

① Explain PERT Technique in Software Project Management.

① PERT (Program Evaluation & Review Technique) is a network based project scheduling & Estimation.

> It is used to handle uncertainty in project durations.

> It is widely applied in SPM to plan, schedule & control complex projects.

* Key points:-

• purpose - to estimate realistic project completion time, identify critical path & manage uncertainty.

• The Time Estimates:

O (Optimistic Time) - minimum possible time if everything goes well.

M (Most likely Time) - Normal conditions duration.

P (Pessimistic Time) - maximum time if problems occur.

Te (Expected Time) - Average of 3 estimates O, P, M.

Formula of Te:-

$$TE = \frac{(O + 4M + P)}{6}$$

* Steps in PERT:-

→ List all activities & dependencies.

→ Draw PERT Network diagram

→ Estimate O, M, P for each activity

→ Calculate TE for each activity

→ Identify critical path

→ Calculate variance & standard deviation for risk analysis.

* Example:- (Software Module Development)

Activity	O	M	P	TE
A	2	4	6	4.0
B	3	5	7	5.0

* Advantages:-

- Handle uncertainty
- Improve estimation accuracy
- Highlights critical tasks.

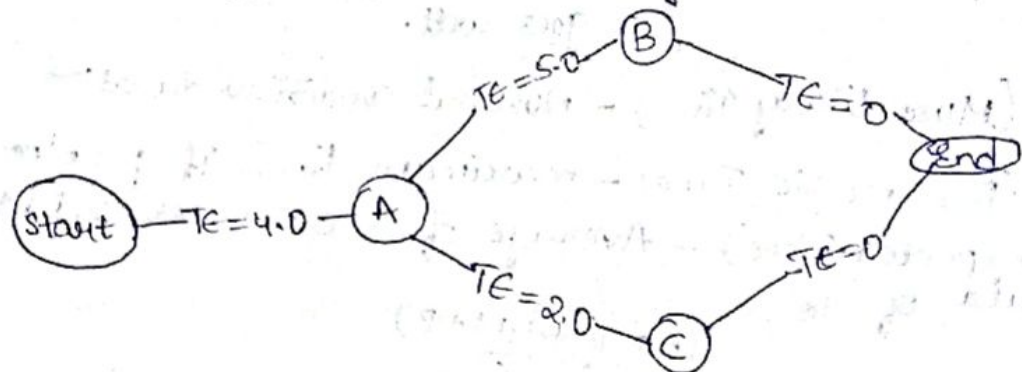
* Disadvantages:-

- Complex to prepare.
- Requires frequent updates.
- Focus on Time.

PERT VS CPM.

- PERT - probabilistic, focuses on time, best for Software/ R&D
- CPM - Deterministic, focuses on cost, best for construction.

PERT Network Diagram



② Explain Monte Carlo Simulation in SPM.

① Monte Carlo Simulation is a probabilistic technique used in Software Project Management to predict possible outcomes of a project by running multiple simulations based on random inputs.

> It is named after Monte Carlo casino in Monaco because it uses randomness & probability.

* Purpose in SPM:-

- > To evaluate risk and uncertainty in project schedules.
- > To forecast project completion times more accurately.
- > To support decision making by showing range & probability of possible results.

* Steps in Monte Carlo Simulation:-

- Define the problem
 - > Identify variable to analyze.
- Assign probability distributions to uncertain variables
 - > Ex:- Activity A might take 3 to 7 days, most likely 5 days.
- Generate random values for each variable within its range.
- Run simulations using these random inputs.
- Analyze results.
 - > calculate mean, variance, probability to meet deadlines.
- Interpret output in the form of histograms or curves.

Example - Suppose a software testing task has

- Optimistic time (O) = 4 days
- Most likely Time (M) = 6 days
- Pessimistic Time (P) = 10 days.

Using random sampling simulation might show

- 70% probability of finishing in ≤ 7 days
- 90% probability of finishing in ≤ 8 days.

* Advantages:-

- > handles complex uncertainties.
- > Gives range of outcomes with probabilities.
- > Helps in risk analysis & contingency planning.

* Disadvantages:-

- > Requires statistical knowledge & simulation tools.
- > can be time consuming to set-up.

③ Explain Resource Allocation in SPM.

① Resource allocation is process of assigning available resources such as manpower, hardware, software and budget - to project tasks in efficient way.

* Purpose:-

- > Ensure optimal use of resources.
- > Avoid overallocation or underutilization.
- > Match the right skills to the right tasks.
- > Maintain project schedule without resource conflicts.

* Steps:-

- Identify resources needed for each task.
- Determine availability of resources.
- Assign resources according to priority & skill match.
- Adjust schedule if there are conflicts.
- Monitor usage to avoid bottlenecks.

* Techniques:-

- Resource leveling - Adjusting start & end dates to balance resource demand.
- Critical Path Method (CPM) & Resource Analysis - Adjust tasks based on resource constraints.
- Gantt charts & Resource Histograms - visual representation of resource usage.

④ what are cost schedule concepts in SPM.

① Cost schedule concepts involve estimating, budgeting & controlling the costs of a project while aligning them with the project timeline.

* Key concepts:-

- planned value (PV) - Budgeted cost for work scheduled at a given time.

- Earned value (EV) - Budgeted cost for work actually completed.
- Actual cost (AC) - Real cost incurred for work done.
- Scheduled variance (SV) - Difference between EV & PV.

$$SV = EV - PV$$

- Cost variance (CV) - Difference between EV & AC.

$$CV = EV - AC$$

* Steps:-

- Estimate costs for each task.
- Create a cost baseline linked to project schedule.
- Track progress regularly using Earned Value Analysis (EVA).
- Identify deviations from the plan.
- Take corrective actions (reallocate resources, adjust scope).

Ex:- Suppose.

PV = ₹.50,000 (planned by week 4)

EV = ₹.45,000 (actual progress by week 4).

AC = ₹.48,000 (actual money spent)

Then.

$$SV = EV - PV = 45000 - 50000 = -5000/- \Rightarrow \text{project is behind schedule.}$$

$$CV = EV - AC = 45000 - 48000 = -3000/- \Rightarrow \text{project is over budget.}$$

* Importance:-

- > Ensures on-time delivery without budget overruns.
- > Helps forecast future performance.
- > Supports management decisions on resource allocation.

③ Explain creation of critical Patterns (Critical Path Method) - CPM

④ Critical Patterns are sequence of dependent activities in a project that, if delayed, will delay the entire project.

• The main critical pattern in project scheduling is called critical path.

* Purpose:-

- Identify tasks with zero float/slack.
- Focus management efforts on activities that affect overall project duration.
- Help in resource allocation & schedule monitoring.

* Steps to Create Critical Pattern:-

→ List all project activities.

• Include activity names, duration & dependencies.

→ Draw the network diagram

• Use nodes and arrows (tasks & sequences)

→ Forward Pass Calculation.

• calculate Earliest Start & Earliest Finish for each activity.

$$EF = ES + \text{duration.}$$

→ Backward Pass calculation.

• calculate latest start (LS) & latest finish (LF) for each activity

$$LS = LF - \text{Duration.}$$

→ Find Float (Slack)

$$\text{Float} = (LS - ES) \text{ or } (LF - EF)$$

• Critical activities have Float = 0.

→ Identify the critical Pattern (critical Path).

• This is longest path in terms of duration from start to end.

Ex:-

Activity	Duration	Predecessor
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A	4 days	-
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B	3 days	A
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C	5 days	A
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D	2 days	B, C
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From calculation, if $A \rightarrow C \rightarrow D$ takes longest total time that becomes critical pattern.

* Importance:-

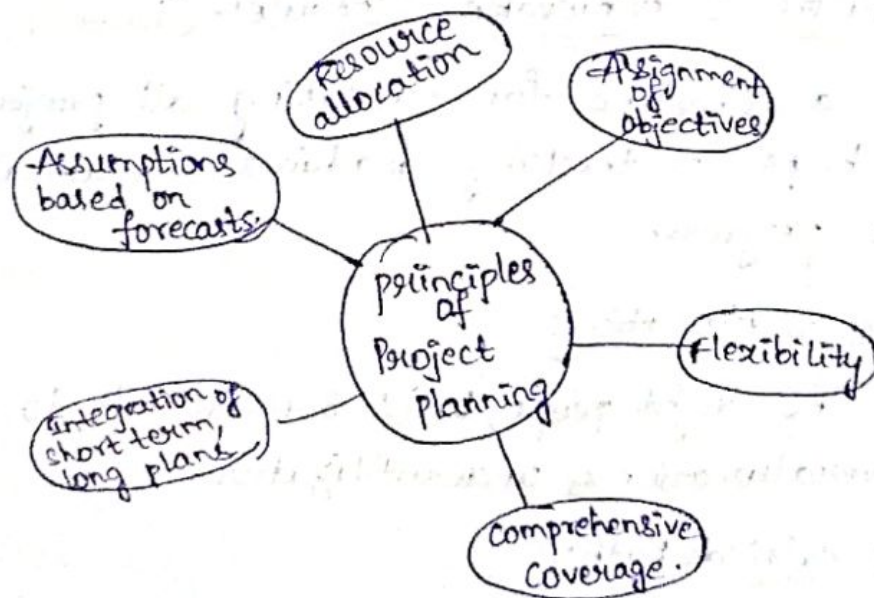
- Ensures focus on time-sensitive tasks.
- Helps in project Monitoring
- Supports what-if analysis if delays occur.

⑥ Explain objectives of Activity Planning.

① Activity planning is the foundation of successful project Management, serving as blueprint for organizing tasks, timelines & resources to achieve project objectives effectively.

> The primary aim is to deconstruct overall project-goal into smaller and manageable tasks.

> Proper Sequencing of activities ensures smooth workflow, minimizes idle time and prevents bottlenecks that delay project.



→ It involves identifying critical path to determine minimum project duration and calculating float time for flexible execution.

→ It also lays the groundwork for monitoring progress & aligning project schedules with budgetary constraints.

→ It improves efficiency & increases likelihood of project success.

→ Defining project Activities:-

Breakdown the overall project into smaller, manageable tasks.

• without clearly defined tasks it is impossible to assign responsibilities.

→ Estimating Time for Each Activity:- (PERT, Expert judgement)

• predict how long each activity will take to complete.
Accurate time estimation prevents delays & helps create realistic timelines.

→ Identifying dependencies & Sequencing Activities:-

Determine the logical order of activities & identify task dependencies like
Finish to Start (FS) - B start & A finish.
Start to Start (SS) - Both start at same time.
Finish to Finish (FF) - Both finish at same time.

→ Creating a Realistic & Achievable Schedule:- (Gantt chart, diagrams)

Develop a timeline for executing all project tasks. A clear schedule helps in tracking deadlines & maintaining control over project's progress.

→ Resource planning & Allocation:-

Assign the right people, tools & materials to each activity.
It avoids overallocation & underutilization.

→ Identifying the critical path:-

The sequence of dependent tasks that determine the minimum project duration.

→ Determining Float & Slack Times:-

Identify how long an activity can be delayed without affecting project deadline. Helps in flexibility.

→ Risk Identification & Contingency planning:-

predict potential obstacles that may impact time and delivery.

- Ensuring Stakeholder Communication & Coordination:-
Align all project team members and stakeholders with the plan.
- Monitoring & control mechanism Setup:-
Set benchmarks for performance tracking & schedule adherence. Allows early detection of deviations & corrective actions.
- Improving overall project efficiency:-
Eliminate bottlenecks and streamline Execution.

* Advantages:-

- > Ensure clear project direction
- > Helps in resource & time estimation.
- > Aids in early detection

* Disadvantages:-

- > Time-consuming if scope is not well defined.
- > Requires detail input.

⑦ Explain brief about Project Schedules:-

- ① • Project Schedule is a crucial tool in project Management that provides a clear timeline for completing activities.
- It is a document that shows planned start & finish date for all project tasks.

* Importance:-

- Set Expectations:- by specifying task timelines, team members what to expect & when.
- coordinate resources — ensure all resources are available when needed.
- Manage dependencies — helps identify which tasks depend on others.
- Track progress — with deadlines it provide a benchmark for performance.
- Mitigate risks — well-structured schedule can help identify risks.

* Components:

- > Project Tasks & Activities: - Tasks are specific actions that need to be taken to complete project & broke into smaller parts.
- > Task Duration: - Duration refers to amount of time needed to complete the each task.
- > Dependencies: -
It defines relationship b/w tasks, showing which tasks must be completed before others can begin.
The four types are:-
 - > Finish-to-start (FS): - Task B can't start until A is finished.
 - > Start-to-start (SS): - Task B can't start until A starts.
 - > Finish-to-finish (FF): - Task B can't finish until Task A finishes.
 - > Start-to-finish (SF): - Task B can't finish until Task A starts.
- > Milestones: -

These are significant events or achievements within a project that mark completion of major phases.

- ## * Challenges:
- > Uncertain duration
 - > Resource conflicts
 - > Scope changes.

* Advantages:

- > Tracks deadlines & milestones
- > Enhances time management & accountability.

* Disadvantages:

- > can become obsolete with scope changes.
- > Might oversimplify complex dependencies.

Ex: website launch schedule for E-commerce.

- ② Explain website launch schedule for E-commerce startup.
- ③ Sample project: website launch schedule for E-commerce startup.

Objective: - To plan & schedule activities involved in launch of ecommerce startup website.

Steps:-

- planning phase — Define project scope & objectives
 - Identify target audience.
 - Determine required features.
 - set project budget, timeline.
- Design phase — Design wireframes, layout
 - Finalize website theme & branding
 - Review design mockups.
- Development phase — set up website hosting & domain
 - Develop front end,
 - Develop back end
 - Implement payment gateway
 - perform initial content population.
- Testing phase
 - perform unit testing
 - conduct usability testing with users
 - Run performance tests.
- Launch Preparation — Finalize SEO & digital marketing strategy
 - Set up Google Analytics.
- Go live — Deploy website on production server.
 - Send out launch announcement emails & promotional
- Post-launch Support:
 - Monitor website for bugs, feedback
 - update website based on reviews.

⑨ Explain about Activities.

- ① In project Management, Activities are fundamental tasks that need to be carried out to achieve overall objectives.
- A well structured project typically consists of a large combination, high-level activities broken down into smaller more manageable tasks.
 - These tasks should be clearly defined with a specific start & end point.
 - Defining activities effectively is crucial as it ensure necessary resources are available.
 - Activities must be well-defined, actionable and logically create a comprehensive & realistic project schedule.
 - project Managers must also identify the dependencies between activities whether they are dependent or independent.
 - At atomic level, activities are smallest, most basic unit of tasks.
 - Atomic level tasks are essential because they are foundation

Dependent Activities

- > Rely on completion of one/more other activities before they begin.
- > These have a clear sequence.
- > It must be managed more carefully.
- > To ensure that prerequisites are completed on time to avoid delays.

Ex: - To construct building, windows cannot be made until building walls.

Independent Activities

- > do not rely on other tasks.
- > can be performed in any order.
- > Greater flexible.
- > Need to be managed to prevent resource conflicts.

Ex: - installing lights can be performed with installing windows.

Q. What are major phases in Sequencing.

A) Sequencing is keeping data in an order, for easy understanding.

Major phases are:

① Site preparation

> land clearance > Soil testing & Analysis > leveling.

② Foundation work

> laying footings > Pouring concrete foundation

> waterproofing & curing.

③ Framing

> Structural skeleton (walls, beams, & floors)

> Roof framing.

④ Plumbing and Electrical (Rough-In)

> Installing & underground plumbing lines

> Electrical wiring

> HVAC duct installation.

⑤ Roofing and Exterior work

> Roof covering installation

> Wall sheathing & insulation

> window and exterior door fitting

⑥ Interior work

> Drywall installation

> Interior doors

> Flooring

⑦ Final fixtures & finishing > Bathroom & Kitchen

> final painting & cleaning

⑧ Inspection & handover

> Building code inspection

> corrections

> final approval & client handover.

⑪ Explain Network Planning Models.

① Network planning Models are visual tools used to outline logical flow & sequence of project activities.

> The primary purpose is to visualize execution path, determine task dependencies.

> There are two main types:

Activity on Node (AON)

Activity on Arrow (AOA).

→ AON is each node represents tasks & arrows gives dependencies.

It is used in Critical Path Method (CPM).

→ AOA represents tasks as arrows & events as nodes.

It is used in Program Evaluation & Review Technique (PERT).

→ CPM used when durations are predictable.

→ PERT is suited for projects with uncertain time frames, using 3 estimates.

→ Precedence Diagramming Method (PDM)

It visualise task dependencies using nodes & arrows. Types are.

Finish-to-Start

Start-to-Start

Finish-to-Finish

Start-to-Finish

→ Gantt chart - bar chart that visually represents schedule of project.

(Write CPM, PERT question after this).

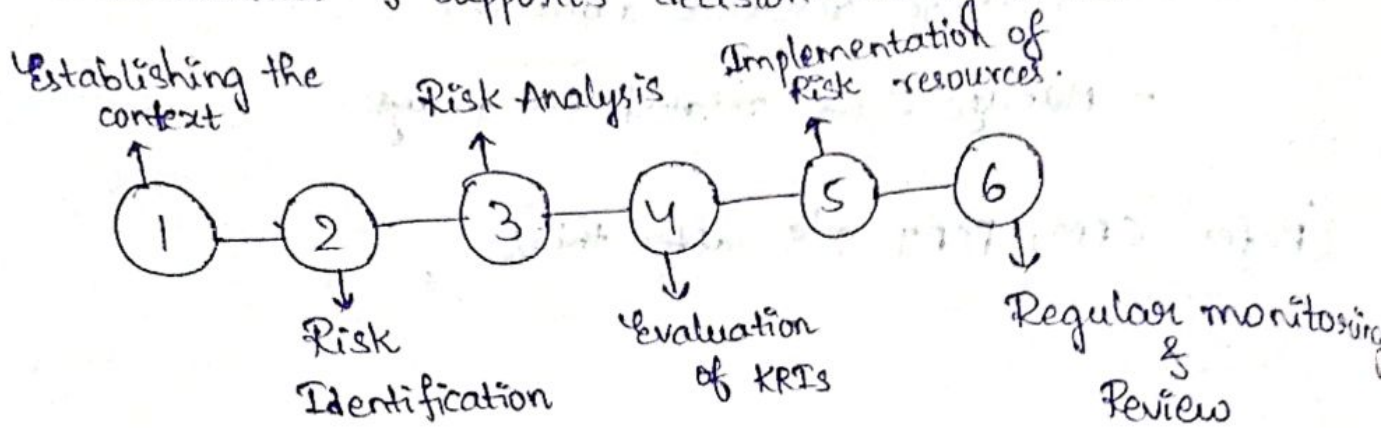
- Advantages - visualise workflow
- identify critical tasks.
 - Estimate project duration
 - Optimize resource allocation
 - Manage risks related to delays.

(Refer CPM, PERT & S after this)

⑫ Explain about Monitoring.

① > It is a continuous process that involves tracking identified risks.

> It plays a vital role in maintaining and control over project uncertainties & supports decision-making in real time.



> During this, project teams continuously observe risk indicators and evaluate whether implemented strategies are effective.

* Components:-

> Risk Register updates — update with new risks
— includes status changes.

> Triggers & thresholds — early warning signs that indicate a risk is to occur.
— defines acceptable limits of project variables.

> Contingency plans — predefined strategies developed during risk planning phase.

> Reassessment & Audits — conducted at major milestones to ensure risk profile is accurate.
— Audits involve reviewing effectiveness of risk management process.

* How to apply risk monitoring in a Project:-

> Start with a Risk register — includes risk id, description, probability, Impact,

> Identify triggers & thresholds

> Implement contingency plans. Risk owner, status.

- > Identify triggers & thresholds - define signs that a risk is about to occur and set limits.
- > Implement contingency plans - have ready made plans for key risks, assign resources and budgets.
- > Monitor Regularly - conduct weekly or milestone based risk reviews.
- > Update risk register - log updates from risk reviews, update probability and keep your register live.
- > Conduct Reassessments and Audits - to learn what worked & improve future planning.

Ex - Software Development Project.

<u>Step</u>	<u>Application</u>
Risk identified	Team member may leave mid-project.
Trigger	Verbal hint of resignation.
Threshold	- official resignation notice
contingency plan	onboard backup developer.
Monitoring	weekly team health check-in.
outcome	Risk occurred, but backup executed.

③ Explain about Forward Pass & Backward Pass techniques
These are fundamentals in project scheduling.

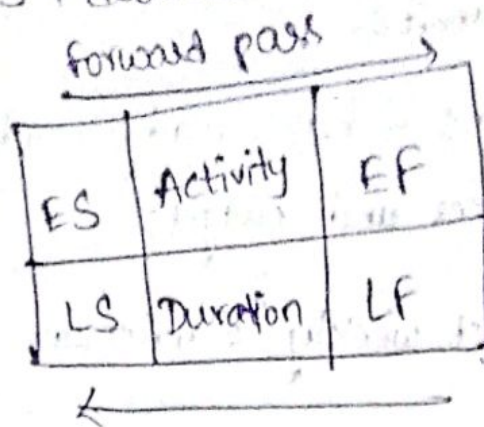
④ Forward Pass:-

It is to determine earliest start (ES) and earliest finish (EF) times for each activity in project

How it works:-

- > Starts from project's start node
- > Move forward through network diagram.
- > For each activity
Earliest start (ES) - maximum of earliest finish times of all its predecessor activities.

$$EF = ES + \text{duration}$$



Backward pass:- To determine latest start (LS) & latest finish (LF) times for each activity without delaying project.

How it works:-

- start from project's end node.
- Move backward through network.

For each activity:

latest finish = minimum of latest start times of all its successor activities.

latest start = LF - activity duration.

* Forward pass & Backward Pass used to calculate slack for each task.

$$\text{Slack} = LS - ES \text{ (or) } LF - EF.$$

* Advantages:-

- > Identifies earliest and latest times for task completion.
- > Helps to find slack.
- > Allows better flexibility.

* Disadvantages:-

- > Complexity increases
- > Requires accurate time estimates.