project, certain activities are to be performed which are as given below



Activities No. Duration (weeks)

1	-----	2
2	-----	3
3	-----	5
4	-----	4
5	-----	2
6	-----	3
7	-----	5



Activity (2) and (3) can be performed simultaneously and can start only after completion of activity (1).

Activity (4) can start only after completion activity (2) is completed.

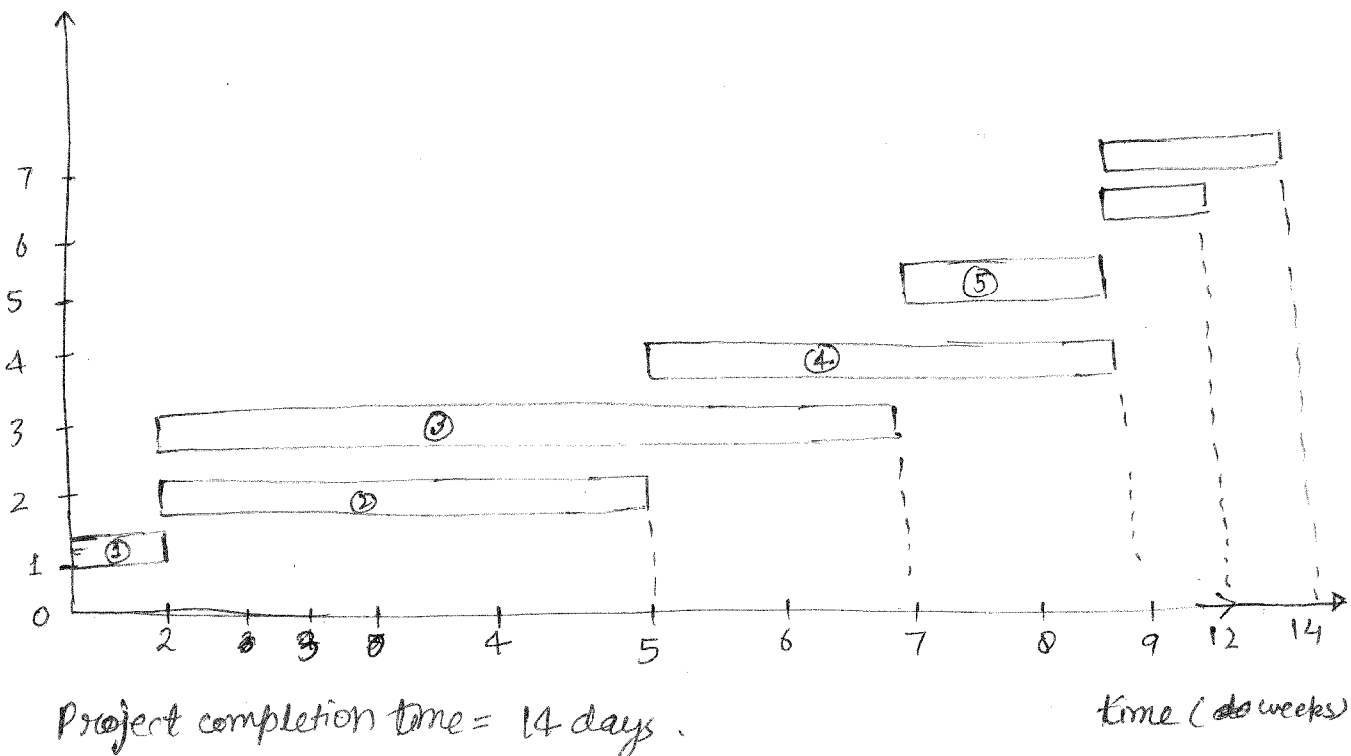
" (5) cannot begin until activity (2) and (3) are completed.

" (6) can only start only after activities (4) and (5) are completed.

" (7) is the last activity can start only after completion of activity (5).

Prepare a bar chart and determine project completion time.

Solⁿ: \Rightarrow



Advantages of Bar chart ⇒

- Simple to draw and easy to understand.
- No skilled person is required. ES-00 Bar chart used for depicting the resource requirement of a construction project.
- * It can be used for determining resource requirement at a particular stage of project which helps us to determine progressive cost of the project.
- Progress Project progress can be expressed in intervals of project percentage.
- Bar chart can include information on cost distribution overtime (project cost over time).

Limitations of Bar chart ⇒ (1) Lack of degree of details ⇒

• In case of big projects only major activities can be shown otherwise it will become very complex hence bar chart is not preferable for very big project.

(2) Review of Project Progress ⇒ • A bar chart does not show exact progress of the work hence it cannot be used for the purpose of controlling.

(3) Activity inter-relationship
It does not show interdependencies among various activities of the project.

(4) Time uncertainty
It is not useful for those projects where uncertainties are involved in estimation of activity time. Exp → Research and development.

(5) It does not indicate critical activities of the project.

critical activities → all activity finish complete or start or yet activity change of start
(6) No cost optimisation
It does not allow cost optimisation i.e. crashing bcz it does not indicate critical activities of the project hence no controlling on cost.

(7) The sequence of activities is not defined at all.

Note ⇒ Gantt chart indicate progressive costs of project.

✓ A bar chart does not indicate the progress of work. Hence comparison of work actual progress with the scheduled progress cannot be done.

Also balance work to be done cannot be determined.

- with the help of bar chart resource requirement at any stage of project can be determined which help in determining progressive cost of project.
- inventory cost → It is all the expenses related to storing raw materials and unsold good.

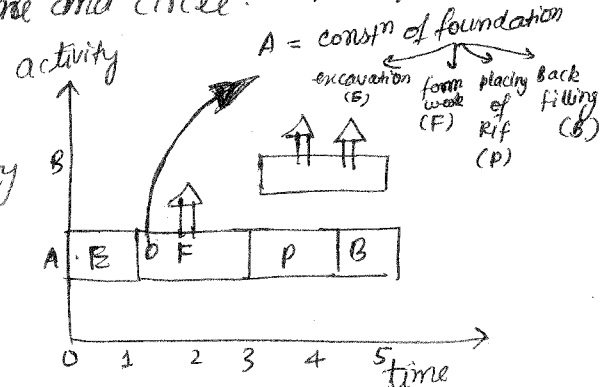
(2) Mile Stone chart

milestone → achievement

- It is an improvement over original bar chart.
- In any activity there are certain key events which are to be carried out for the completion of activity such key events are called as Milestone.
- Milestones can be represented by arrow, square and circle.
- Each milestone can be considered as an event of main activity.

These are present in chronological order.

Limitations ⇒ • Interrelationship b/w subactivities of an activity



is shown by milestone chart but still interdependencies among various milestones of one or different activities are not clear.

- Merit → controlling can be better achieved in milestone chart.

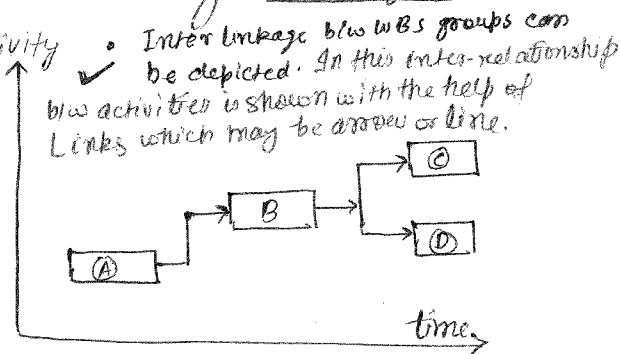
(3) Linked Bar chart

Milestone → event oriented
Bar chart → activity oriented

- It is an ^{*}improvement over bar chart and milestone chart.
- In this, chart activities are link by arrows indicating their sequence of occurrence.

This helps in scheduling of material procurement & hence its utility is enhanced.

- As in linked bar chart interdependencies of all the activities is shown it can be used for monitoring of project including cost.
- Monitoring is related to identify deviations & to fix responsibilities of deviation (for delays).



Link → arrow start

(4) Network Diagram/Analysis

- It is a graphical representation of sequence of activities required to complete the project.

Types of Network Diagram ⇒ (A) A-O-A diagram (Activity on Arrow) or Arrow diagram

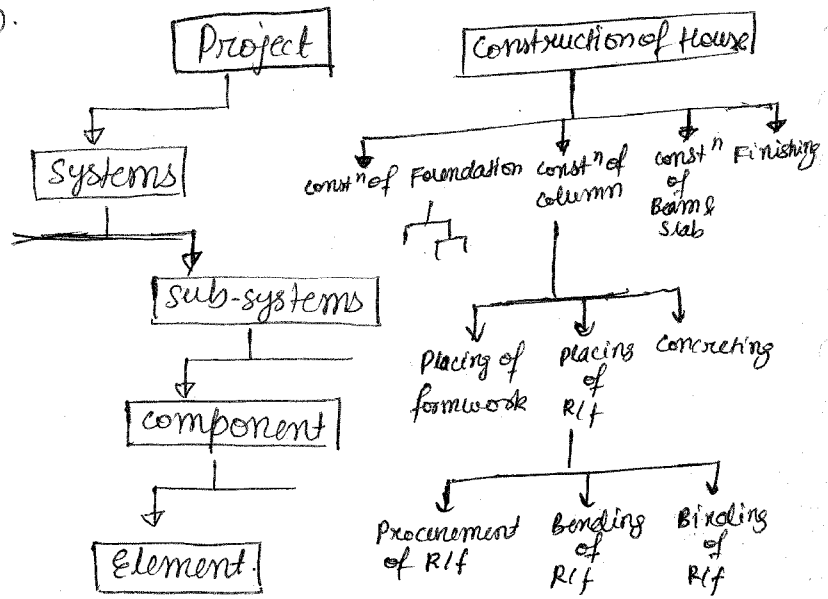
(B) A-O-N (Activity on Node) diagram or Precedence diagram.

- It is modification of bar chart, milestone chart and linked bar chart where all drawbacks are eliminated

audit → देखा परीक्षा
हिस्सा - किताब की चान्द

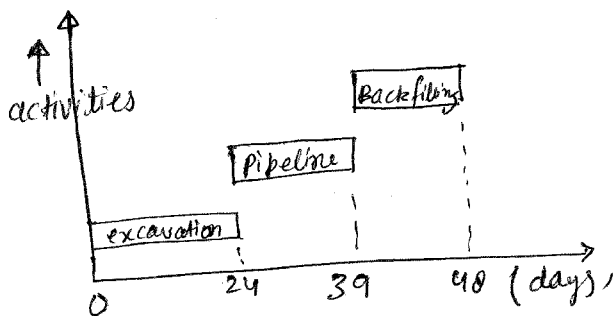
(5) Work Breakdown Structure (WBS)

- It is a graphical representation of functional element of entire project.
- ES-10 • It follows* top to down approach.
- It is a process of breaking complex project into system, subsystems, components and elements.
- Lowest level of WBS is called as work package
- WBS represents "task oriented family trees" of activities and organizes.
- A WBS (usually triangular in shape) progresses down words in the sense that it works from pursuing general to specific objective. ^{** ES-15} Thus it does not refer to a single sub path.

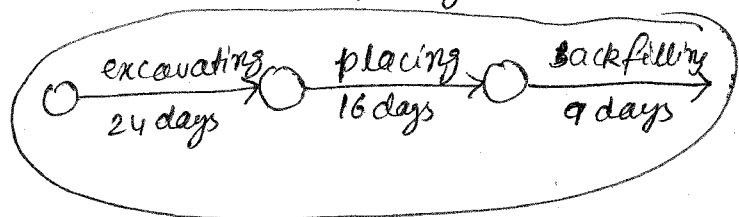


- ES-16 Purpose of WBS ⇒
- Relate activities under particular trade specialization to help in organizing for project staff.
 - Co-ordinate regarding milestone events across trade specialization to improve the synergy b/w the trades.
 - WBS can be hierarchical.

Drawback of Bar chart (3) Activity interrelationship ⇒ eg = Project → laying of pipeline (30km)



- excavation (24 days) 0-0-0 days
- placing the pipeline (15 days) 5-5-5 days
- Backfilling (9 days) 3-3-3 days



1st 0 days	2nd 0 days	3 rd day
Exc 1	Exc 2	Exc 3 ⇒ excavation
	P ₁	P ₂ ⇒ pipeline
	B ₁	B ₂ ⇒ Backfilling.
$0+0+0+5+3= 32 \text{ days}$		

② Fundamentals of Network

• Network diagram is a graphical representation of logical sequence of activities (Network consist of different activities connected logically & sequentially such as required for completion of project).

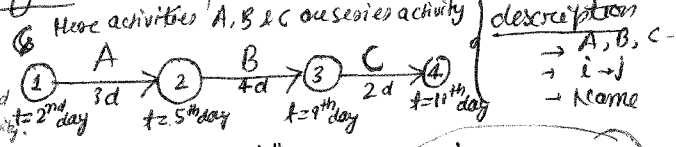
(A) Activity on Arrow Network Diagram \Rightarrow It consist of activities being marked on arrows & events marked on nodes.

Basic Definition \Rightarrow (1) Activity \Rightarrow It is a task or job that consumes

- It is actual performance of task & is termed as activity. resource and time. (eg \rightarrow excavation, foundation preparing, frame work etc for making of Building)
- It has definite starting & completion time. eg \rightarrow preparing for ESE \rightarrow constⁿ of foundation
- It is represented by description \rightarrow (No significance of length of arrow) -
 Tail of an arrow signifies start of activity & head of arrow signifies completion of an activity. • For completion of an activity, resources are required.

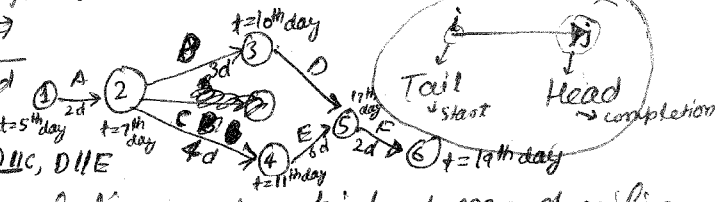
Types of Activity \Rightarrow (A) Serial Activity \Rightarrow performed one after another.

eg. An activity lies b/w two nodes. Number of nodes increases as the activity progresses.
 An activity which can started only after the completion of another activity is termed as serial activity.



(B) Parallel or concurrent Activities \Rightarrow

eg. concurrent activities are mutual independent and can possibly be taken up simultaneously.
 series activities \rightarrow A, B, D, F & A, C, E, F | Parallel activities \rightarrow B, C, D, E, F



(2) Event \Rightarrow An event is an instant of time at which some specific milestone is achieved i.e. start of activity or completion of activity. eg \rightarrow prelims qualified in ESE

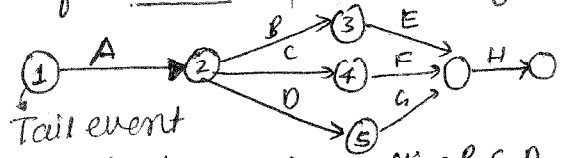
event occurs at the start of activity & finish of activity
 at finish of activity & start of activity

Events do not consume any resource or time.

Events are represented by Nodes (circular (O), square (\square), rectangular (\square), triangular (Δ)).
 eg \rightarrow constⁿ of foundation started, completed, Preparation of ESE started, completed.

Types of Events \Rightarrow (1) Tail Event \Rightarrow It signifies start of an activity. (or Preceding event)

If a particular tail event signifies start of project then it is called as initial event.
 Except last event, all events of network are tail event. is no event before it so it is the initial event.



• event (2) is tail event for activities B, C, D.
 • event (4) is tail event for activity F, also there is no event before it so it is the initial event.

(2) Head event \Rightarrow It signifies completion of an activity. (or succeeding event)
 If a parti Head event signifying the completion of project is called final event or end event.

- All event except first event is head event.
- Last head event is termed as finish event.

