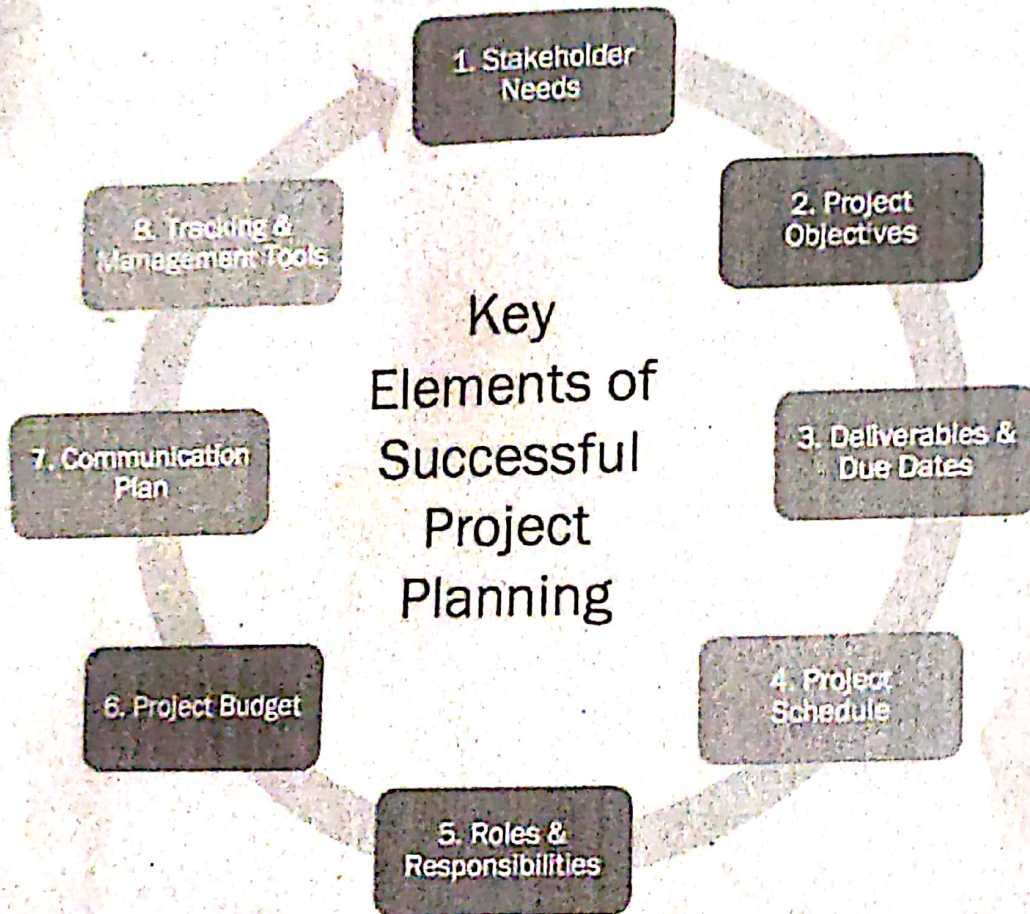


Anirban

Civil Govt. (AE) Job Preparation

Project Planning and Management



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Chapter-1: Project Management

Project management: 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. The primary constraints are scope, time, quality and budget.

Characteristics feature of a project:

- Objectives: A project should have a fixed set of objectives.
- Life an; A project should have a specified lifespan.
- Single entity: A project should have its own identity.
- Uniqueness: A project should have a definite uniqueness.
- Unity in diversity: A project is a complex set of thousands of diversity.
- Successive principle: A project should have a successive set of works.
- Made to order: A project is always made to order according to its customer.
- Risk and uncertainty: Every project has risk and uncertainty

Factors of execution of a project:

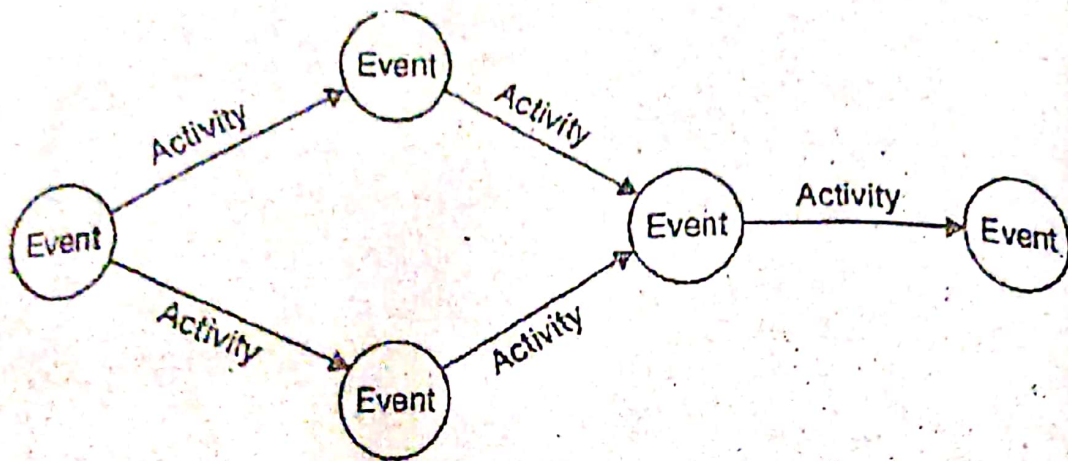
- Location
- Types
- Size
- Technology
- Scope
- Speed of project

Methods of Planning and Programming

Following are some of the tools or techniques of project management:

1. Bar charts and Milestone charts.
2. Network diagrams.

Network diagram is an outcome of the improvements in the milestone charts. A network is a flow diagram consisting of activities and events, connected logically and sequentially. In the network diagram, an activity is represented by arrows while events are represented, usually, by circles, as shown in Fig.



The Major two networks system are:

- I. PERT
- II. CPM

PERT network is event-oriented, while CPM network is activity-oriented. Fundamentally, both CPM and PERT networks are techniques of project management involving graphical and diagrammatic representation, which management can use as an aid in planning, scheduling and controlling of operations in a project.

What do you mean "PERT"?

PERT (Project Evaluation and Review Technique): It is a probabilistic model with uncertainty activity duration. It is an event oriented approach used for planning, controlling and reviewing the project. The expected time for each activity can be calculated using three time estimates-

Optimistic time (t_o)

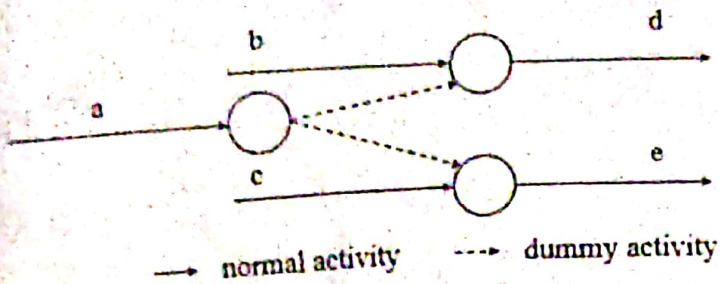
Most likely time (t_m)

Pessimistic time (t_p)

It is used to find the applications in projects where resources (3m — Management, materials and money) are always made available as and when required.

Write down the definition of Dummy Activity?

Dummy activities often have a zero completion time and are used to represent precedence relationships that cannot be easily (if at all) represented using the actual activities involved in the project. By convention dummies are always shown as dotted arcs in network diagrams.



What do you mean CPM?

CPM (Critical Path Method): CPM is a deterministic model with well-known activity time based upon past experience. It assumes that, the expected time is actually the time taken. It is an activity-oriented system and marks the critical activities. CPM is employed to those projects where minimum overall cost is important and there is better utilization of resources.

Write the difference between CPM and PERT. (BUET M.Sc.)

CPM	PERT
CPM uses activity-oriented network.	PERT uses event-oriented Networks.
Durations of activity may be estimated with a fair degree of accuracy.	Estimate of time for activities are not so accurate and definite.
It is used extensively in construction projects.	It is used mostly in research and development project, particularly projects of non-repetitive nature.
Deterministic concept is used.	Probabilistic model concept is used.
CPM can control both times and cost when planning	PERT is basically a tool for planning.
CPM deals with predictable activities	PERT deals with unpredictable activities

Network Diagram Example:

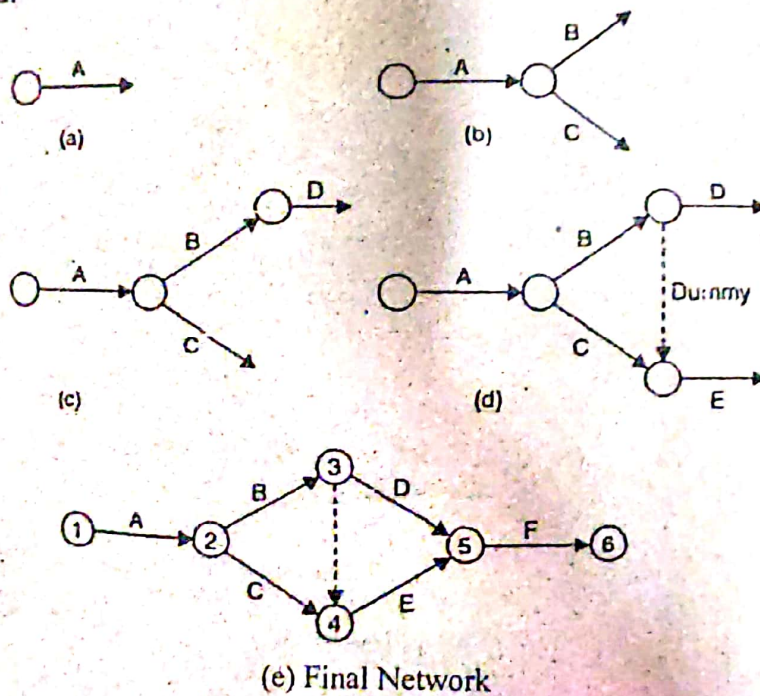
A project consists of six activities (jobs) designated from A to F, with the following relationships:

- (i) A is the first job to be performed.
- (ii) B and C can be done concurrently, and must follow A.
- (iii) B must precede D.
- (iv) E must succeed C, but it cannot start until B is complete.
- (v) The last operation F is dependent on the completion of both.

Draw the network diagram.

Solution.

The step by step development of the diagram is shown in figure. The final diagram has its events numbered.



Chapter-2: PERT: Time Estimate

Write down the types of time which is used for PERT analysis?

PERT has defined four types of time required to accomplish an activity:

Optimistic time: the minimum possible time required to accomplish an activity (t_o) or a path (O), assuming everything proceeds better than is normally expected.

Pessimistic time: the maximum possible time required to accomplish an activity (t_p) or a path (P), assuming everything goes wrong (but excluding major catastrophes).

Most likely time: the best estimate of the time required to accomplish an activity (t_L) or a path (M), assuming everything proceeds as normal.

Expected time: the best estimate of the time required to accomplish an activity (t_E) or a path (TE), accounting for the fact that things don't always proceed as normal.

$$\text{Expected Time, } T_E = \frac{t_o + t_L + t_p}{6}$$

Example 5.2: For a particular activity of a project, time estimates received from two engineers X and Y are as follows:

	<i>Optimistic time</i>	<i>Most likely time</i>	<i>Pessimistic time</i>
<i>Engineer X</i>	4	6	8
<i>Engineer Y</i>	3	5	8

State who is more certain about the time of completion of the job.

Solution.

The degree of uncertainty (or otherwise) is indicated by the variance of the time estimates.

The variance of time estimates given by engineer X is

$$\sigma_X^2 = \left(\frac{t_P - t_O}{6} \right)^2 = \left(\frac{8 - 4}{6} \right)^2 = 0.4356$$

The variance of time estimate of engineer Y is

$$\sigma_Y^2 = \left(\frac{t_P - t_O}{6} \right)^2 = \left(\frac{8 - 3}{6} \right)^2 = 0.69.$$

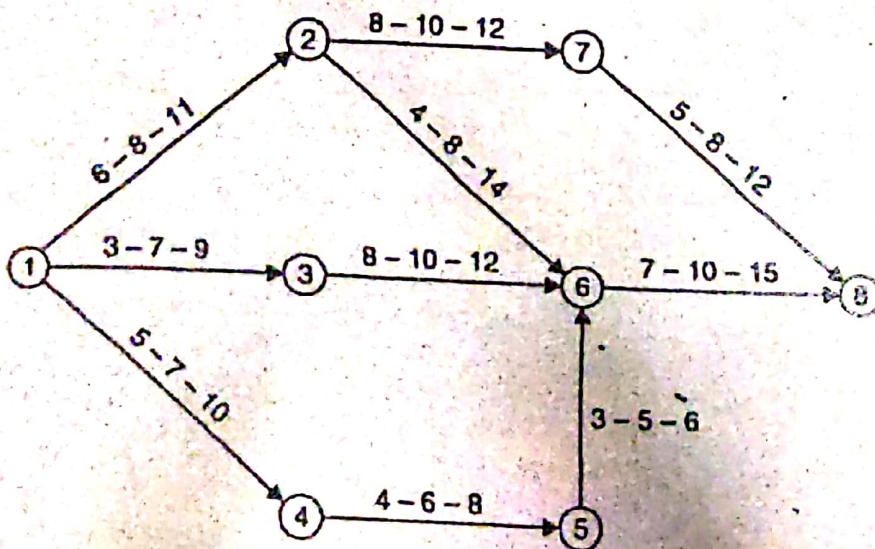
Thus, the variance of time estimates given by Y is more. Since greater the variance, greater will be uncertainty, engineer X's time estimates have more certainty.

Example:

The network for a certain project is shown in given Figure Determine the expected time for each of the path. Which path is critical?

Solution.

In the network, event 1 is the starting event while event 8 is the end event. There are following four paths from the starting event to the end event:



Path A : 1-2-7-8

Path B: 1-2-6-8

Path C: 1-3-6-8

Path D: 1-4-5-6-8

The optimistic time for each of the path is equal to the sum of all t_o 's of activity of that path. Similarly, the pessimistic time and most likely time of each of the paths can be found. These times are shown in Table

	<i>Optimistic time</i>	<i>Most likely time</i>	<i>Pessimistic time</i>
Path A 1-2-7-8	19	26	35
Path B 1-2-6-8	17	26	40
Path C 1-3-6-8	18	27	36
Path D 1-4-5-6-8	19	28	39

From the point of view of pessimistic time, path B is critical since it takes longest duration. From the point of view of optimistic

time, paths A and D are equally critical. However, from the most likely time point of view, path D is the most critical. In the PERT analysis, the expected time t_E is taken as the basis for finding the critical path. As indicated earlier, the expected time t_E is computed from the equation

$$\text{Expected Time, } T_E = \frac{t_O + t_L + t_P}{6}$$

Thus, expected time for each activity can be found. The expected time (t_E) for any path is equal to $\sum t_E$ of all activities. The computations are shown in Table

Path	Activity	t_o	t_L	t_p	t_E	Σt_E
A	1-2	6	8	11	8.17	26.34
	2-7	8	10	12	10.00	
	7-8	5	8	12	8.17	
B	1-2	6	8	11	8.17	26.83
	2-6	4	8	14	8.33	
	6-8	7	10	15	10.33	
C	1-3	3	7	9	6.67	27.00
	3-6	8	10	12	10.00	
	6-8	7	10	15	10.33	
D	1-4	5	7	10	7.17	28.33
	4-5	4	6	8	6.00	
	5-6	3	5	6	4.83	
	6-8	7	10	15	10.33	

From Table 5.6, we find that path *D* is critical since Σt_E for this path is the maximum.

Write down the different stages of construction project? (EGCB-2015)
 Projects are divided into six stages:

- > Initiation phase
- > Definition phase
- > Planning & Design phase
- > Execution phase.
- > Monitoring & Control phase.
- > Closure.

Chapter-3: Contract

Describe the various types of Contract?

Contract is an agreement between two or more than two parties in which one is agreed to provide goods and services to other for which he will get the return in the some form. The contract is legal document and binding on both the parties. The form in which return for providing goods and services is delivered, is called type of contracts. There are different types of contracts which can be employed in any of the delivery methods. Owner can pay the money to the contractor, in lump-sum, based on measured work with unit price, based on percentage plus quantity involved. In the following, we shall briefly discuss the different type of contract.

1. **Lump-sum contract:** This is a single fixed price contract. In this contract, contractor agrees to perform specified job for fixed sum. The owner provides the contractor exact specification of the work. In this contract both the parties try to fix the conditions of the work as precisely as possible.

Following are the advantages of the fixed price contract.

- Owner is aware of the cost of the project before the project construction starts.
- It avoids a lot of details and accounting by both owner and contractor.
- Contractor gets free hand to execute the work.
- If this contract is used with design-construct method of delivery, contractor gets opportunity to use value engineering.

Disadvantage:

- It is very difficult to accommodate any change in design and specification.
- This contract is as good as the accuracy of the contract document. If errors exist in the contract document, the contract need to be renegotiated and hence more risk is involved from the owner side.
- In the case of unforeseen hazard during the construction, contractor may be put in adverse situation.

2. **Unit price contract:** In this type of contract, the price is paid per unit of the work carried out. There are different variations of this type of contract. Some of them are mentioned below.

1. **Bill of quantities contract:** In this type of contract owner provide the drawing, quantities of work to be done and specification. The contractor bid based on the unit cost of the items of construction. The contractor overhead, profit and other expenses can be included in the unit cost of the item of work. Sometimes contractor quotes the of the work and lump-sum amount separately as profit overhead.

- This type of construction is usually followed in government sector for large infrastructure construction. This type of contract provides owner a competitive bid. Disadvantage of the methods are:
- Owner needs to measure the quantity of work done in the field, hence requires owner presence at the site.

- Final price of the construction is not known precisely until last price of work is completed. If there is significant difference between the estimated

quantities and the reality of the situation, owner is put in adverse situation. Mistaken quantities is called unbalanced bid.

- II. **Cost plus contract:** In this contract, the payment is made based on the work carried out plus the fee which includes overhead, profit etc. Sometimes a cap is put on the type of contract by provided maximum and minimum cost limit such as guaranteed maximum cost contract. If project cost exceed this limit, contractor is responsible for that. Sometimes incentive clause is also included if the contractor bring the project before certain specified limit. The advantage of this type of contract is that considerable overlap is providing between design and construction. Hence the project can be executed in the fast-tracked basis. This contract is suitable or the work where it is difficult to define the task to be done before the awarding the contract.

Q. Define Claim? Difference between contractual and extra contractual clam?
[RRI-15]

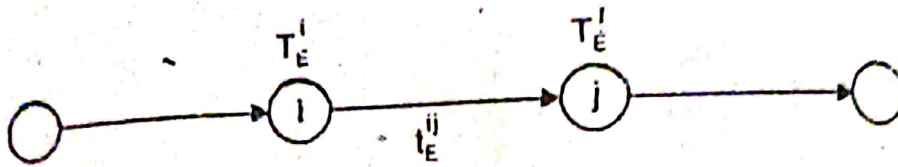
Construction Claim: Construction Claim can be defined as a request by either party to the contract, usually the Contractor, for compensation for damages caused by failure of the other party to fulfill his part of obligations as specified in the contract. The compensation is usually in the form of the additional payment or an extension of time (EOT). Construction claims are measured by many project participants to be one of the most worrying and unpleasant events of a project. The high competition has forced contractors to submit projects with minimum profits in order to stay in business.

Contractual Claims: These are the claims which arise out of the express provision of the particular contract i.e., for extra cost, expense and direct loss specifically provided as a remedy in the contract for breach of contract on the part of the party concerned.

Extra Contractual Claims: These claims are also known as common law claims. These claims are for damages for breach of contract at common law.

Chapter-4: PERT: Time Computations

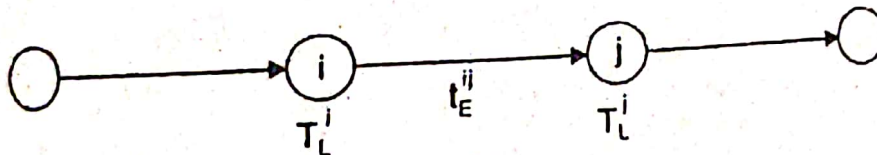
Earliest expected time: The earliest expected time is the time when an event can be expected to occur. It is represented by symbol T_E and appear above or below the node (event circle) in a network. The earliest expected time (T_E) is computed by adding the expected times (t_E) of all the activities along an activities path leading to that event.



$$T_E (\text{successor event}) = T_E (\text{predecessor event}) + t_E (\text{activity}).$$

$$T_E^j = T_E^i + t_E^{ij}$$

Latest allowable time: A planner is equally concerned with the completion of the project within the scheduled time. For each event, therefore, some time limit is allotted by which that event must occur. The latest time by which an event must occur, to keep the project on schedule is called the latest allowable occurrence time. It is denoted by symbol T_L



$$T_L (\text{successor event}) = T_L (\text{predecessor event}) + t_E (\text{activity}).$$

$$T_L^i = T_L^j + t_E^{ij}$$

PERT: Network Analysis

Slack: may be simply defined as the difference between the latest allowable time and the earliest expected time of an event. Slack can be positive, zero or negative, depending upon the relationship between T_L and T_E .

Slack for any event,

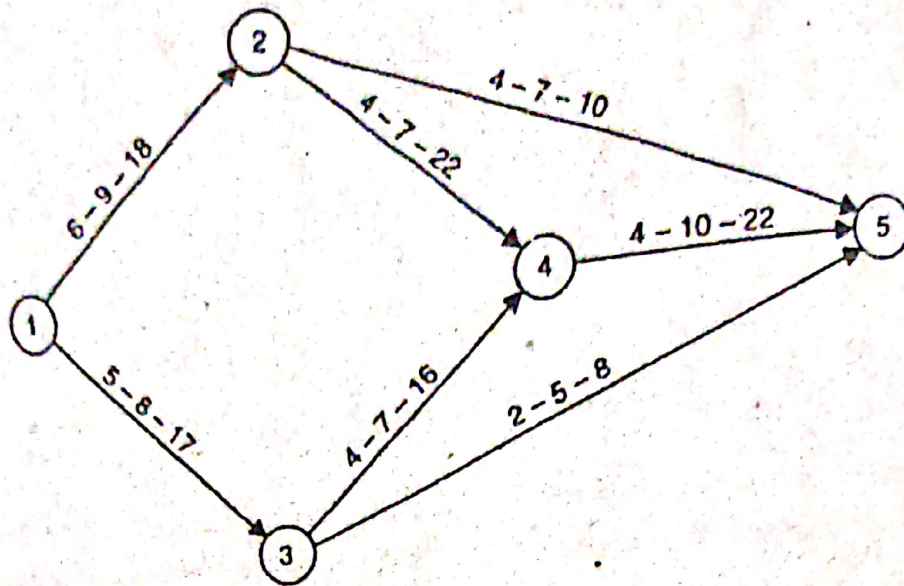
$$S = T_L - T_E$$

Positive Slack: Positive slack is obtained when T_L is more than T_E for an event. It is an indication of an ahead of schedule condition (excess resources).

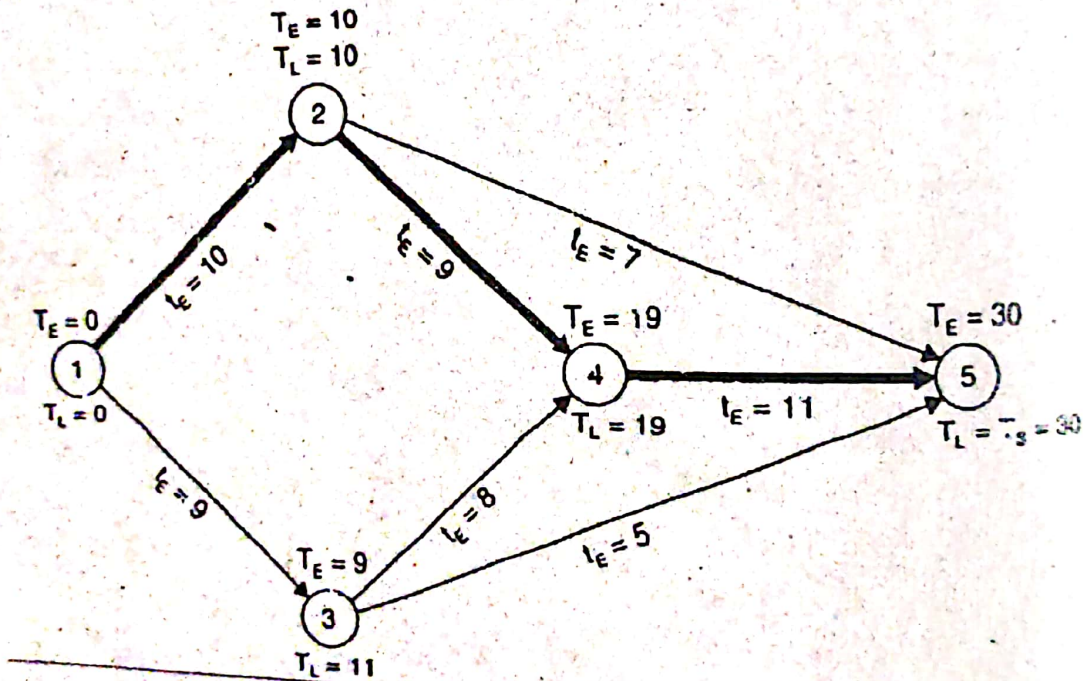
Zero slack: Zero slack is obtained when T_L is equal to T_E for an event. It is an indication of an on schedule condition (adequate resources).

Negative slack: Negative slack is obtained when the scheduled time of completion, T_s (and hence T_L) is less than the T_E . It is an indication of a behind of schedule condition (lack of resources).

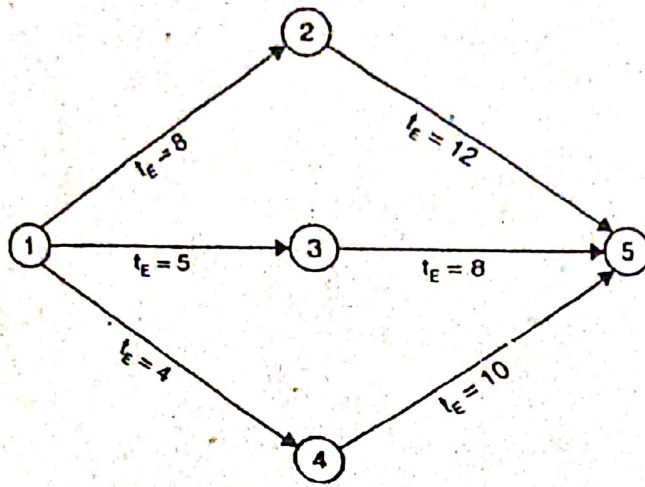
compute the critical path for following networks



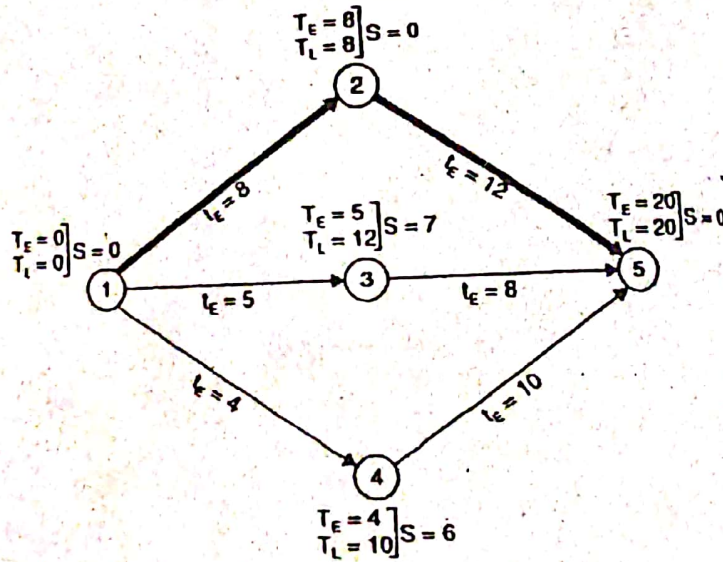
Solution:



Compute the critical path for following networks



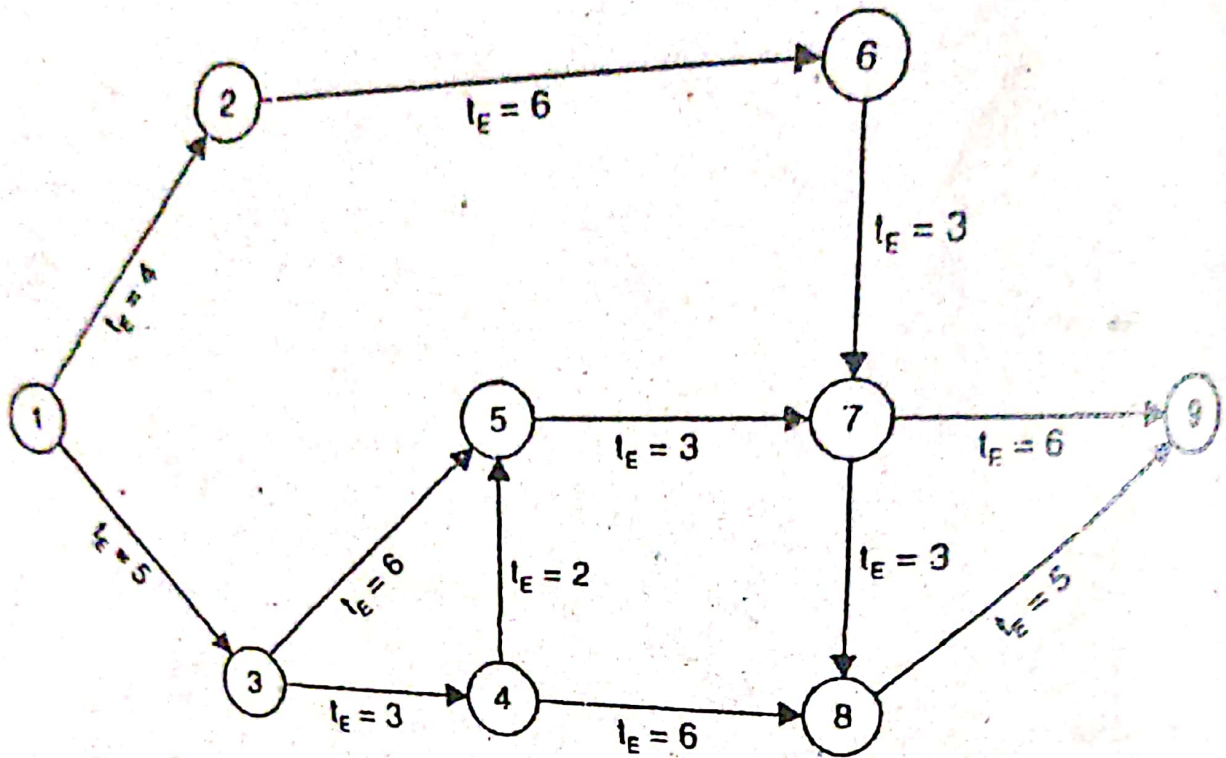
Solution:



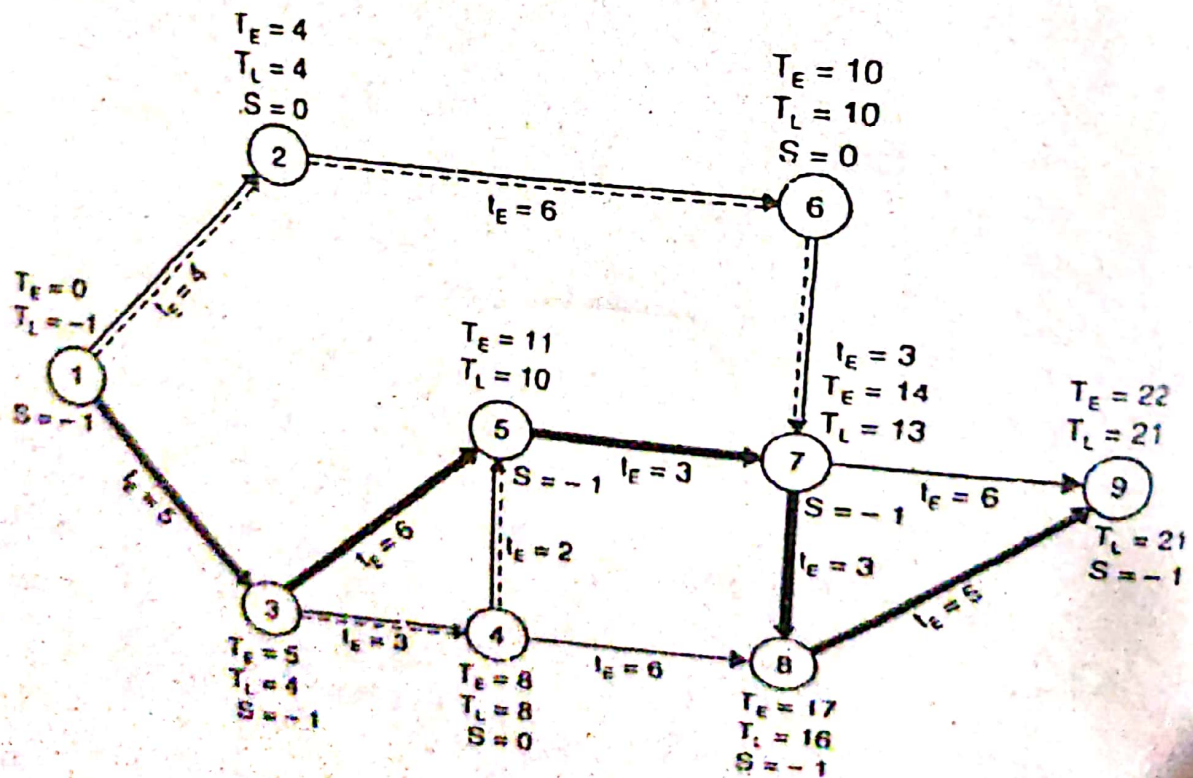
A critical path is distinctly marked in the network, usually by thick. The path 1-2-5 is along the events having zero slack times. This

Note that $\sum t_E$ of all the activities along the critical path is equal T_E of that last event. Along any other path, $\sum t_E$ is less than T_E of last event. Thus, critical path is the longest path.

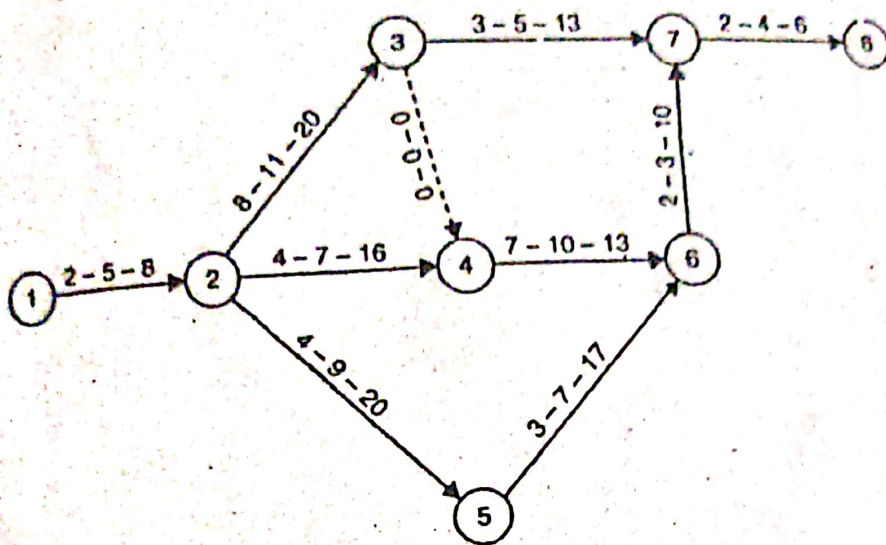
Compute the critical path for following networks



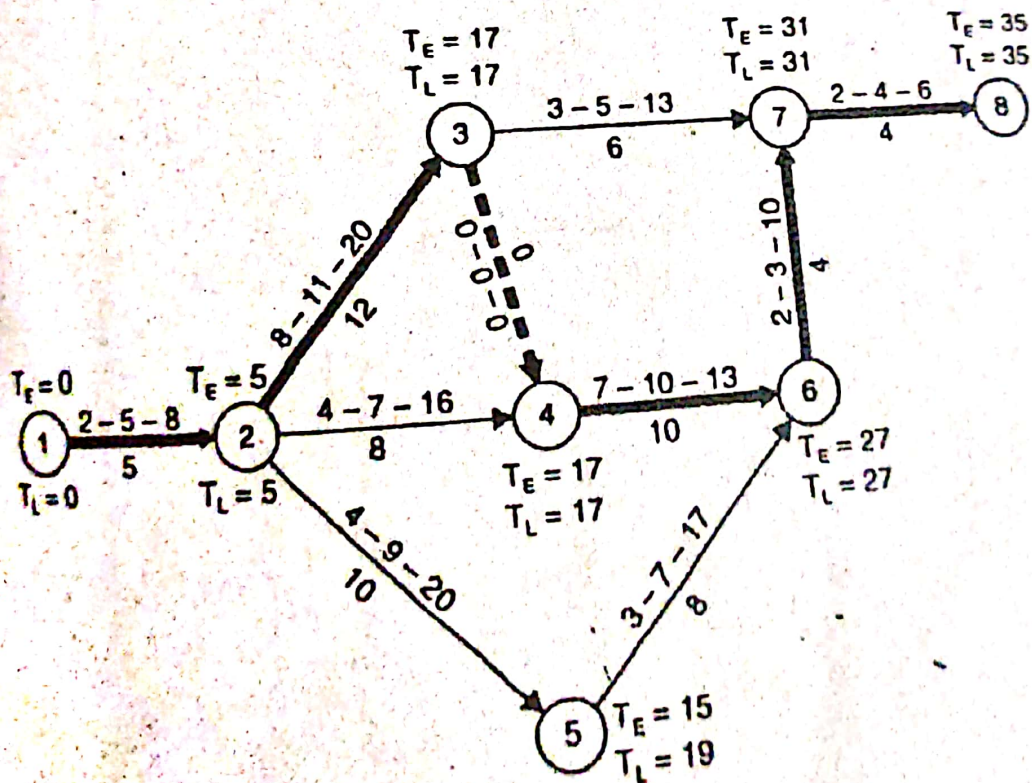
Solution:



Compute the critical path for following networks



Solution:



Chapter-5: Engineering Ethics

What is Engineering Ethics? Also write down the principle of it? (RAJUK-14)

Engineering Ethics: Engineering ethics is the field of system of moral principles that apply to the practice of engineering. The field examines and sets the obligations by engineers to society, to their clients, and to the profession. As a scholarly discipline, it is closely related to subjects such as the philosophy of science, the philosophy of engineering, and the ethics of technology.

General Principle of Ethics: Fundamental principles of conduct of engineers include truth, honesty and trustworthiness in their service to society, and honorable and ethical practice showing sagas to fairness, courtesy and good faith toward clients, colleagues and others. Engineers take societal, cultural, economic, environmental, and safety aspects into consideration, and strive for the efficient use of the world's resources to meet long term human needs.

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Reference Book:

PROJECT PLANNING AND CONTROL With PERT and CPM by Dr. B. C. Purnia & K. Khandelwal