Management is a function of guidance and leadership, control of efforts of a group or individuals in order to achieve goals/ objectives of an organization. Management has gained importance in recent days. It is possible for any country to reach a substantial level of economic development by bringing together the 5 M's (Men, Money, Materials, Machines and Management).

Management is generally the same process in all forms of organizations, but may vary in its complexity with size and nature of organization. It is a dynamic and life-giving element in every organization. It resolves disputes, provides leadership and adopts the organization to its changing environment. It plans the activities, sets individual and overall goals, engage right and suitable people, provide necessary training to carry out the work more effectively and efficiently, leads, monitors, controls and helps in overall functioning of any organization

## NATURE AND CHARACTERISTICS OF MANAGEMENT

Management: Management is the attainment of organizational goals in an effective and efficient manner through planning, organizing, staffing, directing and controlling organizational resources. Organizational resources include men (human beings), money, machines and materials.

### Characteristics:

1. Management is a Process:

- A process consists of series of interrelated activities or steps to be followed in a sequence.
- Management process includes 5 steps of functions- planning, organizing, staffing, directing and controlling. Here the management process starts with planning and ends with controlling.

2. Goal oriented:

- The primary tasks of management is achieving the goals .The goals can be defined as the end expected results that can be actualized in the future.
- A manager, by applying managerial knowledge achieves goals with given resources in time.
- If one has nothing to achieve, there is no need of management.

3. Decision Making:

- Management is synonymous with decision making and a manager is known as decision maker consists of a set of decisions.

- Success of an organization depends upon quality of decisions taken by its manager.
- A manager takes decision on various areas like finance, marketing, personnel and production.

4. Working with and through people:

- A manager makes the people in an organization work. He himself doesn't perform the actual work but is responsible for lending motivating, directing and controlling the efforts of people to get the desired results.
- Hence management is essentially a human activity in which a person (manager) manages people (employees)

5. Factor of production:

- There are 4 factors of production (Land, labor, capital and entrepreneur). Except entrepreneur others are passive and they cannot contribute automatically to the organization activities.
- The entrepreneur organizes and co-ordinates these productive resources in an optimum manner to get maximum possible results. Here the manager integrates the efforts of employees for effective achievement of objectives.

6. Integrated activity:

- Management integrates the activities and functions of various groups and departments. Integration is necessary to ensure that all people, groups and departments work consciously and actively for the same purpose.
- If not integrated it would lead to failure of objectives.

7. as an art and science:

- Management is both an art and science.
- It satisfies most of the conditions of an art and some conditions of science.
- An art increases with practical use of managerial knowledge and science concerns with systematic development of knowledge.

8. as a profession:

- Management is also regarded as profession. A profession is specialized knowledge which is based on intensive study, experienced and observation and is use to serve others for fees.

- Management cannot be treated as pure profession as all the conditions of a profession and may not be fully satisfied.
- It is considered as emerging profession moving towards professional status.

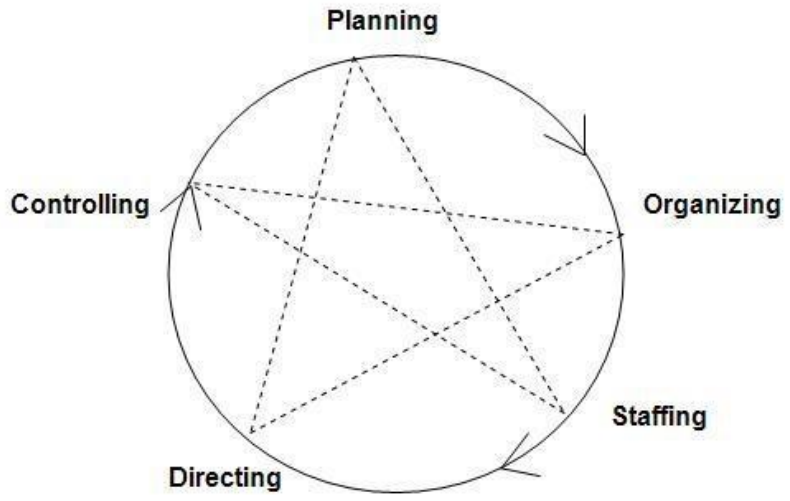
9. Management universal activity:

- Many experts believe that management is universal. Any subject which can be applied everywhere in all the times without any discrimination can be said to be universal.
- Management is universal with reference to fundaments, concepts, processed principles and functions.

10. Multi displinary subjects:

- Management is managing human beings .
- To this end, management has enriched its knowledge by borrowing concepts, principles and theories from disciplines like economics, marketing, sociology, psychology etc.
- Management is a combination of all the subjects or disciplines.

## FUNCTIONS OF MANAGEMENT




- Planning
- Organizing

- Staffing
- Directing
- Controlling

**Planning:**

- Planning is the primary functions of management. It is a thinking process. It determines the future course of action by deciding what to do (types of work), what to do(objectives), when to do(time), where to do(place or location), how to do(methods and procedures), who is to do (people).
- Thus planning helps in selecting the best course of action among several alternatives but can contribute most to the objective of the organization.
- A planning mostly includes forecasting and decision making.
- The process of planning involves analyzing business environment , establishing objectives, setting planning premises , identifying alternatives, evaluating alternatives, selecting best alternatives, formulating secondary plans, implementation of plan.

**Organizing:**

Organizing is the second function of management. It is the process of bringing together physical, financial and human resources and developing productive relationship amongst them for achievement of organizational goals.

According to Henry Fayol,

“To organize a business is to provide it with everything useful or its functioning i.e. raw material, tools, capital

- It is dependent on type of plan. It is aimed at preparing a formal structure design of the organization, consisting of people, task, responsibility, authority, communication network and a scheme for organizing all these aspects.
- The structure so prepared facilitates implementation of the plan. The structure is presented in the form of an organization chart.

- Organizing ensures provision for all activities necessary for accomplishment of desired objectives. As a result of organizing , various positions come into existence. Different departments and divisions are created.
- The process of organizing includes the following steps.

1. Determining activities necessary for achieving objectives.
2. Classifying and grouping of activities into units.
3. Assigning tasks and duties.
4. Establishing relationships among several position holders
5. Preparing organization chart and manual.

**Directing:**

- Directing is also known as commanding or executing function. It involves instructing, guiding, inspiring, supervising employers to make them work according to the plan.
- The manger needs to suitably and advocately direct employees to ensure better co-ordination and integration in their efforts so as to achieve the objectives.
- Directing techniques includes

1. leadership-It is concerned with guiding and instructing employees at work.
2. Motivation-It is concerned inspiring and encouraging people at work.
3. Communication- It is concerned with providing receiving necessary information
4. Supervision- It is concerned with observing and correcting employees work.

**Controlling:**

- Controlling is the last but very critical function management. It is regulating function.
- It ensures that the plan has been implemented successfully and easy accomplishing objectives.
- A suitable control management helps in achieving objectives effectively and efficiently.

- Controlling is useful in finding out what is wrong and how it can be corrected. This function helps in preventing and improving poor performances.
- It should be noted that both planning and controlling are interrelated and independent.
- Planning is meaningless if there is no control and controlling is impossible if there is no plan.
- The process of controlling involves the following steps:

1. Settling standards
2. Measuring actual results
3. Comparing actual results with expected results
4. Identifying deviation between actual results and expected results
5. Taking corrective actions so that actual results match with expected results.

## SCOPE AND FUNCTIONAL AREAS OF MANAGEMENT

1. Product Management

- It is applicable of management principal to the production function in a factory.
- It involves application of planning, organizing and controlling the production process.

2. Financial Management

- It refers to the efficient and effective management of money in such a manner as to accomplish the objectives of the organization.

3. Human resource Management

- It is the management of human resources.
- It is designed to minimize employees performance in service of an employers strategic objectives.
- Human resources is concerned with the management of people within organization focusing on policies and on system.

4. Marketing Management

- It is the organizational discipline with focuses on practical application of market orientation techniques and methods inside enterprises and organizations and on the management of firms marketing resources and activities.

5. Materials Management

- The planning and control of the functions supporting the complete cycle of materials and the associative flow of information's.

6. Transportation Management

- It is the sub set of supply chain management conquering transportation, operations and may be part of an enterprise resource planning system.

7. Supply chain Management

- The management of the flow of goods and services involve the moment and storage of raw materials and finished goods from point of origin to point of consumption.

8. Sales Management

- A business discipline which is formed on the practical application of sales technique and the management of firms sales operation. It is an important business function as net sales through the sale of products and services and resulting profit in commercial business.

## LEVELS OF MANAGEMENT

There are 3 levels of management in business i.e top level, middle level and lower level, each having different roles and responsibilities.

The top level management constitutes the chief executive and directors. At this level, the mission goals, corporate strategies are formulated. Long term plans are made. Major policy decisions are taken. Basic organizational structure is outlined. The employees are motivated to strive for meeting organizational objectives. The performance of middle level managers is evaluated and controlled by the top management. The time horizon for this level of management is often 5-10 years. in business organization, the top management is solely responsible for the welfare of all employees.

Middle level management is responsible for carrying out the decisions and policies made by the top management. It includes departmental managers, functional managers such as marketing manager, production manager, and others. Here, the managers plan, organize, direct, and control for the activities within their respective departments only. The time horizon for this level of management is commonly one year. They are responsible to their superiors for the operations of their department or unit only.

Lower level management is is also called operational level, which includes foremen, superior. Managers at the operational level supervise their workers in their day to day tasks. As a part of this, they plan (make targets and schedule), organize (allocate tasks and time to meet daily targets), direct( instruct and motivate the employees to do the better job), and control (ensure that the work is completed satisfactorily according to the schedules). The time horizon for this group may vary accordingly: between a week and a month. They are responsible for the work of all the employees under them.

## PLANNING

- The beginning process of management is Planning. It is in fact a blue print of a business, how it grows, how it implements various actions required for growth etc.
- Planning is deciding in advance what to do, how to do, when to do and who is to do.
- Planning sets goals and therefore is the corner stone of management.
- It is the process of analyzing the situation, determining the objectives that will influence in the future and deciding in advance , the actions that will be taken to achieve the goals.
- It involves anticipating the future and consciously choosing the future course of action.
- It is the basic function of management. It deals with chalking out a future course of action & deciding in advance the most appropriate course of actions for achievement of pre-determined goals.
- According to KOONTZ, "**Planning is deciding in advance - what to do, when to do & how to do. It bridges the gap from where we are & where we want to be**".
- A plan is a future course of actions. It is an exercise in problem solving & decision making. Planning is determination of courses of action to achieve desired goals. Thus, planning is a systematic thinking about ways & means for accomplishment of pre-determined goals. Planning

is necessary to ensure proper utilization of human & non-human resources.

## TYPES OF PLANNING:

- **Purposes or missions,**
- **Objectives**-It is the ultimate goal towards which the activities of the organization are directed
- **Strategies**-general program of action and deployment of resources
- **Policies**-general statement or understanding which guide or channel thinking in decision making
- **Procedures**-states a series of related steps or tasks to be performed in a sequential way
- **Rules**-prescribes a course of action and explicitly states what is to be done
- **Programs**-comprehensive plan that includes future use of different resources
- **Budgets**-statement of expected results expressed in numerical terms

## IMPORTANCE OF PLANNING:

1) Planning minimizes risk and uncertainty:

- By providing more rational, fact based procedure for making decisions-planning allows the management to minimize the risks and uncertainty.
- It helps in coping with changing environment.
- Planning helps the manager to relate the uncertainty and possibility of tomorrow, keeping in mind facts of today and yesterday and by making assumptions of business environment.

2) Focus on attention on the tangeted goal/ objective:

- Proper planning ensures that organizations goals and objectives are never set aside.
- It constantly reminds the manager to focus his attention towards the intended and present goal

- It enables the project team and its leader to workout in advance an orderly sequence of steps for realization of organizational goals .
- Planning rings in the quality, economy and team effort, since by the effort of all the employes the organizational goals are achieved.

3) Orientation of activities towards success:

- Planning does not guarantee success. It provides the direction to employees so as to what and how to do.
- Employees know in advance how work has to be done and in which direction they should work. This leads to unity of direction also.
- If there was no proper direction, the organization will be unable to achieve the desired goals.

4) Planning establishes standard for controlling:

- Controlling means comparison between planned and actual output, if there is difference, measures has to be taken.
- In planning, setting of goals and development of activities to accomplish the goal is established. Thus these goals are bench marks to which the accomplishment is related and measured.
- So the controlling has to be done towards conformation of the activities as per the plan.

5) Planning reduces over lapping and wasteful activities:

- The organizational plans are made keeping in mind, the requirements of all the departments. The department plans are derived from main organizational plan.
- As a result, there will be co-ordination in the different departments.
- Plans ensure clarity of thoughts and action and work can be carried out smoothly.

6) Planning facilitates decision making:

- Planning helps the manager to take various decisions.
- As in, planning goals are set in advance and predictions are made for future. These predictions and goals helps the manager to take fast decisions.

## PURPOSE OF PLANNING:

1) Identification of common objectives and goals, keeping in mind, vision and mission of the organization.
2) Establishing communication channels, systems and method in an organization.
3) Co-ordination between different functional groups within the organization, consultant, market and end users.
4) Defining authority and responsibility within the organizational structure.
5) Ensuring effective functions of an organization in a dynamically changing environment. Planning process needs to be systematic and shall take care of economic, social, political and logical environmental influences, which may affect the functions of organization.
6) Planning process identifies and determines the activities to be performed in a sequential manner and shall always focus on time and cost optimization along with effectiveness of product delivery.
7) Through proper planning it would be easy to exercise control measures/ corrective steps so that the performance of individuals.
8) The numbers, needs, preferences and limitations of the objectives and persons are updated periodically to achieve the objective of excellence in performance.
9) The planning process should ensure that statutory provisions/ law of land etc are not violated and whenever needed proper permissions/ consents are duly obtained.
10) The planning shall invariably ensure that there is least disturbance to the surrounding environment and there are no adverse socio-economic effects of people around.

## TYPES OF PLANS:

- Single use plan:

These plans are generally prepared for one time use. The aim of these plans is to meet the needs of a particular situation. They are developed to achieve non-routine and unique goals of an organization. The course of action developed as a part of these plans is less likely to be repeated in future.The important forms of single use plans are programs, projects, budgets etc.

- Standing Plans:

These plans are repeatedly used because they focus on situations that regularly over a period of time. The primary purpose of standing plans is to make sure that the internal operations of the organization are performed efficiently. Standing plans are normally developed once and then modified to suit the changing business needs. These plans offer guidance for repetitively performed actions of the organization. Policies, procedures, and rules and regulations are important forms of standing plan.

- Strategic Plan: This is concerned with broad matters that may vitally effect the department of an organization. The factors include the economic, technological and environmental factors. The emphasis based upon predicting the future behavior of external variables and formulation of alternative types.
- Administrative Plan: this is less subjective than strategic plan .it focuses on how to accomplish the objective of the project or organization. This type of planning is concerned within the control of the organization.

**STEPS INVOLVED IN PLANNING**:

1) Define-Crystalizing the opportunity or problem. The first step of planning would be to find out the problem or identity the opportunity to be sized. This is necessary to be able to formulate practical and realistic objectives. Thus, the objective of the project has to be defined in definite goals.
2) Analysis- It is necessary to determine the nature of the information required and where this information will be available. This information must be analyzed to establish the relationship and tabulate them.
3) Evaluate- The resources such as financial, managerial, operational are to be evaluated and this evaluation is important to carry out activities and to determine what is feasible or not.
4) Alternative Determination- Based on the analysis and evaluation, possible alternative coarse of action will be identified and examined.
5) Selecting optimum plan- An evaluation of the above alternative course of action can be carried out either by judgment alone or with the help of quantitative techniques and staff assisstants, to suit the interest of the organization.

6) Determining derivative plan- The above selected plan will form the basic plan from which other plans will develop to support it.
7) Deciding the time of introduction- The question of timing who will do, what will have to be decided and an appropriate time schedule drawn up with the details of construction work for communication.
8) Arranging future evaluation of plans- Since he ultimate aim of the plan is to achieve the objective, result or goal, an evaluation at the earliest possible opportunity is necessary to evaluate the adequacy of cost and time and determining within the planned objectives and reached as desired.

## CONSTRUCTION TEAM

- Generally this consists of the Owner, the engineer and the Contractor. Each one has to discharge his responsibility and co-operate with the owner members. Usually delays and accidents occur due to unco-ordinated efforts among the members of the team. The construction team members have to co-ordinate each other's for completing the project as per drawings, design and specifications within the stipulated time.
- The owner or the user is the initiator of the project.
- The engineer is responsible for the preparation of estimates, design of various components of the work, procurement of the material and labour and supervision of the work.
- The major works construction team consists of: Owner, design professional (engineer/ architect) general contractor, sub-contractor, suppliers and other consultants.

## INTRODUCTION TO CONSTRUCTION MANAGEMENT

Construction Management comprises of systematic approach to manage cost, time and quality of construction project based of recorded research and experience.

Construction Management deals with economical consumption project (Men, Materials, Machinery and Money) is termed as resource in construction management.

**Importance of Construction Management**

- Proper management practices lead to "maximum production least cost". A good project management results in completion of a construction project with the stipulated budget.
- Construction management provides importance for optimum utilization of resources.
- Construction management provides necessary leadership, motivates employees to complete the difficult task in time and extracts potential talents in employee.
- Construction management is beneficial to society. Effective and efficient management of construction projects will avoid escalation of costs, time overrun, wastage of resources, unlawful exploitation of labor and pollution of environment.

**Necessity of Construction Management**

- To check wastage of material and labor.
- To arrange completion of the work in the minimum possible time.
- To effect the economy in the cost of construction by adopting new techniques of construction and supervision etc.
- To improve the quality and speed of work by using modern equipment and machinery on construction.
- Using modern techniques of management to have proper co-ordination.

**Objectives of Construction Management**

- The work should be properly planned and organized.
- The work should be executed as per specifications.
- The work should be completed within the specified time and estimated cost.
- The workmanship and quality of the work shoud be good.

## PROJECT ORGANIZATION

Organization is a group of people working together to achieve the common goal set by a firm. Organization is a social entity that has a collective goal and is linked to an external environment. This organization helps the manager to relate tasks to people and to other agencies in order to achieve an economical and timely completion of the project.

**Principles of organization:**

- Objectives -Objectives must be clearly defined as the entire enterprise for each department and even for each position in the organization structure. There must be unity of objective so that all efforts can be concentrated on the set goals.
- Specialization –Effective organization must include specialization precise division of work facilitates specification.
- Co-ordination –organization involves division of work among people whose efforts must be co-ordinated to achieve common goals. A manager is mainly a co-coordinator. Chosen grouping of activities minimize co-ordination problems.
- Clear unbroken line of authority- The line of authority flows from the highest executive to the lowest managerial level and chain of command should be broken.
- Responsibility – Authority should be equal to responsibility i.e. each manager should have enough authority to accomplish the task.
- Unity of command – Each person should be accountable to a single superior i.e. one superior or one boss and one sub co-ordinate. Thus no one in the organization should have more than 1 boss.
- Span of control – No superior at higher level should have more than 6 immediate sub-ordinates. Grouping must ensure that each supervisor and manager is not over-burdened with subordinates.
- Communication – A good communication is essential for smooth flow of information and understanding and for effective business performance.
- Personnel ability- Organization structure must encourage management development program and ensure optimum use of human resources.
- Flexibility- It should be adaptable to changing circumstances. It should not be rigid or in elastic.
- Grouping of activities – A good communication involves precise and systematic distribution of work and responsibilities between managerial group and administrative group. Departmentation maintains balance and harmony in the working of the organization.

**ORGANISATIONAL STRUCTURE:**

An **organizational structure** defines how activities such as task allocation, coordination and supervision are directed toward the achievement of organizational aims.[1] It can also be considered as the viewing glass or perspective through which individuals see their organization and its environment.

## TYPES OF ORGANISATION STRUCTURE

### 1. LINE ORGANISATION

This is the oldest and simplest form of organization. It is also called as military organization. There is a clear line of authority and responsibility between the superiors and subordinates. Line Organization is practiced in many private construction programmes and in government construction projects.

**Advantages**

- Discipline among the employees is enhanced
- It is simple, easy to understand and there is a clear line of authority
- Facilitates quick decision making and responsibility for any mistake can be fixed easily

**Limitations**

- Communication from lower to top level management is handicapped
- There is too much concentration of authority at the top levels leading to partiality of favoritism
- Innovation and creativity are hampered

### 2. FUNCTIONAL ORGANISATION

In this type, whole work is divided in such a way that each person has to perform a minimum number of functions and is responsible for those functions. All similar and related works are grouped together under one person. This type of organization permits tightest discipline and control of any of the organizational concept.

**Advantages**

- Entire work is divided on the basis of functional specialization and hence the efficiency will be increased
- Mental work is separated from manual work
- The work will be completed with better quality due to the functional specialist

**Limitations**

- There is no clear cut line of authority and each subordinate is accountable to a number of Specialist or

supervisor. This leads to the confusion among the subordinates

- Coordination becomes more difficult.

### 3. LINE AND STAFF ORGANISATION

It is a combination of line and functional organization. The functional specialists with their knowledge and experience carry out the staff responsibility, while the line authority maintains discipline and stability in the organization.

**Advantages**

- Good combination of specialist service with project construction team
- The project will be executed with better quality
- The line personnel can devote their entire time to achieve their target of the project
- The staff personnel carryout all the specialized work due to their skills and experience

**Limitations**

- Possibilities of conflicts between the line and functional staff
- Overhead costs will increase due to hiring the services of the specialist staff personnel

### 4. MATRIX ORGANISATION

Here the entire organization is divided into several departments. Each department is assigned with a specific task. Each department with the coordination of other department can effectively use the available resource. It is defined as, “Any organization that employees a multiple command structure but also related support mechanisms and an associated organizational culture and behaviour pattern”. This type of organization is best suited where large number of small projects are to be managed. For the matrix organization to function effectively, the following conditions should prevail,

- Scalar chain of command is not followed i.e. a project manager will give reports to several Superiors.
- The physical, financial and human resources are to be shared by people of different projects in a cooperative way.
- Sharing the resources may lead to conflicts if not understood each other properly.

**Advantages**

- It combines the advantages of functional and line organization.
- It ensures the achievement of objectives with technical specialization.
- It ensures effective utilization of available resources.
- It adopts itself easily to external changes.
- It is highly flexible.
- Motivation can be effectively applied.
- Makes room for training and development of people

## MANAGEMENT STYLES

Effective management style is the extent to which a leader continually and progressively leads and directs followers to a pre-determined designation agreed upon by the whole group. It is a manner of approach to issues of the managers towards achieving the goals of their organization by transforming various resources available to any organization by transforming various resources available to any organization into output through the functions of management.

Management style is based on different behaviors or actions that manager exhibits in different leadership positions. This is also known as leadership styles. A manager has to lead different types of sub-ordinates and has to adopt different styles for leading them accordingly to situations.

Following are 3 main type ofs of management styles

- Autocratic or authoritarian style
- Democratic or participative style
- Laissez-faire or Free rein style

1. AUTOCRATIC

- A style of a manager who tends to make unilateral decisions and centralizes authority is called the autocratic leader. Autocratic manager uses legitimate, reward and coercive power to influence others.
- Autocratic manager basically make decisions without consulting the sub-ordinates. Such leaders also also known as task master or dictator. Such leader maintains high degree of control. They st

very clear, quantitable, short term objectives using rewards for successful accomplishment and punishment for non-achievement. They are task oriented hence when immediate productivity gains are required, autocratic leaders prove to be very effective.

2) DEMOCRATIVE

- A behavioral style of leader who tends to involve the group in decision making, to delegate authority and encourage participation is called democratic or participative leadership style.
- Democratic leaders tend to use referent and expert power to influence others.
- They take pride in involving sub-ordinates in decision making process. They encourage group involvement in setting objectives and establishing strategies.
- They promote high morale and are concerned with work climate and atmosphere. They look in position manner to the situations. It is based on the assumption that everyone can contribute to the organization if they are asked to do so.

3) LAISSEZ-FAIRE STYLE

- A behavioral style of leader who generally gives the group complete freedom, provides necessary materials, participates only to answer questions and avoids giving feedback is called Laissez-Faire style
- This philosophy can be used when workers are knowledgeable, motivated, goal directed and independent.

## CONSTRUCTION PLANNING AND SCHEDULING

### TYPE OF PROJECT PLANS:

| Development Stage | Nature of plan |
|---|---|
| Inception Stage | Project feasibility plan |
| Engineering Stage | Project preliminary plan |
| Implementation Stage | Project construction plan |

1) Project Feasibility Plan:

Planning by client begins as soon as he gets the idea about developing a facility to fulfill certain motives. His early thought process conceptualizes the cost, time and benefit implication of his idea he decides to go ahead with feasibility studies.

Feasibility study team examines needs of the client and the way to fulfill them. It defines the overall scope of the work and breaks it down into various task groups. It develops an outline plan of work and assesses time and cost of accomplishing project. This outline plan forms the basis for identifying project objectives and developing project plan.

2) Project Preliminary Plan:

Its aim is to provide direction to the client managers and staff employed during development phase of project. The project preliminary plan forms basis for developing the project construction plan.

Preliminary plan may include the following:

- A project time schedule and selection network to highlight work dependencies, project milestone and expected project completion time.
- Project design and drawing preparation schedule.
- A breakdown of projects into contracts along with schedule of activities, including tender preparation period, tender finalization period, start and final date of work.
- Forecast of resources indicating phased requirement of men, important materials, plant and machinery.
- Resource procurement system
- Project organization and staffing pattern.
- Preliminary forecast of funds requirements.

3) Project construction plan:

- The project management team may be from clients own construction agency or a client appointed construction management consultant firms.

This plan includes the following:

1. Time Plan -It depicts the schedule of project activities for completion of project within specified time.

2. Resources Plan –it forecast required input resources of men, material, machinery and money for achieving project completion time target and cost objectives.
3. Plan for Controlling Project – It encompasses design of control system, monitoring system, codification system and computerized information.

**Project Planning**

Project planning involves the following

- Material coordination
- Labour coordination
- Finance coordination
- Risk analysis
- Quality assurance

**Objectives of planning**

- Planning helps in proper design
- Proper selection of equipment and machines
- Constant flow of funds
- Employment of trained and experienced staff

**Steps in planning**

- Identification of problem/opportunity. This is necessary to formulate practical and realistic goals.
- Securing and analyzing necessary information
- The analysis of the information will lead to formulation of certain processes and course of action.
- Ascertaining alternative course of action
- Selecting an efficient plan

**SCHEDULING:**

Scheduling is the graphical representation which shows the phasing rate of construction activities with the starting and completion dates and the sequential relationship among the various activities on operation in a project so that work can be carried out in an orderly and effective manner.

Scheduling is defined as putting the project on a calendar basis. A project network shows the sequence of interdependence of activities and their time duration. However, it needs to be scheduled to determine the commencement and termination dates of each activity, using optimum resources.

**Preparation of construction schedules:**

1. The project is divided into number of operations and the sequences of this operations can be derived after knowing their relationship properly.
2. The quantity of work involved in each operation has to be calculated.
3. The time required for the completion of the project as well as the different activities are to be calculated.

**Methods of Scheduling**:

1. Bar or Gantt chart
2. Milestone charts
3. Network analysis

**Advantages of scheduling**

- Clear picture regarding the resources is obtained
- Arrangement and rearrangement of activities can be done prior to the commencement of Work
- Monitoring of work is streamlined
- Total duration of the project is known and is suitable for all type of project

**Uses of Scheduling**:

- It gives the quantity of work involved , labor, materials and equipment's for each stage of work
- The actual progress of the work can be checked
- The project can be carried out in a systematic manner using scheduling.

## WORK BREAKDOWN STRUCTURE

A work breakdown structure expresses the project scope in simple graphical terms. The diagram starts with a single box at the top to represent the entire project, the project is then divided into different components with related activities or elements listed under them. Work breakdown structure involves breaking down of the project work into manageable parts (sub-projects, tasks, work packages and activities) arranged in a hierarchical order until the desired level is reached. Company owners and project managers use the work breakdown structure to make complex projects more manageable.

**Reasons for creating WBS in a project**:

- Accurate and readable project organization.
- Accurate assignment of responsibilities to the project team.
- Indicates the project milestones and control points.
- Helps to estimate the risks that occur
- Helps for more accurate estimation of cost and time.
- Used to report program status

The work breakdown levels are broadly cauterized into **five levels**. They are,

- Sub-project level
- Task level
- Work-package level
- Activity level
- Operations level

- **Sub project Level** – They are derived by dividing the project work into independent large volume mini-projects or task groups.
- **Tasks Level** – The project or sub project work can be split up into various tasks. A task is an identifiable and deliverable major work. It is an entity in itself and can be performed without much interference from other tasks. Each task is assigned time and cost objectives and is provided with planned resources for accomplishing the task objectives. The task execution is entrusted to a task responsibility unit headed by a manager or a senior engineer.

- **Work packages Level** – A project task can be further subdivided into one or more work packages. Each work package contains a sizeable, identifiable, measurable, costable and controllable package of work. In a project master plan or the contracted works control plan, each work package is assigned its performance objectives. These are generally stated in terms of its completion period, standard cost, resource productivity standards and the standard sale price. The measure of performance thus gets closely linked with the execution of its work packages. Work packages form a common base for linking the key functions in project management. The work package concept leads to the simple management theory of managing, designing, estimating, planning, organizing, directing, communicating and controlling, using these work packages as the base lines.
- **Activity Level** – A work package can further be broken down into various identifiable jobs, operations and processes, which consume time and possibly, other resources and are necessary for its completion. Each one of this is called an activity. The breaking down of a work package into its constituent activities requires a study of the methodology of execution of the work package. This methodology, generally known by the term 'method statement', is evolved by the concerned planning engineer using his construction experience and through his discussions with the respective project engineers
- **Operations Level** – An activity comprises one or more operations. Each operation contains a part of the work content of the activity. It generally has a particular type or a fixed group of resources associated with it. It is performed during the scheduled time duration of the activity. Some operations may start with the commencement of the activity, while others may take place during its time duration. Operations are not considered during the network modelling and analysis stage except that the sum of the costs of operations equals the activity cost. They form the basis for allocation and scheduling of resources of each activity.

**Project management tools**

- Gantt chart
- Network diagrams
- Histograms
- CPM – Critical Path Method

## GANTT CHART/ BAR CHART

Hennery Gantt introduced Gantt chat or bar chart around 1900 AD. It is the oldest project management tool. It consists of two coordinate axes, horizontal axis representing the time elapsed and vertical axis representing the jobs or activities to be performed. Each bar represent one specific job or activity of the project. The beginning and end of each bar represent the time of start and time of finish of that activity. The length of bar therefore represents the time required for the completion of that job or activity. Each bar can be represented either by a set of two lines running parallel to each other or by a thick solid line.

**Development of bar chart**

The following is the important stages in developing a bar chart

- BREAKDOWN: The project is broken down into various activities, jobs, or operations, each representing manageable unit for planning and control.
- DECIDE: The method to be employed in execution of the project, as well as for each activity or operation or task is decided. In addition, the sequence in which the activities are to be completed is decided.
- ASSIGN: Duration of time for the completion of each activity is assigned. Once the activities are separated and choice of method is made, it is possible to estimate the time required for the completion of each activity.
- REPRESENT: The above information is represented in a bar chart indicating the relative positions of each activity.

**Advantages of Gantt chart**

- It is to represent the Project schedules and Activities
- Easy to represent Tasks, Sub-tasks, Milestones and Projects Visually on a Graph
- Clear visibility of Dates and Time Frames
- It helps to see the Plans by Day, Week, Month, Quarter and Year
- It helps in effective time management
- Easy to check the project status

**Limitations of Gantt chart**

- Require more efforts for Creating and Managing the Chart

- They can only be used for small projects
- It does not show the interdependies between various activities in the project
- Delays in the work cannot be detected
- It does not indicate the critical activities in the project
- The progress of work in the project cannot be monitored scientifically
- It gives some idea about the physical progress of the project, but the financial aspect involved is not known
- Updating a Chart is Very Time Consuming
- All Tasks are not visible in a single view of a Gantt, need to scroll and Click additional buttons to view remaining items

## MILD STONE CHART

Mild stone chart is a modification over the original bar chart. Milestones are key events of a main activity represented by a bar, these are specific points in time which mark the completion of certain portions of the main activity. These points are those which can be easily identified over the main bar. It is seen that when a particular activity, represented by a bar-chart is very long.

The activity is broken or sub divided into a number of sub activities, each one of which can be easily recognized during the progress of the project, controlling can be easily done and inter relationship between other similar activities can be easily established. The beginning and end of these sub- divided activities or tasks are termed as milestones.

## NETWORK

A network is a graphical and logical model or plan which lists out the sequence of various operations which are required to be performed for the final achievement of the project objectives.

**Objectives of Network Techniques**:

- It provides an integrated construction management of projects.
- Determines project duration more accurately.
- Identifies the effect of schedule delays well in advance for timely corrective action.
- Facilitates optimization of resources.

- Provides a scientific method of progress reporting and progress control, enabling the management to take better decisions for effective monitoring.

**TYPES OF NETWORK**:

1) Activity on arrow (AOA) or arrow diagrams
2) Activity on node (AON) or precedence diagram
3) Event oriented network (PERT type)

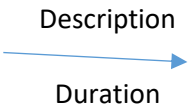
1) A-O-A Networks:
   - It is composed of arrows and nodes.
   - Arrow represents the activities and node represents the event
   - Each activity carry a brief description usually printed on the logical diagram, the activity name or symbol and the time duration.
   - At present, this method seems to be most popular method and it was the first method to be introduced, developed and computerized.
   - It is also easier to associate with time flow of activity.
2) A-O-N Network or Precedence Diagrams:
   - In A-O-N networks, the nodes represent the activities and the arrows, their interdependencies or precedence relationships.
   - Nodes are usually represented by circles, squares or rectangles.
   - Activity number and description are written within the boxes representing the nodes.
   - Length and direction of the arrows have no significance as they indicate only the dependency of one activity on another.
   - Precedence diagraming allows more flexibility in modeling relationships than A-0-A networks as it eliminates dummy activity.

**PREPARATION OF NETWORK DIAGRAM**

**TERMS AND DEFINATIONS:**

**ACTIVITY** –Activity stands for time consuming part of the project. It represents a job. It is denoted by an arrow.

- An activity is denoted by an arrow
- Length of the arrow has no significance
- The symbol above arrow indicates activity description.
- The number below indicates activity duration in time




**EVENT** –the event also called a node, which is either starting or end of the job. It indicates a particular instant of time at which some specific milestone has been achieved. It does not consume any resource or time by itself.

**NETWORK**- When all activities and events, in a project are connected, logically and sequentially they form a network.

**Types of events**

**TAIL EVENT** – An event, which marks the beginning of an activity, is called the tail event

**HEAD EVENT** - An event, which marks the completion of an activity, is called the head event

**DUAL ROLE EVENT** – An event, which acts as an tail event for some activity and head event for some other activity

**BURST and MERGE EVENT** – The nodes to which a number of activities converge are called merge event. The node from which a number of activities emerge are called as burst events.

**Interrelationship of events**

**SUCCESSOR EVENT** – An event that follows a particular event in the sequence of their completion is called a successor event to that event.

**PREDECESSOR EVENT** – An event which occurs before the particular event in the sequence of completion are called predecessor event.

**DUMMY** – A dummy is a type of operation in a network which neither requires any time or resource, but is merely a device to identify a dependence among operations. A dummy is also represented by an arrow, but since it is not an activity, it is represented by dashed arrow.

**Uses of dummies**

- Grammatical purpose – no two activities should have common initial and final node.
- Logical purpose – any activity cannot have dual identity. It should have unique identity.

**Rules for drawing network**

- A network will have only one initial node; initial node will have outgoing arrows.
- A network can have only one final node, final node will have only one incoming arrows.
- No activity can start until its tail event has started.
- An event cannot occur until all the activities leading up to it are completed.
- No event can occur twice. Hence network looping is not permitted.
- An arrow should represent a singular situation. Individuality and separate entity of each activity should be maintained.
- The network should be drafted such that all activities are completed to reach the end objective.
- All constrains and interdependies should be shown properly on the network using dummies.
- Network logic should always be maintained.
- The time flow is usually showed from left to right.

**Numbering the event (Fulkerson Rule)**

- There is a single initial event in a network diagram. The initial event will have arrows coming Out of it. Number this initial event as 1.
- Neglect all arrows emerging out of the initial event numbered 1. Doing so will apparently provide one or more new initial events.
- Number these apparently produced new initial events as 2, 3, 4 etc.
- Again neglect all emerging arrows from these from these numbered events, this will create few more initial events.
- Follow step 3

- Continue this operation until the last event.

## CRITICAL PATH METHOD

The critical path method (CPM) is a project modeling technique developed in the late 1950s by Morgan R. Walker of DuPont and James E. Kelley Jr. of Remington Rand.

The method of planning and scheduling based on network diagram in which total project time is determined by a sequence of activities is known as critical path method.

CPM is a procedure that was developed especially for the time management of construction projects.

CPM involves the analysis of the sequence and time characteristics of projects by the use of networks.

It provides information necessary for the time scheduling of a construction project, guides the contractor of time for completion of each activity can be made and cost estimation can be made with fair degree of accuracy.

It is applied usually for following types of project:

1. Building new bridges
2. Construction of multi-stored buildings
3. Extension of factory building
4. Manufacture of new automobiles
5. Repairs of locomotives
6. Shifting on manufacturing unit to the new site

The essential technique for using CPM is to construct a model of the project that includes the following:

- A list of all activities required to complete the project
- The time (duration) that each activity will take to complete,
- The dependencies between the activities and,
- Logical end points such as milestones or deliverable items.

**Steps involved in CPM**

1. Prepare a list of activities of the project
2. Estimate the duration of each activity

3. Determine the sequence in which activity or activities should follow or preceeds the other activities.
4. Draw a interconnected diagram with the activity or activities and events.
5. Assign the number of nodes.
6. Prepare a tabular columns which shows the activity, duration, earliest start time, earliest finish time, latest start and latest finish time , total floats of each activity.
7. Determine the critical path, minimum completion time of the project.

There may be various sequences of activities, leading the initial event to final event. These activities can be classified on the basis of degree of the floats.

**Advantages of CPM**

- The sequence of operations is established.
- Proper co-ordination of activities is established.
- Difficulties associated with the activities are known well in advance.
- Inter- relationship and sequence of performance of various activities/ items of work are clear from the network.
- Eliminate idle period and hence reduces project time and the cost.
- Provides most economical development of project resources such as personnel, equipment, machinery etc.

## EVENT TIMES

### 1) EARLIEST EVENT TIME

The earliest event time or the earliest occurance time is the earliest time at which an event can occur. It is the time at which all the activities discharging into the event under consideration are completed.

$$TEj = (TEi + tij)Max$$

Where,

TEi= the earliest event time of the tail event

TEJ= The earliest event time of head event

tij = Duration of activity ij

**2) LATEST EVENT TIME**

It is the latest occurrence time y which an event must occur to keep the project on schedule. It is denoted by TL

$$TLi = (TLj - tij)Min$$

## ACTIVITY TIMES

As discussed earlier, CPM is an activity oriented network method. Hence apart from 2 event times, activity times are also useful for analyzing the network.

**1) EARLIEST START TIME (EST)**

The earliest start time of an activity is the earliest time by which an activity can start. This is therefore equal to earliest event time of the tail event of the activity.

If (i-j) is the activity then,

EST = TEi

**2) EARLIEST FINISH TIME (EFT)**

The earliest finish time of an activity is the earliest time by which it can be completed. An early finish time is said to occur if the activity starts at its EST and takes the estimated duration for completion.

EFT = EST + tij

Or EFT = TEj + tij

**3) LATEST START TIME (LST)**

It is the latest time by which an activity can start without delaying the completion of the project as a whole. For this, the activity should start by a time equal to the latest finish time less the activity duration.

LST = LFT- tij

**4) LATEST FINISH TIME ( LFT)**

It is the latest time by which an activity can be completed without delaying the project. This will be therefore equal to the latest allowable time of the head end of the activity.

LFT = TLj

## FLOAT

Float denotes the flexibility range within which the activity start time and finish time may fluctuate without affecting the total project duration.

### 1) TOTAL FLOAT (TF)

It is the time span by which the starting or finishing of an activity can be delayed without affecting the overall completion time of the project. It is sometimes found that certain activities have a difference between the maximum time available for completion and their actual duration. The difference is termed as total float.

TF = LST - EST

= (LFT-tij) - (TEi)

### 2) FREE FLOAT (FF)

It is the duration by which an activity can be delayed without delaying any other succeeding activity. Free float is a portion of the total float.

FF = TEj - EFT

Or FF = TEj -( TEi+ tij )

### 3) INDEPENDENT FLOAT (FID)

It is the excess time available if the preceding activity ends as late as possible and the succeeding activity starts as early as possible.

FID = ( TEi – TLi ) – tij

### 4) INTERFERRING FLOAT

It is the difference between the total float and free float.

FIT = Total float –free float

## PROGRAM EVAULATION AND REVIEW TECHNIQUE (PERT):

- PERT is a management tool used for planning, controlling and reviewing a project.

**Uses of PERT**

1) This system is preferred for those functions, which are of non- repetitive nature.
2) PERT technique is most valuable in projects, where many of its activities require considerable research and development.

   E.g.: Space industry, aerospace industry, defense , production industry where large amount of uncertainties exist, for the development of new engineering designs, ultimate construction etc.

3) PERT is also a powerful tool for project management in planning, scheduling and controlling of projects.

## TIME ESTIMATES:

The 3 kinds of Time Estimates are as follows:

1) The Optimistic Time Estimate ($t_o$) – This is the shortest possible time, in which an activity can be completed, under ideal conditions. This particular time-estimate represents, the time in which people complete an activity. If everything went along perfectly, with no problems or adverse condition (worst condition) are assumed to exist.
2) The Pessimistic Time Estimate (tp) – It is the maximum time, that could be required to complete an activity. This particular time estimates represents, the time it might take to complete a particular activity if everything went wrong and abnormal situations prevailed( exists).
3) The Most likely Time Estimates (tm) – This represents, the time an activity would more often required, if normal conditions prevail(exits). This time estimate lies between optimistic and pessimistic time estimates. This time reflects a situation where conditions are normal, things are as usual.

**Difference between CPM and PERT:**

CPM

1. Activity oriented network
2. Time estimates are of a fair degree of accuracy
3. CPM follows the deterministic approach
4. Cost is the governing factor
5. Has only 1 time estimates
6. Concept of crashing is applied
7. CPM is used for repetitive jobs like residential construction.
8. The original is industrial based
9. Project duration is fixed so that the cost is minimum
10. Critical path is that which joins critical activities.

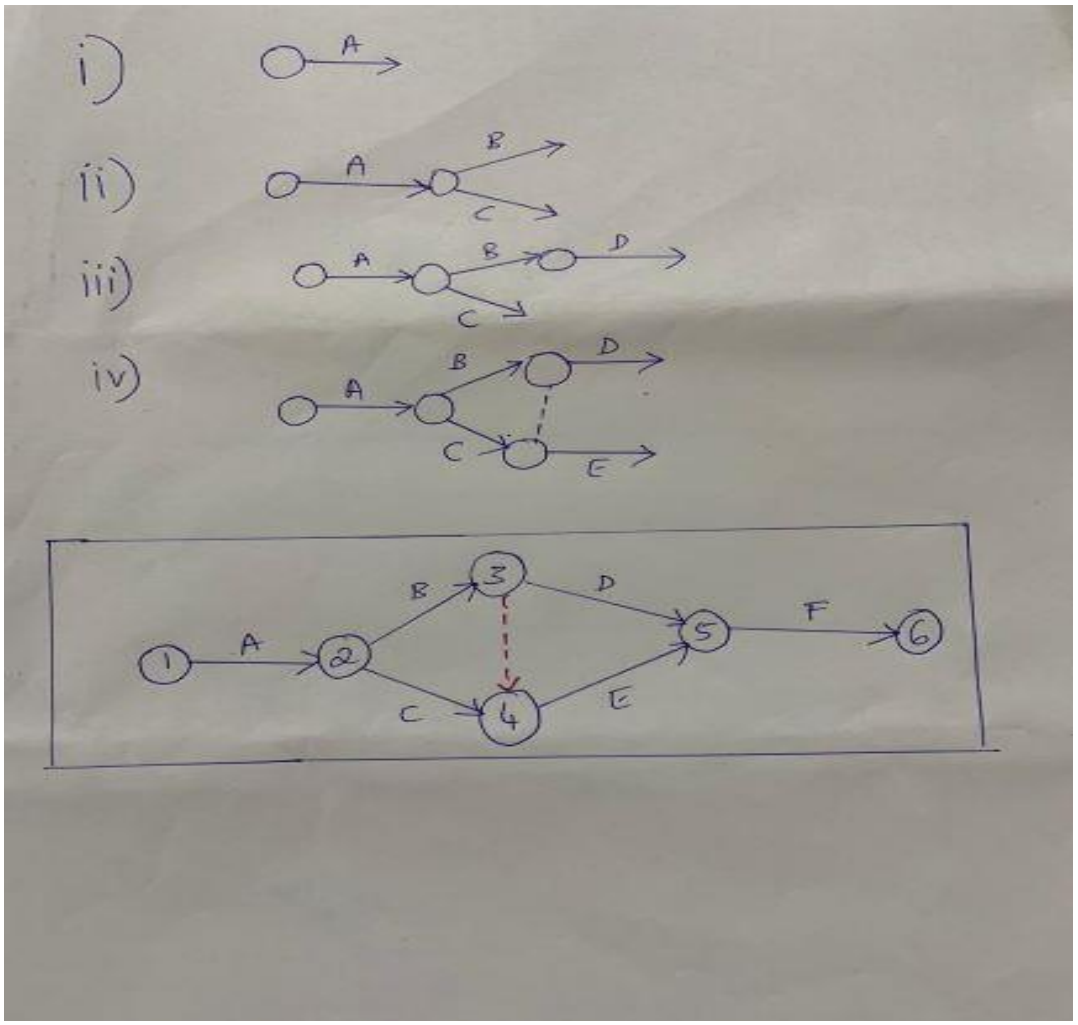
PERT

1) Event oriented network
2) Time estimates are not that accurate and there is an uncertainity attached to it.
3) PERT follows probabilistic approach
4) Time is governing factor
5) Has 3 time estimates
6) Concept of crashing is not applied
7) It is known for non-repetitive jobs like planning and scheduling of research program
8) The original is military based.
9) Cost is directly proportional to the time, so time is reduced to maximum possible so as to enjoy least cost
10) Critical path is that which joins critical events.

## PROBLEMS

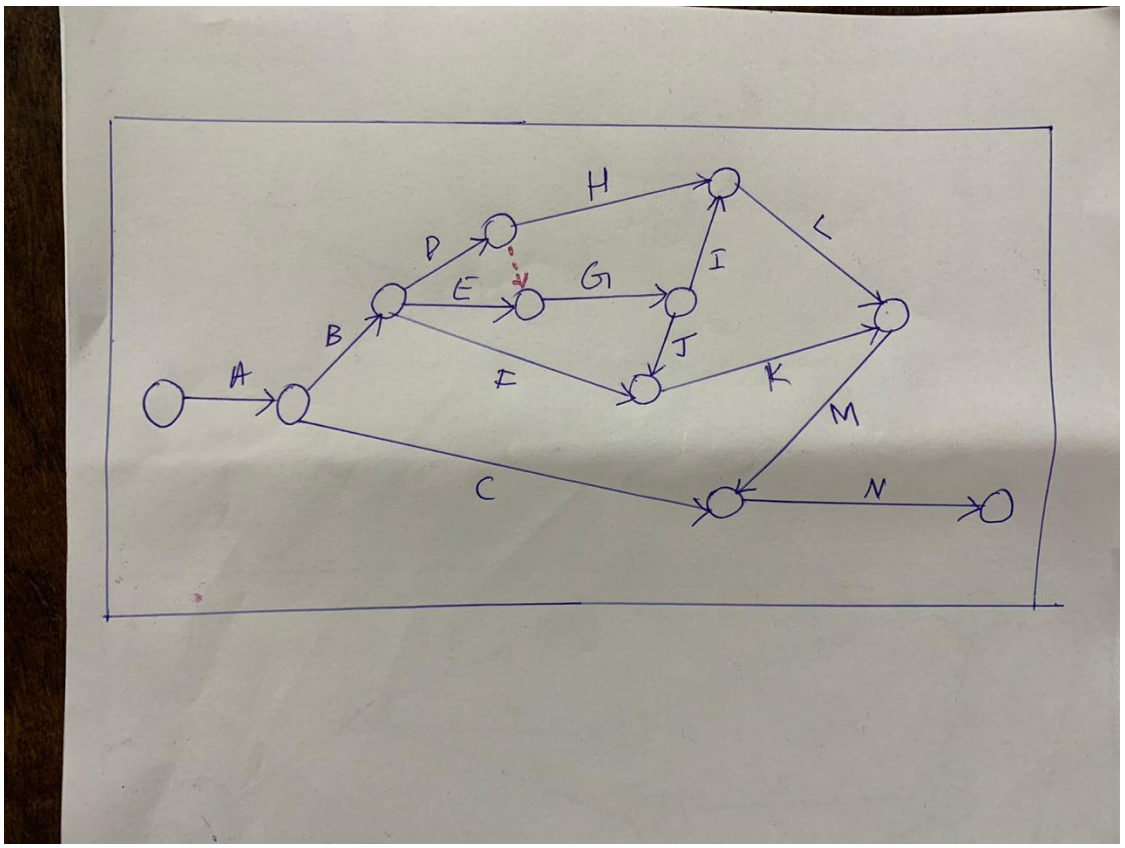
1. **A project consists of 6 activities (jobs) designed from A-F , with the following relationships**
   - i. **A is the first job to be performed.**
   - ii. **B and C can be done concurrently, and Must follow A.**
   - iii. **B must preceed D**
   - iv. **E must succeed C, but it cannot start until B is complete.**
   - v. **The last operation F is dependent on the completion of both.**

**DRAW THE NETWORK DIAGRAM.**




2. **A project has activities A to N. The relationship among these activities are given below.**
    - **A is the first activity.**
    - **B and C can be performed in parallel and are immediate successors to A.**
    - **D, E, F follows B.**
    - **G follows E**
    - **H follows D but H cannot tart until E is complete.**
    - **I and J succeed G**
    - **F and J preceed K**

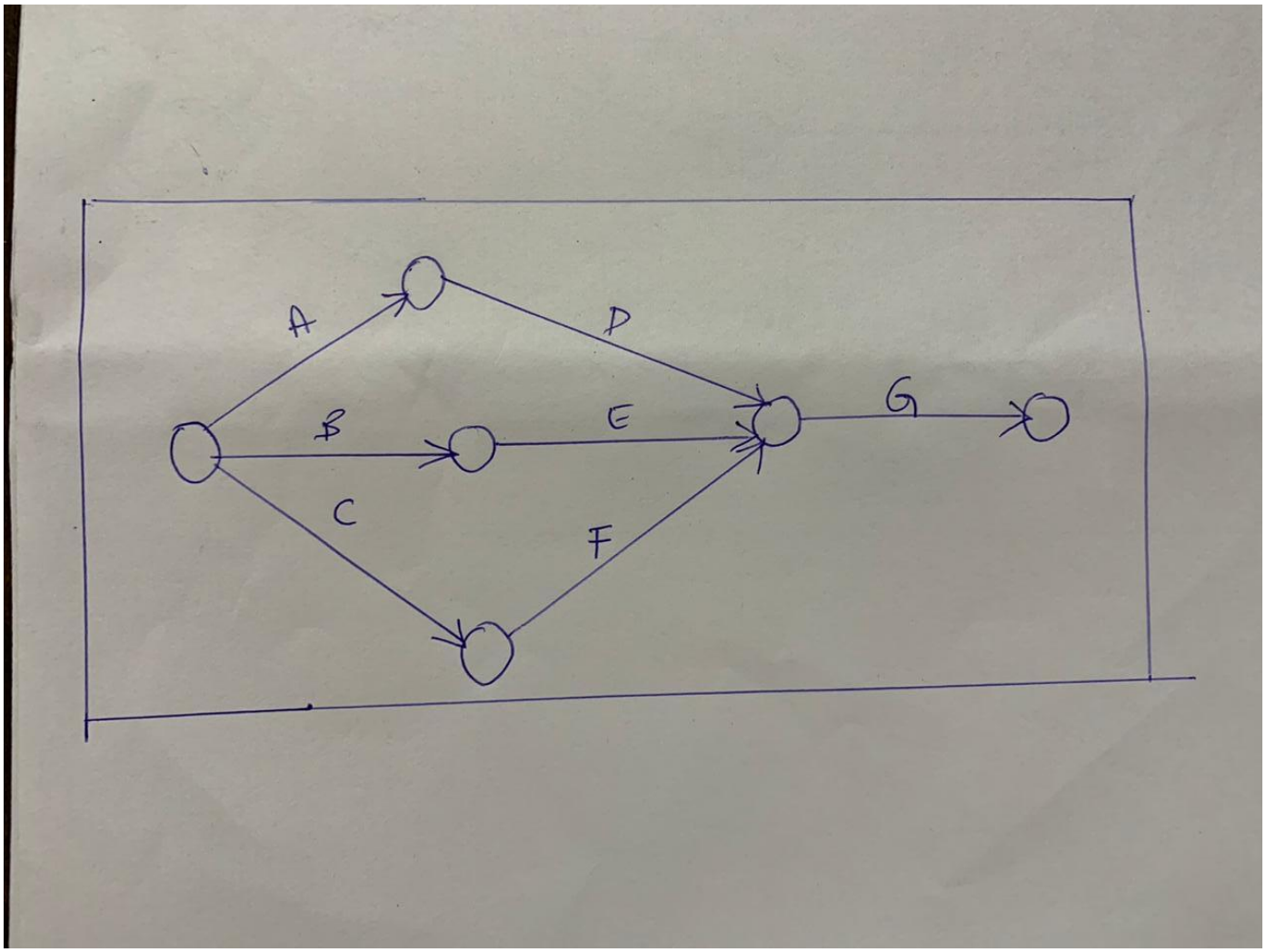
- **H and I preceed L**
- **M succeed L and K**
- **The last opearation N succeeds M and C.**




3. **Draw the network of the project having 7 activities A, B and D run continuously. Activity predessor relationship is as follows.**

| **ACTIVITY** | **D** | **E** | **F** |
|---|---|---|---|
| **Immediate Predessor** | **A** | **B** | **C** |

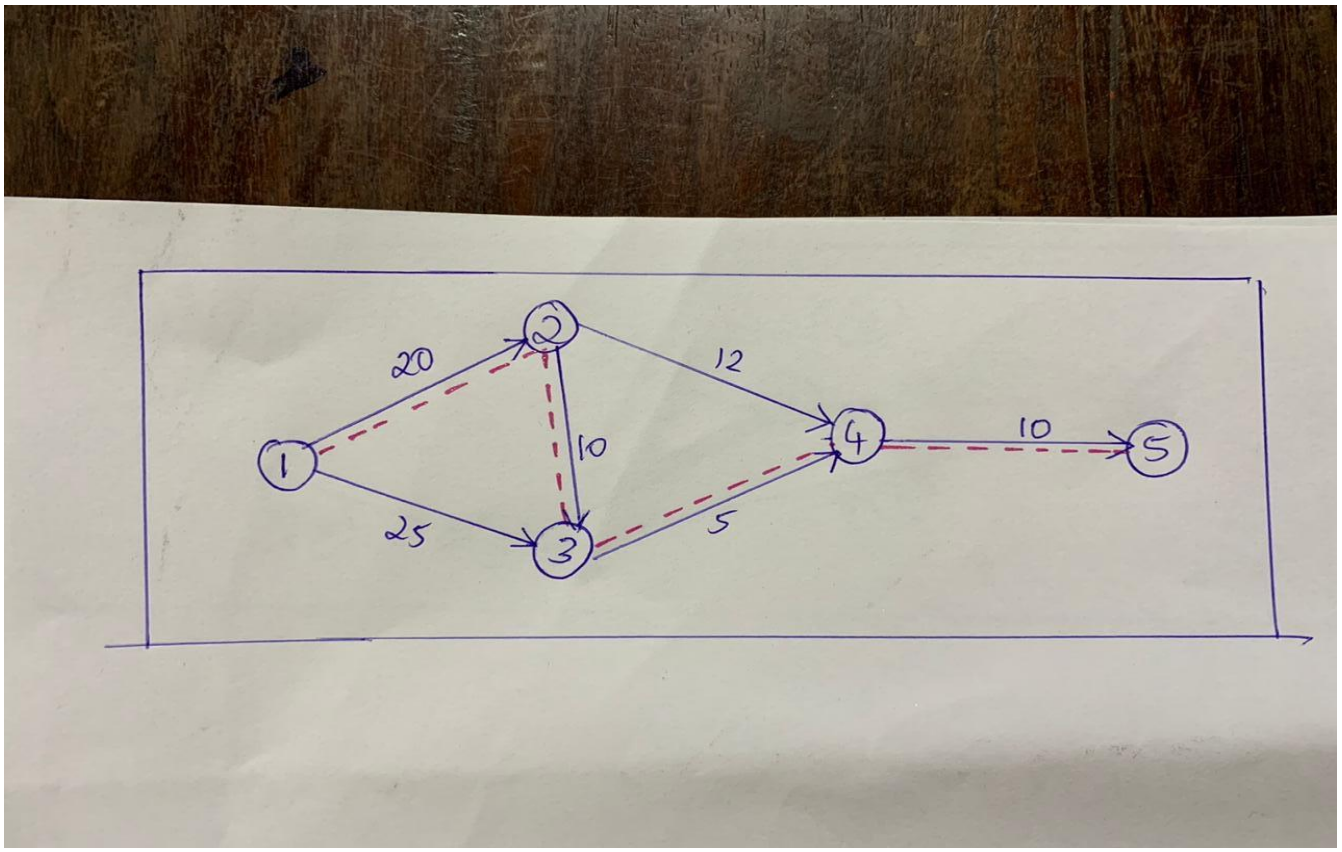
**Activity G is last operation of project and also immediate successor to D,E, F.**




1) **Draw the network for the following activities and find critical path and total duration of project.**

| **ACTIVITY** | **DURATION (Days)** |
|---|---|
| **1-2** | **20** |
| **1-3** | **25** |

| | |
|---|---|
| **2-3** | **10** |
| **2-4** | **12** |
| **3-4** | **5** |
| **4-5** | **10** |

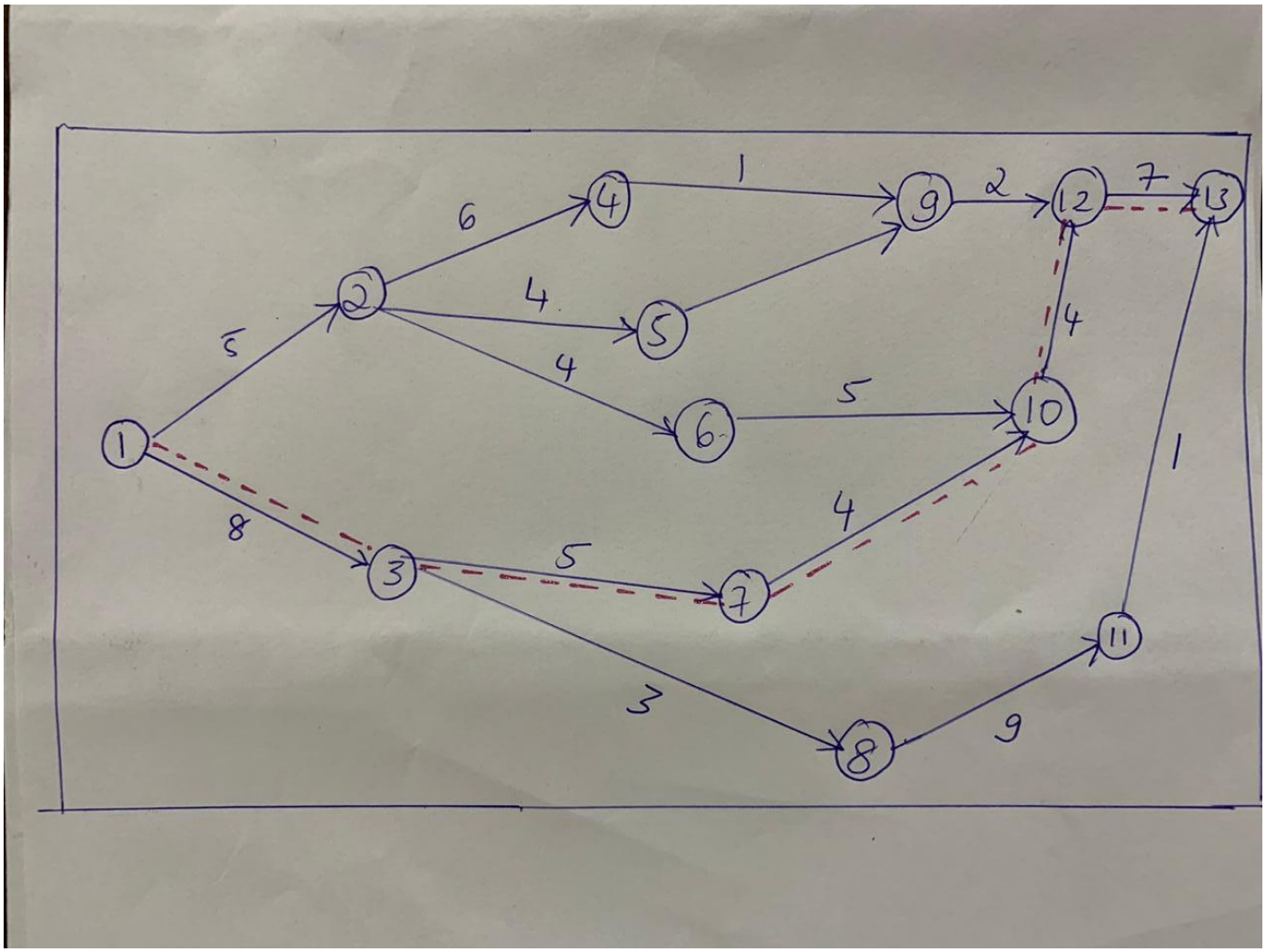



| VARIOUS PATHS | DURATION OF TIME |
|---|---|
| **1-2-4-5** | **(20+12+10)= 42** |
| **1-2-3-4-5** | **(20+10+5+10)= 45** |
| **1-3-4-5** | **(25+5+10)= 40** |

**Hence the critical Path is 1-2-3-4-5 with project time of 45 days**

**2) Draw the network fom the following activities and find the critical path and duration of project.**

| ACTIVITY | DURATION (Days) |
|---|---|
| 1-2 | 5 |
| 1-3 | 8 |
| 2-4 | 6 |
| 2-5 | 4 |
| 2-6 | 4 |
| 3-7 | 5 |
| 3-8 | 3 |
| 4-9 | 1 |
| 5-9 | 3 |
| 6-10 | 5 |
| 7-10 | 4 |
| 8-11 | 9 |
| 9-12 | 2 |
| 10-12 | 4 |
| 11-13 | 1 |
| 12-13 | 1 |



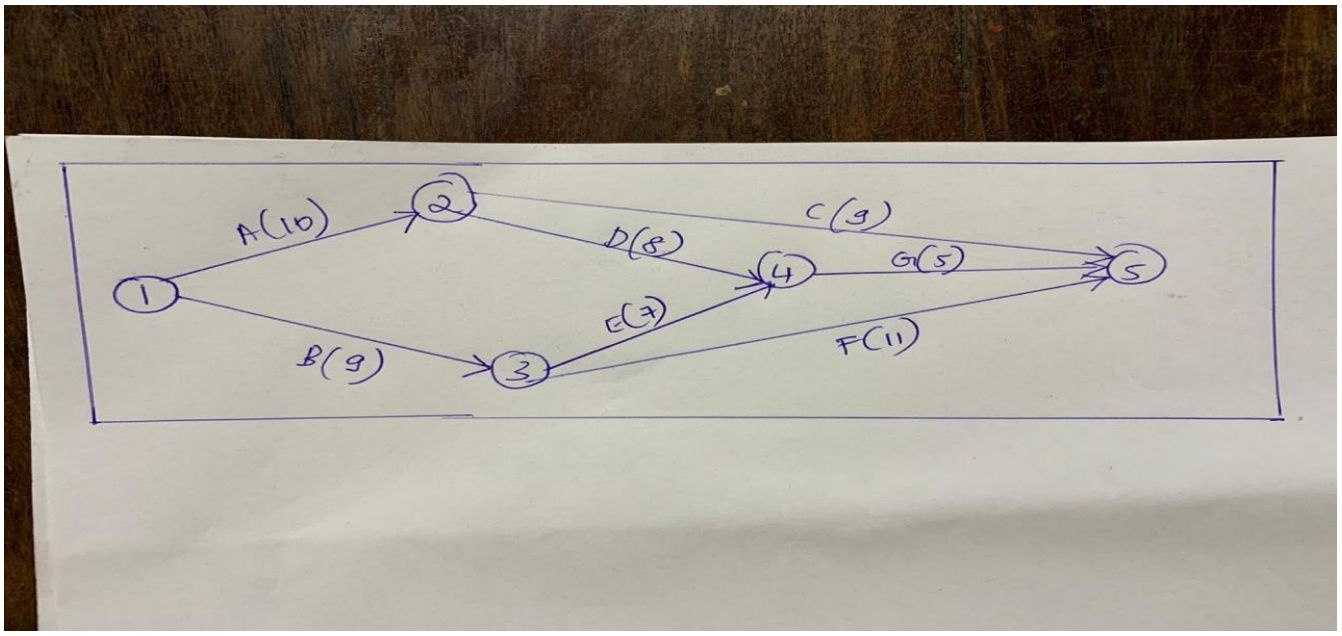

| VARIOUS PATHS | DURATION OF TIME |
|---|---|
| 1-2-4-9-12-13 | (5+6+1+2+7)= 21 |
| 1-2-5-9-12-13 | (5+4+3+2+7)= 21 |
| 1-2-6-10-12-13 | (5+4+5+4+7)= 25 |
| 1-3-7-10-12-13 | (8+5+4+4+7)= 28 |

| | |
|---|---|
| **1-3-8-11-13** | **(8+3+9+1)= 21** |

**Hence the critical Path is 1-3-7-10-12-13 with project time of 28 days**

**3) Draw the network from the following activity and find critical path and total project duration.**

| ACTIVITY | IMMEDIATE PREDECESSOR | DURATION (Days) |
|---|---|---|
| A | - | 10 |
| B | - | 9 |
| C | A | 9 |
| D | A | 8 |
| E | B | 7 |
| F | B | 11 |
| G | D, E | 5 |

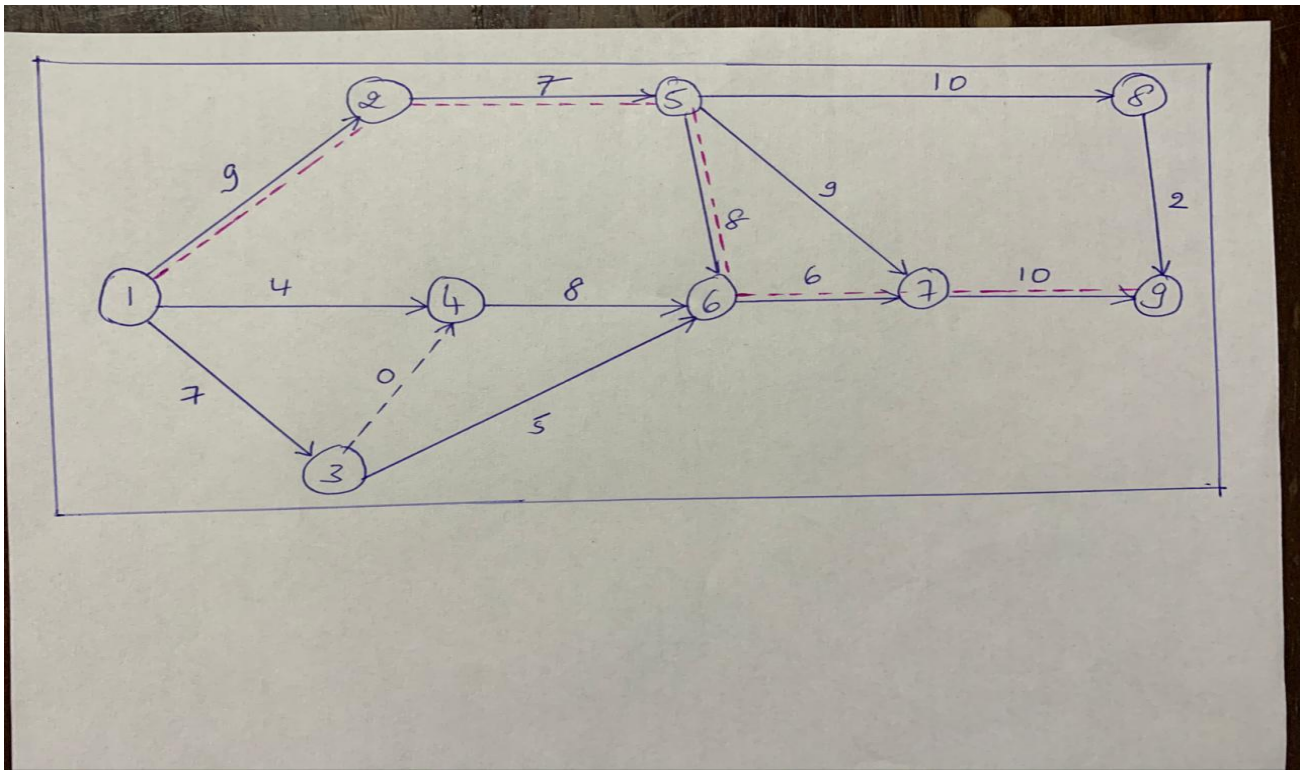



| VARIOUS PATHS | DURATION OF TIME |
|---|---|
| 1-2-5 | (10+9)= 19 |
| 1-2-4-5 | (10+8+5)= 23 |
| 1-3-4-5 | (9+7+5)= 21 |
| 1-3-5 | (9+11)= 20 |

**Hence the critical Path is 1-2-4-5 with project duration of 23 days**

**4 ) Draw a network from the following and find a critical path and duration of project**

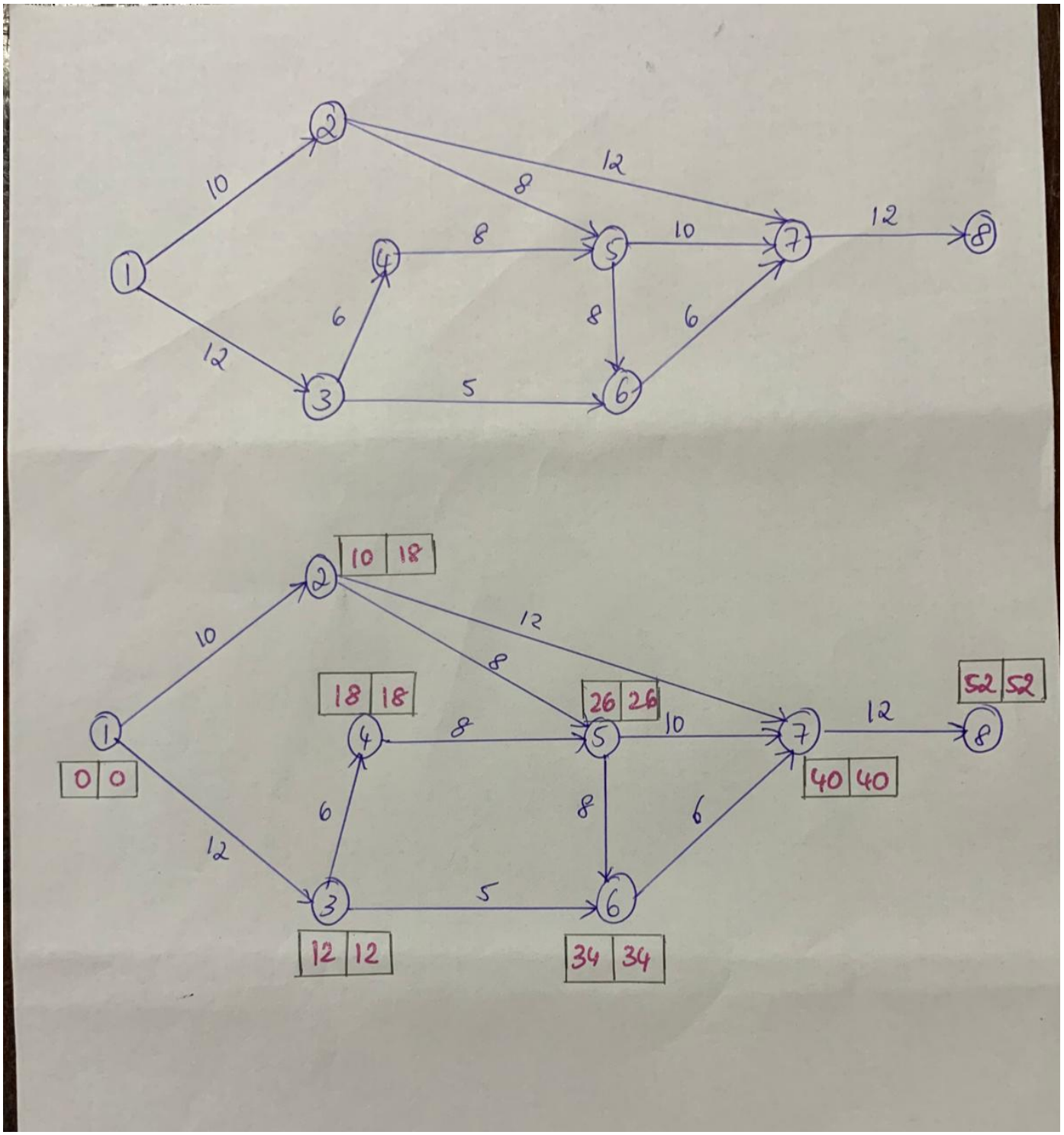
| ACTIVITY | DURATION (Days) |
|---|---|
| 1-2 | 9 |
| 1-4 | 4 |
| 1-3 | 7 |
| 2-5 | 7 |
| 3-4 (Dummy) | 0 |
| 3-6 | 5 |
| 4-6 | 8 |
| 5-6 | 8 |
| 5-7 | 9 |
| 5-8 | 10 |
| 6-7 | 6 |
| 7-9 | 10 |
| 8-9 | 2 |




| VARIOUS PATHS | DURATION OF TIME |
|---|---|
| 1-2-5-8-9 | ( 9+7+10+2)= 28 |
| 1-2-5-6-7-9 | (9+7+8+6+10 )= 40 |
| 1-2-5-7-9 | ( 9+7+9+10 )= 35 |
| 1-4-6-7-9 | ( 4+8+6+10 )= 28 |
| 1-3-4-6-7-9 | ( 7+0+8+6+10 )=31 |
| 1-3-6-7-9 | ( 7+5+6+10 )= 28 |

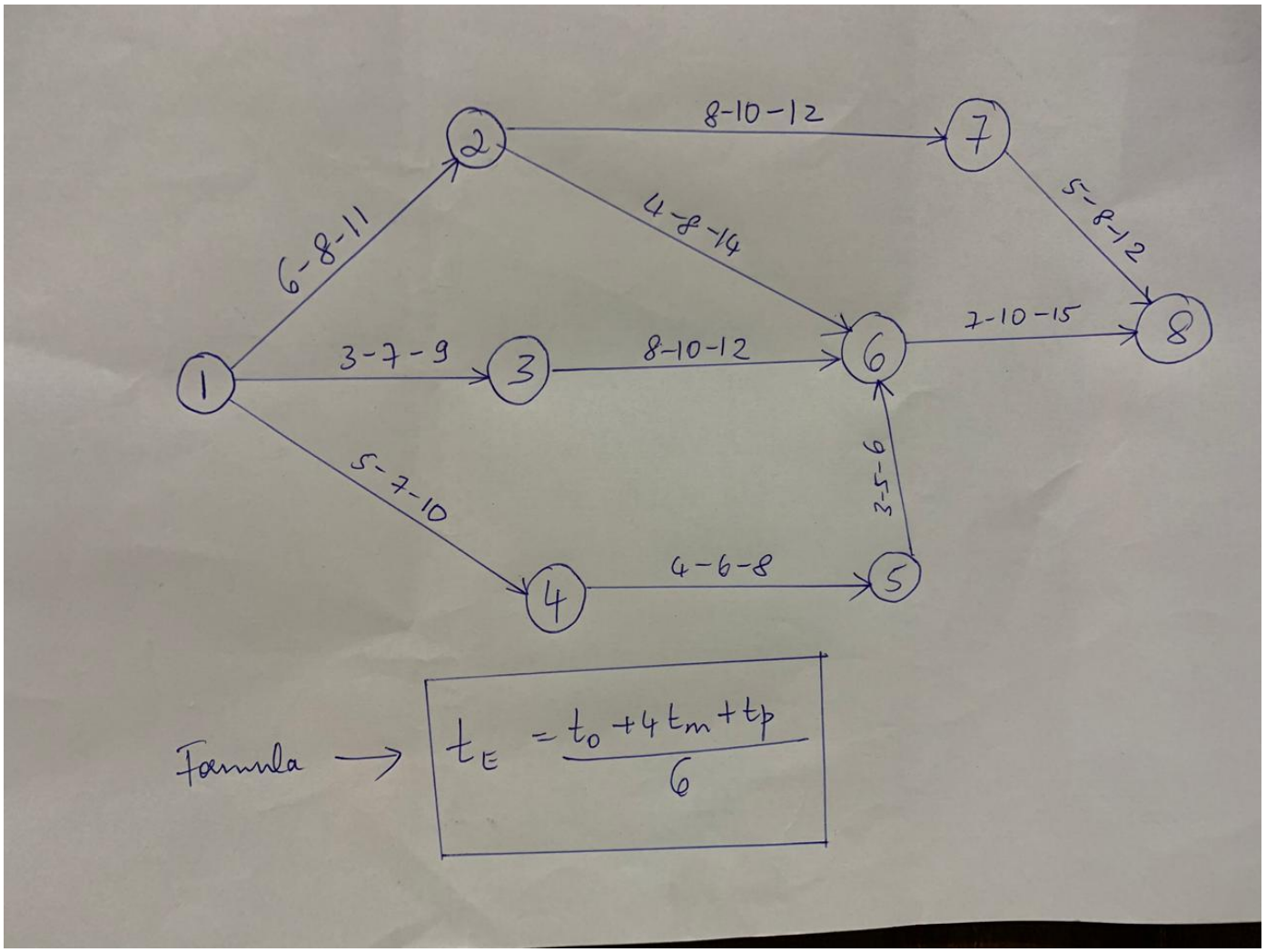
**Hence the critical Path is 1-2-5-6-7-9 with project duration of 40 days**

1) **For a network diagram below prepare a table showing activity times, Total float and Free float. Indicate critical path and determine the minimum time required to complete the project.**



| Activity | Duration | EST | EFT | LST | LFT | TOTAL FLOAT | FREE FLOAT | IND FLOAT |
|---|---|---|---|---|---|---|---|---|
| 1-2 | 10 | 0 | 10 | 8 | 18 | 8 | 0 | 0 |
| 1-3 | 12 | 0 | 12 | 0 | 12 | 0 | 0 | 0 |
| 2-5 | 8 | 10 | 18 | 18 | 18 | 8 | 8 | 0 |
| 2-7 | 12 | 10 | 22 | 28 | 40 | 18 | 18 | 10 |
| 3-4 | 6 | 12 | 18 | 12 | 18 | 0 | 0 | 0 |
| 3-6 | 5 | 12 | 17 | 29 | 34 | 17 | 17 | 17 |
| 4-5 | 8 | 18 | 26 | 18 | 26 | 0 | 0 | 0 |
| 5-6 | 8 | 26 | 34 | 26 | 34 | 0 | 0 | 0 |
| 5-7 | 10 | 26 | 36 | 30 | 40 | 4 | 4 | 4 |
| 6-7 | 6 | 34 | 40 | 34 | 40 | 0 | 0 | 0 |
| 7-8 | 12 | 40 | 52 | 40 | 52 | 0 | 0 | 0 |

1) **The network for certain path is shown in the figure. Determine expected time for each path which path is critical?**



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| PATH | Activity | to | tm | tp | tE | €tE |
|---|---|---|---|---|---|---|
| A | 1-2 | 6 | 8 | 11 | 8.17 | |
| | 2-7 | 8 | 10 | 12 | 10 | 26.34 |
| | 7-8 | 5 | 8 | 12 | 8.17 | |
| B | 1-2 | 6 | 8 | 11 | 8.16 | |
| | 2-6 | 4 | 8 | 14 | 8.33 | 26.83 |
| | 6-8 | 7 | 10 | 15 | 10.33 | |
| C | 1-3 | 3 | 7 | 9 | 6.67 | |
| | 3-6 | 8 | 10 | 12 | 10 | 27 |
| | 6-8 | 7 | 10 | 15 | 10.33 | |
| D | 1-4 | 5 | 7 | 10 | 7.16 | |
| | 4-5 | 4 | 6 | 8 | 6 | 28.33 |
| | 5-6 | 3 | 5 | 6 | 4.83 | |
| | 6-8 | 7 | 10 | 5 | 10.38 | |

**Path ‘D’ is critical, since €D is maximum**

**1-4, 4-5, 5-6, 6-8**

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## EXPECTED QUESTIONS:

1. Explain the characteristics of management?
2. Explain the functions of management?
3. Write a short note on importance and purpose of planning process?
4. Explain the function and styles of management in construction work?
5. Explain organizational structure and its types?
6. Describe principles of organizational structure?
7. Describe construction planning and schedule?
8. Explain the work breakdown structure?
9. Write short note on Gantt chart?
10. What are the key terms in network analysis for time scheduling?
11. Explain critical path method?
12. Explain PERT.
13. Explain time estimates.
14. Differentiate between AOA and AON?
15. Differentiate between CPM and PERT.

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