MODULE 1

MANAGEMENT

OBJECTIVES

- Describes the basic concepts and principles of Management.
- To understands history of Management.
- To know the roles of Manager.
- To know levels of Management.
- Analyze the nature and importance of planning
- Discuss various types of planning and understand types of plans
- Discuss steps in decision making

INTRODUCTION

In today's tough and uncertain economy, a company needs strong managers to lead its staff toward accomplishing business goals. But managers are more than just leaders — they're problem solvers, cheerleaders, and planners as well. And managers don't come in one-size -fits-all shapes or forms. Managers fulfill many roles and have many different responsibilities at each level of management within an organization. In this chapter, you not only discover those roles and functions, but you also find out the truth about several common misconceptions about management.

MEANING OF MANAGEMENT

Management is distinct process consisting of planning, organizing, actuating & controlling performance to determine & accomplish the objectives by the use of people & resources.

NATURE AND CHARACTERISTICS OF MANAGEMENT

• Involves decision-making: Management in the decision making process & the decisions are involved in all the functions of management.

- It Co-ordinates all activities & resource: It is concerned with the Co-ordination of all activities & resources it's various functions to attain the stated objectives.
- It is a universal activity: It manages irrespective of the enterprise in which they are working & their place in the organizations makes use of the management principles.
- It is an integrating process: It integrates men, machines & materials for carrying out the operations of the enterprise & for achieving the stated objectives.
- It is concerned with direction & control: It in concerned with the direction & control of various activating the enterprise to attain the business objectives.
- It is in tangible: It is abstract & cannot be seen with the eyes. It is evidenced by the quality of organization & results such as increased productivity.
- It is a profession: Because there are established principles of management which are being applied in practice.

SCOPE OF MANAGEMENT

- Developing Management
- Distribution Management
- Financial Management
- Marketing Management
- Production Management
- Office Management
- Transport Management

FUNCTIONAL AREAS OF MANAGEMENT

The functions of management are planning, organizing, staffing, leading, and controlling.

I. **Planning:** This step involves mapping out exactly how to achieve a particular goal. Say, for example, that the organization's goal is to improve company sales. The manager first needs to decide which steps are necessary to accomplish that goal. These steps may include increasing advertising, inventory, and sales staff. These necessary steps are developed into a

plan. When the plan is in place, the manager can follow it to accomplish the goal of improving company sales.

- II. Organizing: After a plan is in place, a manager needs to organize herteam and materials according to her plan. Assigning work and granting authority are two important elements of organizing.
- III. Staffing: After a manager discerns his area's needs, he may decide to beef up his staffing by recruiting, selecting, training, and developing employees. A manager in a large organization often works with the company's human resources department to accomplish this goal.
- IV. Leading: A manager needs to do more than just plan, organize, and staff her team to achieve a goal. She must also lead. Leading involves motivating, communicating, guiding, and encouraging. It requires the manager to coach, assist, and problem solve with employees.
- V. Controlling: After the other elements are in place, a manager's job is not finished. He needs to continuously check results against goals and take any corrective actions necessary to make sure that his area's plans remain on track. All managers at all levels of every organization perform these functions, but the amount of time a manager spends on each one depends on both the level of management and the specific organization.

MANAGEMENT AS A SCIENCE, ART OR PROFESSION

• Management as a science: Management is not like the exact or natural science such as physics, chemistry etc which are called exact sciences which makes it possible to study any one of many of the factors affecting a phenomenon individually by making the other factors inoperative for that moment of time by examining the effects of heat on the density of air by holding other factors constant in the laboratory for example but where as in management it is not possible to study in management as it involves the study and multiplicity of factors affecting him in which involves the study of monitory incentives on workers' productivity which means that findings are not accurate and dependable as those of physical sciences and therefore, a management can be put in the category of a behavioral science. Management

are not culture bound because even though the different cultures may give rise to different management practices, techniques or theory concepts and principles remain the same which lead to the conclusion that management did not differ from country to country which is true even in the field of natural sciences.

- Management as a art: As the science considers the why phenomena management as an art is concerned with the understanding how a particular task can be accomplished which involves art of getting things done through others in a dynamic and non repetitive fashion and has to constantly analyze the existing situation, determine the objectives, seek the alternatives, implement, coordinate, control and evaluate information and make decisions. As the knowledge of management theory and principles is a valuable kit of the manager but it cannot replace his managerial skills and qualities which has to be applied and practiced which makes us to consider manager as an art. Like the art of a musician or the art of a painter who uses his own skill and does not copy the skills of others.
- Management is a profession: Does not have fixed norms of managerial behavior. No uniform of code of conduct or licensing of managers. Entry of managerial jobs are not restricted to individuals with a special academic degree only and hence management cannot be called a profession.

Basic difference	Administration	Management	
Nature of work	It is primary concerned with	It is dues the implementation plans &	
	determination of objectives &	policies, doing function.	
	polices. It is thinking function		
Scope	It takes major decision	It takes the decision within frame work	
		of administration.	
Level of authority	It is a top level function	Lower level function	

MANAGEMENT & ADMINISTRATION

Status	It consist of owners of an enterprise	It consists of managerial personal with
		specialize knowledge who may be
		employees.
Nature of	It is used in relation to good military,	It is making in business forms.
organization	educational &fuliginous	
	organization.	
Influence	Its decisions are influenced by	The influence by internal factors
	External factors such as social,	such as values, beliefs, opinions.
	political labor	

ROLES OF MANAGEMENT

A manager wears many hats. Not only is a manager a team leader, but he or he is also a planner, organizer, cheerleader, coach, problem solver, and decision maker — all rolled into one. And these are just a few of a manger's roles. In addition, managers' schedules are usually jam-packed. Whether they're busy with employee meetings, unexpected problems, or strategy sessions, managers often find little spare time on their calendars. These roles fall into three categories:

- I. Interpersonal: This role involves human interaction.
 - a) Monitor: Seek and receive information; scan periodicals and reports; maintain personal contact with stakeholders.
 - b) Disseminator: Forward information to organization members via memos, reports, and phone calls.
 - c) Spokes person: Transmit information to outsiders via reports, memos, and speeches.
- II. Informational: This role involves the sharing and analyzing of information.
 - a) Figurehead: Perform ceremonial and symbolic duties, such as greeting visitors and signing legal documents.
 - b) Leader: Direct and motivate subordinates; counsel and communicate with subordinates.
 - c) Liaison: Maintain information links both inside and outside organization via mail, phone calls, and meetings.

- III. **Decisional:** This role involves decision making. Decisional Entrepreneur Initiate improvement projects; identify new ideas and delegate idea responsibility to others.
 - a) Disturbance: Take corrective action during disputes or handler crises; resolve conflicts among subordinates; adapt to environments.
 - b) Resource: Decide who gets resources; prepare allocator budgets; set schedules and determine priorities.
 - c) Negotiator: Represent department during negotiations of union contracts, sales, purchases, and budgets.

LEVELS OF MANAGEMENT

- Two leaders may serve as managers within the same company but have very different titles and purposes.
- Large organizations, in particular, may break down management into different levels because so many more people need to be managed.
- Typical management levels fall into the following categories:
- I. **Top level:** Managers at this level ensure that major performance objectives are established and accomplished. Common job titles for top managers include chief executive officer (CEO), chief operating officer(COO), president, and vice president. These senior managers are considered executives, responsible for the performance of an organization as a whole or for one of its significant parts. When you think of a top- level manager, think of someone like Dave Thomas of thefast-food franchise Wendy's. Although John T. Schuessler was elected CEO in 2000, Dave Thomas is the founder and still the chairman of the board. He is the well-known spokesperson for the chain.
- II. Middle level: Middle managers report to top managers and are in charge of relatively large departments or divisions consisting of several smaller units. Examples of middle managers include clinic directors in hospitals; deans in universities; and division managers, plant managers, and branch sales managers in businesses. Middle managers develop and implement action plans consistent with company objectives, such as increasing market presence.

III. Low level: The initial management job that most people attain is typically a first-line management position, such as a team leader or supervisor — a person in charge of smaller work units composed of Hands on workers. Job titles for these first-line managers vary greatly, but include such designations as department head, group leader, and unit leader. First-line managers ensure that their work teams or units meet performance objectives, such as producing a set number of items at a given quality, that are consistent with the plans of middle and top management.

DEVELOPMENT OF MANAGEMENT THOUGHTS

Evolution of the management can be studies as

I. Early classical approaches

- a) Scientific management: Fredric Winslow(1856-1915) is considered as the father of Scientific management Exerted a great influence on the development of the management through his experiment and writings. Conducted as a series of experiments in three companies Midvale steel, Simonds Rolling machine and Bethlehem Steel while serving as a chief engineer of Midvale steel company for a period of 26 years.
- b) Administrative management: Henry Fayol is considered as the father of administrative management(1841-1925) Where the focus is on development of broad administrative principles. Was a French mining engineer turned a leading industrialist and a successful manager. Provided a broad analytical framework of the process of administration.

II. Modern approaches

a) Quantitative approach: Gained momentum during the second world war when UK and USA were desperately trying to seek the solutions to a number of few, complex problems in warfare. Interdisciplinary group of scientists were engaged for this purpose were known as operations research(OR) teams because their work consisted of analyzing operations and carrying out applied scientific research which were the same which were used for solving problems in the industry. solving problems in the industry using OR techniques.

- A mixed team of specialists from relevant disciplines is called to analyze he problem and to propose a course of action to the management.
- The team constructs the a mathematical model t simulate the problem which in symbolic terms all relevant factors that bear the problem, and the interrelationship amongst them.
- By the changing the values of the variables in the model generally with a computer and they team can determine the effect of each change.
- Thus we can conclude that the focus is on quantitative approach is based on decision making with quantitative tools and techniques for making objectively rational decisions.
- Approach facilitates disciplined thinking, precision and perfection by expressing relationships in quantitative terms which has been widely used in planning and control activities where problems can be precisely indentified and defined in quantitative terms.
- **b)** Systems approach: Provides integrated approach to management problems and the key concepts of systems approach are
- System is a set of independent parts: Which together works as a single unit and performs some function. Similarly an organization can also be considered to be composed of four independent parts namely task, structure, people and technology.
- Structure subsystem: refers to the formal division of authority and responsibility, communication channels and workflow.
- People subsystem: refers to the employees with their motives, attitudes and values and the informal organization.
- Technology subsystem: refers to the tools and equipment as well as techniques which are used by the organization to perform the task.
- Concept of considering the system as a whole: Means that no part of the system can be analyzed and understood apart from the whole system and conversely, the whole system cannot be accurately perceived without understanding all its parts. Each part bears a relation of interdependence to every other part which rather than dealing separately with the various parts of the organization as a whole. The above concept facilitates more effective diagnosis of complex situations and increases the likelihood of appropriate managerial functions.

- System can be either open or closed: Open system is one which interacts with its environment and closed system is one which is independent of the environment. All living systems are actually dependent on the external environment for information, material and energy. They enter the system from the environment as inputs and leave the system as outputs and therefore they are rightly conceived as open systems. Inputs of a business organization: raw materials, power, finance, equipment, human effort, technology, information about market, new products, government policies and the changes these inputs into output of goods, services and satisfaction and the transformation process is known as throughput.
- c) Contingency approach: Is the second approach which tries to integrate the various schools of management thought. There is no best way of doing things under all conditions Methods and techniques are highly effective in one situation may not work in other situations and results differ because the situations differ. The task of a manger is to try to identify which technique will in a particular best contribute to the attainment of the management goals and managers have therefore to select the situational sensitivity and practical selectivity. Contingency views are applicable in designing organizational structure, in deciding the degree of decentralization, in planning information decision systems, in motivational and leadership approaches in establishing communication and control systems, in solving conflicts and management.

PLANNING

Planning is an intellectual process which requires manager to think before acting. It is thinking in advance. it is planning that managers of organization decide what is to be done, when it is to be done, how it is to be done, and how has to do it.

NATURE OF PLANNING

A plan must be flexible. By flexibility of a plan is mean its ability to change direction to adapt to changing situations without undue cost. It needs to possess a built in flexibility in at least major

areas technology, market, finance, personal and organization. Flexibility in technology means the mechanical ability of a company to change and vary its product-mix according to changing needs of its customers

Planning is all pervasive function. In other words, planning is important to all managers regardless of their level in the organization. There are however some differences in involvement by managers at different levels. One major difference concerns the time period covered. Top level managers are generally months to five years later, or even after that. Lower level managers are more concerned with planning activities for the day, week or month .first line supervisors, for example plan the work activities for their people for the day.

They are not responsible for predicting sales levels and ordering materials to produce Products six months in the future. A second major difference concerns the time spent on planning. Top managers generally spend more time on planning. They are concerned with establishing objectives And developing plans to meet those o bjectives. Lower level managers are more involved in executing these plans.

IMPORTANCE OF PLANNING

The importance of planning are as follows

• Minimizes risk and uncertainty

By providing a more rational, fact-based procedure for making decisions, planning allows managers and organizations to minimize risk and uncertainty. Planning does not deal with future decisions, but in futurity of present decisions.

If a manager does not make any provision for the replacement of plant and machinery, the problems he will have to face after ten years can well be imagined. The manager has a feeling of being in control if he has anticipated some of the possible consequences and has planned for them. It is like going out with an umbrella in cloudy weather. It is through planning that the manger relates the uncertainties and possibilities of tomorrow to the facts of today and yesterday.

• Leads to success

Planning does not guarantee success but studies have shown that, often things being equal, companies which plan not only outperform the non-planners but also their past results. This may be

because when a businessman's actions are not random arising as mere reaction to the market place Planning leads to success by doing beyond mere adaption to market fluctuations. With the help of a sound plan, management can act proactively and not simply react. It involves to attempt to shape the environment on the belief that business is not just the creation of environment but its creator as well.

• Focus attention on the organizations goals

Planning helps the manger to focus attention on the organizations goals and activities. This makes it easier to apply and coordinate the resources of the organization more economically. The whole organization is forced to embrace identical goals and collaborate in achieving them. It enables the manager to chalk out in advance an orderly sequence of steps for the realization of organizations goals and to avoid needless overlapping of activities.

• Facilitates control

In planning, the manager sets goals and develops plans and to accomplish these goals. These goals and plans then become standards against which performance can be measured. The function of control is to ensure that activities conform to the plans. Thus control can be exercised only if there are plans.

• Trains executives

Planning is also an excellent means for training executives. They become involved in the activities of the organization and the plans arouse their interest in the multifarious aspects of planning.

Strategic planning	Tactical planning	
1)decides the major goals and policies of	1) decides the detail use of resources for	
allocation of resources to achieve these goals	achieving these goals	
2) Done at higher levels of management.	2) is done at lower levels of management	
Middle managers sometimes not even aware		
that strategic planning being considered.		
3) it is long term	3) it is short term	
4) Is generally based on long term forecasts	4) is generally based on the past performance	

TYPES OF PLANNING

about technology and is more uncertain.	of the organization and is less uncertainly
5)is less detailed because it is not involved	5) is more detailed because it is involved with
with the day to day operations of the	the day-to-day operations of the organization
organization	

TYPES OF PLANS

Plans are arranged in a hierarchy within the organization as shown in the figure below At the top of this hierarchy stand objectives. Objectives are the broad ends of the organization which are achieved by means of strategies. Strategies in their turn are carried out by means of the two major groups of plans. Single use plans and standing plans.

I. Single use plans

These are developed to achieve a specific end and when the end is reached the plan is dissolved. The two major types of plans are single use plans are programmes and budgets.

• Programmes

Programmes are precise plans or definite steps in proper sequence which need to be taken to discharge a given task. Programmes are drawn in conformity with the objectives and are made up of policies, procedures, budgets etc. The essential ingredients of every programme are time phasing and budgeting. This means that the specific dates should be laid down for the completion of the each successive stage of a programme. A provision should also be made in the budget for financing the programme. Often a single step in a programme is set up as a project.

• Budgets

A budget is a financial and/or quantitative statement prepared prior to a definite period of time, of the policy perceived during that period, for the purpose of obtaining a given objective. Budgets are plans for a future period of time containing the statements of the expected results in numerical terms that is rupees, man hours Product units and so forth. The important budgets are sales budget, revenue budgets, cash budget and expense budget.

II. Standing plan

On the other hand are designed for situations that recur often to justify the standardized approach. For example, it would be inefficient for a bnak to develop a single use plan for processing a loan application for each new client. instead it uses one standing plan that anticipates in advance whether to approve or turn down the request based on the information furnished, credit rating, etc. the major types of plans are policies, procedures methods and rules.

• Policies

A policy is a general guideline for decision making which sets up boundaries around decisions including those that cannot be made and shutting out those that cannot. A policy can be considered as a verbal, written or implied overall guide setting up boundaries that supply the general limits and the direction in which ,managerial action takes place Policies suggest how to do the work. They do not dictate terms to subordinates and provide only a framework within which the decisions must be made by the management in different spheres.

• Procedures

Policies are carried out by means of more detailed guidelines called procedures. A procedure provides a detailed set of instructions for performing a sequence of actions involved in doing a certain piece of work. The same steps are followed each time that activity is performed.

For example: the procedure for purchasing raw material may be

- the requisition from the storekeeper to the purchasing department.
- Calling tenders for purchase of materials.
- placing orders with the suppliers who are selected
- inspecting the materials purchased by the inspecting department
- Making payment to the supplier of materials by the accounts department.

Similarly, the procedure for the recruitment of personnel may be

- inviting applications through advertisement
- screening the applications
- conducting written test
- conducting interview for those who have passed the written test and
- Medical examination of those who are selected for the posts.

a) Methods

A method is a prescribed way of in which one step of a procedure is performed. For example the specified technique to be used in screening the applications or conducting a written test is a method where as the sequence of steps involved in the recruitment of personnel consists of a procedure. Methods help in increasing the effectiveness and usefulness of the procedure. By improving the methods reduced fatigue better productivity and lower costs can be achieved. Methods can be improved in a number of ways. Manual methods of performing a task can be replaced by the mechanical means, or the existing mechanized process may be improved and unproductive methods improved by conducting motion study.

b) Rules

Are detailed and recorded instructions that a specific action must or must not be performed a given situation. In sanctioning overtime to workmen, in regulating travelling allowances, in sanctioning entertainment bills and in other similar matters a uniform way of handling them or dealing with case has to be followed which are all covered by the rules of the enterprise. They make sure that the job is done in the same manner every time bringing uniformity in efforts and results.

STEPS IN PLANNING

The various steps involved in planning are as follows:

• Establishing verifiable goals or set of goals to be achieved

The first step in planning is to determine the enterprise objectives which are often set up by the upper level or top managers, usually after number of possible objectives have been carefully considered. There are many types of objectives managers may select: desired sales volume or growth rate, the development of a new product or service or even a more abstract goal such as becoming more active in the community. The type of goal selected will depend on a number of factors: the basic mission of the organization, the value its mangers hold and the actual and the potential abilities of the organization.

• Establishing planning premises

It of planning as they is the second step in planning to establish planning premises which is vital to the success supply pertinent government facts and information relating to the future such as population trends, general economic conditions, production costs and prices, probable competitive behavior, capital and material availability and control and so on. Planning can be variously classified as under

- internal and external premises
- tangible and intangible premises
- controllable and non controllable premises

I. Internal and external premises:

Premises may exist within and outside company. Internal premises include sales forecasts, policies and programmes of the organization, capital investment in plant and equipment, competence of management, skill of labour, etc. External premises can be classified into three different groups Business environment, factors which influence the demand for the product, and the factors which affect the resources available to the enterprise.

II. Tangible and non-tangible premises:

Tangible premises: those which can be quantitatively measured while Intangible premises are those which being qualitative in character and cannot be measured. Tangible examples: population growth, industry demand, capital and resources invested in the organization are all tangible. Intangible: political stability, sociological factors, business and economic environment are all tangible.

III. Controllable and non controllable premises:

Some of the planning premises are controllable and some are non-controllable and because of the non-controllable factors there is need for the organization to revise the plans periodically in accordance with the current development. Examples of uncontrollable factors: strikes, wars, natural calamities, emergency, legislation etc. Examples of controllable factors: company's advertising agency, competence of management member's skill of the labour force, availability of resources in terms of capital and labour, attitude and behavior of the owner's of the organization.

• Deciding the planning period

It is the next task once the upper level managers have selected the basic long term goals and the planning premises. Business plans are made in some instances once for a year and plans are made for decades based on some logic and future thinking.

• Finding alternate courses of action

The fourth step of planning is to find the alternate courses of action. Example: securing the technical knowhow by engaging a foreign technician or by training staff abroad.

• Evaluating and selecting the alternate courses of action

After selecting the alternate courses selection the best course or course of action with the help of quantitative techniques and operations research.

• Developing the derivative plans

Once plan formulated, its broad goals must be translated on day to day operations of organization Middle level managers must draw up the appropriate plans, programmes and budgets for their sub-units which are described as derivative plans.

• Measuring and controlling the process

Plan cannot be run without monitoring its progress. The managers must check the progress of their plans.

DECISION MAKING

Decision-making is necessary in a business concern because there are many alternative courses of action to most business situations. For instance, for establishing a business, the entrepreneur may salute one of the forms of organization. All management functions such as planning, organization direction & control are settled by managers with the tool of decision-making. Decision- making can be defined as the selection based on some criteria of over behaviors choosing alternative from two or more possible alternatives. To decide means to cut off or in practical content to come to a conclusion.

MODULE 2

ORGANIZING AND STAFFING

OBJECTIVES

- To introduce meaning and characteristics of Organization
- To understand the nature and purpose of organization
- To understand departmentation and to know the process of staffing
- To understand the meaning and nature of direction, leadership styles, motivation theories.
- Discuss the meaning and importance of communication.
- Understand the types and forms of communication.
- Understand the meaning, importance and techniques of coordination.
- Present the meaning of controlling.
- Discuss the essentials of sound control system.
- Present methods of establishing control.

INTRODUCTION

An organization can be defined as a social unit or human grouping deliberately structured for the purpose of attaining specific goals. An organization can also be defined as the process of identifying and grouping of the work to be performed, defining and delegating responsibility and authority and establishing relationships for the purpose of enabling people to work most effectively together in the accomplishment of their objectives.

NATURE AND PURPOSE OF ORGANIZATION

The nature of organization is as follows

- An organization basically consists of group of people who form the dynamic human element of the organization.
- Organization helps in identifying the various tasks to be performed which are assigned to the individuals to perform to achieve the common objectives or common purpose of the organization.

- It ensures to achieve coordination amongst the people working in various departments of the organization And ensures integrated efforts to achieve organizational objectives or goals.
- It delegates authority to the managers with commensurate responsibility and accountability for the discharge of their duties and also amongst different hierarchical levels in an organization.
- It also aides in achieving financial, physical material and human resources.
- Organizations are part of the larger environment and hence they are influenced by the external environment.
- Organization helps in the realization of the plans made by the managers

The purpose of any organization is to achieve goals for which it is formed which aims at achieving common objectives through its group member efforts. The organizations exist for different purpose and the efforts for organizational members are directed for the achievement of this purpose. For example: For business organization the purpose is to develop people and their skills for contributing towards the growth of the enterprise through profits For nonprofit organization the purpose the objective would be to serve the members of the committee in a productive manner.

PRINCIPLES OF ORGANIZATION

The principles of organization are as follows

- **Objectives:** The objectives of the enterprise influence the organization structure and hence the objectives of the enterprise should first be clearly defined. Then every part of the organization should be geared to the achievement of these objectives.
- **Specialization:** Effective organization must promote specialization. The activities of the enterprise should be divided according to functions and assigned to persons according to their specialization.
- **Span of control:** As there is a limit to the number of persons that can be supervised effectively by one boss, the span of control should be as far as possible, the minimum. That means, an executive should be asked to supervise a reasonable number of subordinates only.

- **Exception**: As the executives at the higher levels have limited time, only exceptionally complex problems should be referred and routine matters should be dealt with by the subordinates at lower levels. This will enable the executives at higher levels to devote time to more important and crucial issues.
- Scalar Principle: This Principle is sometimes known as the "chain of command". The line of authority from the chief executive at the top to the first-line supervisor at the bottom must be clearly defined.
- Unity of command: Each subordinate should have only one superior whose command he has to obey. Multiple-subordination must be avoided for it causes Uneasiness, disorder, indiscipline and undermining of authority.
- **Delegation:** Proper authority should be delegated at the lower levels oh manager of the organization also. The authority delegated should be equal to responsibility That is each manager should have enough authority to accomplish the task assigned to him. Inadequate delegation often results into multiplication of staff and service activity..
- **Responsibility**: The superior should be held responsible for the acts of his subordinates. No superior should be allowed to avoid responsibility by delegating authority to his subordinates
- Authority: The authority is the tool by which a manager is able to accomplish the desired objective. Hence, the authority of each manager must be clearly defined. Further, the authority should be equal to responsibility.
- **Efficiency:** The organization structure should enable the enterprise to function efficiently and accomplish its objectives with the lowest possible cost.
- **Simplicity:** The Organization structure should be as simple as possible and the organization levels should as far as possible, be minimum. A large number of levels of organization means difficulty of effective communication and coordination. Too many committees and excessive procedures Also unduly complicate the structure.
- Flexibility: The organization should be adaptable to changing circumstances and permit correction of demonstrated deficiencies in the existing structure without dislocation and disruption of the basic design.
- **Balance:** There should be a reasonable balance in the size of various departments, between centralization and decentralization, between the principle of span of control and

the short chain of command, and among all types of factors such as human, technical and financial.

- Unity of direction: There should be one objective and one plan for a group of activities having the same objective. Unity of direction facilitates unification and coordination of activities at various levels.
- **Personal Ability**: As people constitute an organization, there is need for proper selection, placement and training of staff. Further the organization structure must ensure optimum use of human resources and encourage management development programmes
- Acceptability: The structure of the organization should be acceptable to the people who constitute it. Two things generally happen if people oppose the structure: it is modified gradually by the people, or it is used ineffectively.

TYPES OF ORGANIZATION

The types of organization are

- **Business organization:** are those organizations which are formed with the purpose of earning profits the sole purpose being to earn surplus in the form of profits without which they cannot survive and grow Example: Firms engaged in manufacturing, trading, services etc
- Non -profit service organizations: are those organizations who do not have the motive of making profits but to serve the people of the a specific community or a segment of a society. Example: Rotary club, Lions club, Orphanages, Charitable hospitals etc.
- Formal organizations : are officially formed with definite structure which describes authority and responsibility, relationship and behavior of organizational members
- **Informal organization:** do not have any official recognition and they are formed due to the social interaction needs of the people resulting in different types of social networks. Found in all formal organizations where people come together and form social groups for various reasons like common interests, friendship or affiliation, satisfaction of emotional needs .

DEPARTMENTALIZATION

The horizontal differentiation of tasks or activities into discrete segments is called departmentalization. Departmentalization is one important step of building an organization. There are several bases for departmentalization, each of which is suitable for particular corporate sizes, strategies and purposes. Following is a brief description of these bases.

- **Functions:** the most widely used base for departmentalization is function. Each major function of the enterprise is grouped into a department. Example: finance and marketing departments in a manufacturing company
- **Products:** Eminently suited for large organization manufacturing a variety of products. For each major product a separate semi autonomous department is created and is put under the charge of a manager who may also be responsible for producing profit of a given magnitude. For each department, all the needed manufacturing, engineering, marketing, manpower and other facilities are assembled. Product departmentalization is the logical pattern to be followed when each product requires raw materials, manufacturing technology and marketing methods that are markedly different from others from those used by other products in the organization.
- **Customers:** An enterprise may be divided into number of departments on the basis of the customers that it services.

COMMITTEES

A committee is a group of people who have been formally assigned some task or some problem for their decision and implementation

Classification of committees: be broadly classified into advisory committees and executive committees.

- Advisory committees: Committees are vested with staff authority. Only have a recommendation role and cannot enforce implementation of their advice or recommendation. Examples of advisory committees formed in business enterprises: works committees, sales committees, finance committees etc.
- **Executive committees:** Vested with the line of authority. Not only take decisions but also enforce decisions and thus perform a double role of taking a decision and ordering

its execution. Example: Board of directors is an example of an executive committee. Are also classified as standing committees or ad-hoc task forces.

AUTHORITY AND RESPONSIBILITY

- Authority : Is the institutionalized right of a superior to command and compel his subordinates to perform a certain act. Rests in the chair or position. If position changes the authority of the individual also changes.
- **Responsibility:** Responsibility is the obligation the subordinate to obey these commands. Whenever a superior assigns a task to him, it is the responsibility of the subordinate to perform it.

MBO & MBE

- MBO (MANAGEMENT BY OBJECTIVES): It is a process whereby subordinate and superiors of an organization jointly define common goals, define each individual major areas of responsibility in terms of results expected of him and use these measures as guides for operating the unit and assessing contribution of each of its members
- MBE (MANAGEMENT BY EXCEPTION): Management by Exception is a management style wherein managers intervene only when their employees fail to meet their performance standards. If the employees are performing as excepted, the manager will take no action. It is an organizational system where in which managers delegate as much responsibility as possible to those who below them stepping in only when it is absolutely essential. MBE policy focuses on those issues or events in which there is a deviation from the established standard. Management spends its valuable time on important strategic issues. Attention is given only when there is a deviation.

NATURE AND IMPORTANCE OF STAFFING

The process of recruiting, retaining, developing and nurturing the workforce is called staffing

- It helps in discovering talented and competent workers and developing them to move up the corporate ladder.
- Ensures greater production by putting the right man in the right job.
- It helps to avoid a sudden disruption of an enterprises production run by indicating shortages of personal if any in advance.

- Helps to prevent underutilization of personnel through over manning and the resultant high labour cost and low profit margins.
- Provides information to management for the internal succession of managerial personnel in the event of unanticipated turnover.

PROCESS OF SELECTION

Steps in the selection procedure is as follows

- **Application bank:** Filling the application blank by the candidate is the first step in which the applicant gives relevant personal data such as qualification, experience, firms in which he has worked.
- **Initial interview:** Selected personnel based on the particulars furnished in the application blank are called for the initial interview by the company Which is the most important means of evaluating the poise or appearance of the candidate.
- **Employment tests:** Are used for the further assessment of the candidate of his nature and abilities certain tests are conducted by the company. These are:
 - a. **Aptitude test:** is used in finding out whether a candidate is suitable for clerical or a mechanical job which helps in assessing before training as how well the candidate will perform the job.
 - b. **Interest test:** is used to find out the type of work in which the candidate has an interest.
 - c. **Intelligent test:** used to find out the candidates intelligence and candidates mental alertness, reasoning ability, poor of understanding are judged.
 - d. **Trade or performance achievement test**: this test is used to measure the candidate's level of knowledge and skill in the particular trade or occupation in which all he will be appointed, in case he is finally selected. in this test the candidate is asked to do a simple operation of the proposed job.
 - e. **Personality test:** is used to measure those characteristics of a candidate which constitute his personality.
 - f. **Checking references:** used to know about the important personal details about the candidate, his character, past history his background verified from the people mentioned in the application after selection and found satisfactory at the interview.

- **Physical or medical examination:** is another step in selection procedure. The objectives of this examination are to check the physical fitness of the applicant for the job applied for and to protect the company against the unwarranted claims for compensation under certain legislative enactments.
- **Final interview**: This interview is conducted for those who are ultimately selected for employment and the selected candidates are given an idea about their future projects within the organization.

PROCESS OF RECRUITMENT

It is defined as the process of identifying the sources for prospective candidates and to stimulate them to apply for the jobs. About more commonly used external sources of recruitment are:

- **Re-employing former employees:** laid off employees or employees left due to personal reasons may be reemployed who may require less training compared to the strangers of the enterprise. **Friends and relatives of the present employees:** personnel with a record of good relationships may be encouraged to recommend their friends and relatives for Appointment in the concern where they are employed.
- Applicants at the gate: suitable unemployed employees who call at the gates of the factories or companies are called are interviewed by the factory or company personnel and those who are found suitable for the existing vacancies are selected.
- **College and technical institutes:** many big companies remain in touch with the colleges and technical institutions to recruit young and talented personnel.
- Employment exchanges: employment exchange set up by the government for bringing together those men who are in search of the employment and these who are in search of employment and those who are looking for men. Employment exchanges are considered a useful source for the recruitment of clerks, accountants, typists.
- Advertising the vacancy: can be done by advertising the vacancy in leading news papers which may be used when the company requires services of persons possessing certain special skills or when there is acute shortage of labour force.
- Labour unions: persons are sometimes recommended for appointment by their labour unions.

DIRECTING & CONTROLLING

INTRODUCTION

Direction is a vital managerial function, performed by every manager. Whenever decision is taken, it must be converted into action by proper implementation. Otherwise, it is of no use. Effective implementation of a decision is made possible by directions. Planning, organizing and staffing are concerned only with the preparation for work performance and it is the direction which stimulates the organization.

MEANING AND NATURE OF DIRECTING

Means issuance of orders and leading and motivating subordinates as they go about executing orders Consists of the process and techniques utilized in issuing instructions and making certain that operations are carried on as originally planned. Is a vital in managerial function Is used to stimulate action by giving direction to his subordinates through orders and also supervise their work to ensure that the plans and policies achieve the desired actions and results. To conclude direction is the process of utilizing the techniques in issuing instructions and making certain that operations are carried out on as originally planned. The nature of Directing is as follows

- **Harmony of objectives:** The goals of its members must be in complete harmony with the goals of an organization The manager must direct the subordinates in such a way that they that they perceive their goals to be in harmony with enterprise objectives. For Example the company's profits may be associated with the employee's gains by giving additional bonus or promotion.
- Unity of Command: The subordinates must receive orders and instructions from one supervisor only the violation of which may lead to conflicting orders, divided loyalties and decreased personal responsibility for results.
- **Direct supervision** Every supervisor must Maintain face-to-face contact with his subordinates which boosts the morale of the employees, increases their loyalty and provides them with feedback on how well they are doing.
- Efficient Communication: Communication is An instrument of direction through which the supervisor gives orders, allocates jobs. explains duties and ensures performance. Is a two way process which enables the superior to know how his subordinates feel about the

company and how the company feels on a number of issues concerning them. In communication comprehension is more important than the content.

• Follow-through: Is an act of following through the whole performance of his subordinates to keep check on their activities, help them in their cat and point out deficiencies if any and revise their direction if required.

LEADERSHIP STYLES

Three leadership styles widely used:

- I. Traits approach: Trait is basically a character and deals with personal abilities and assumed to be God's gift and abilities Are identified as mental and physical energy, emotional stability, knowledge of human relations, empathy, objectivity, personal motivation, communication skills, teaching ability, social skills, technical competence, friendliness and affection, integrity and faith, intelligence etc.Trait theories argue that leaders share a number of common personality traits and characteristics, and that leadership emerges from these traits. Early trait theories promoted the idea that leadership is an innate, instinctive quality that you either have or don't have. Now we have moved on from this approach, and we're learning more about what we can do as individuals to develop leadership qualities within ourselves and others. traits are external behaviors that emerge from things going on within the leader's mind and it's these internal beliefs and processes that are important for effective leadership.
- II. Behavioral approach: What does a good leader do? Behavioral theories focus on how leaders behave. Do they dictate what needs to be done and expect cooperation? Or do they involve the team in decisions to encourage acceptance and support. In the 1930s, Kurt Lewin developed a leadership framework based on a leader's decision-making behavior. Lewin argued that there are three types of leaders:
 - Autocratic leaders make decisions without consulting their teams. This is considered appropriate when decisions genuinely need to be taken quickly, when there's no need for input, and when team agreement isn't necessary for a successful outcome.
 - Democratic leaders allow the team to provide input before making a decision, although the degree of input can vary from leader to leader. This type of style is

important when team agreement matters, but it can be quite difficult to manage when there are lots of different perspectives and ideas.

- Laissez-faire leaders don't interfere; they allow people within the team to make many of the decisions. This works well when the team is highly capable and motivated, and when it doesn't need close monitoring or supervision. However, this style can arise because the leader is lazy or distracted, and, here, this approach can fail.
- III. Contingency approach: situation influencing good leadership The realization that there isn't one correct type of leader led to theories that the best leadership style is contingent on, or depends on, the situation. These theories try to predict which leadership style is best in which circumstance. When a decision is needed fast, which style is preferred? When the leader needs the full support of the team, is there a better way to lead? Should a leader be more people oriented or task oriented? These are all examples of questions that contingency leadership theories try to address.

MOTIVATION THEORIES

There are five of them namely

- I. Maslow's need hierarchy theory: An unsatisfied need is the basis for the motivation process and the starting point and begins the chain of events leading to behavior. Begins with the person's unsatisfied need at the lowest level-identification of the need develops in the form of as goal which leads to the fulfillment of the need to achieve the goal.
- **II. Herzberg's Two-factor theory:** Original study based on the research by Fredrick and Herzberg who interviewed 200 engineers and accountants and were asked about the good times and bad times they think about their jobs. Out of these interviews two factors emerged called the maintenance factors and motivators or satisfiers.
- III. McClelland's need for achievement theory: According to McClelland there are three important needs (i)The need for affiliation (n Aff) (ii)the need for power(n Pow) (iii)the need for achievement(nAch) (i)Need for affiliation (n Aff): Reflects desire to interact socially with people Concerned about the quality of an important personal relationship (ii) The need for power (n Pow): Person having high need for power tries to exercise the power and authority Concerned with influencing others and winning arguments (iii) the need for achievement(n Ach): has three distinct characteristics (a)preference in setting moderately difficult but potentially achievable goals (b) doing most things himself rather

than getting them done by others and willing to take personal responsibility for his success or failure and does not want to hold responsible for it. (c) seeking situations where concrete feedback is possible.

- IV. Victor Vroom's Expectancy theory: Works under conditions of free choice where an individual is motivated towards activity which he is most capable of rendering and which he believes has the highest probability of leading to his most preferred goal. The basic concepts of this theory are
 - First and second level outcomes: Job related goals before an individual such as promotion, increase in salary, recognition, praise and so on are called second level outcomes. Each second level outcome can be associated with a value called valence for each individual. The valence can be positive, negative or zero Valence positive: individual wants to attain promotion Valence negative: does not want to attain promotion Valence zero: outcome towards which he is indifferent Second level outcomes can be achieved in different ways: (i)promotion by leaving the organization , by absenting himself to show dissatisfaction, by joining a pressure group, by attending a training programme,or developing intimacy with the boss, by bribing somebody, by improving performance or by bribing somebody and so on.
 - Instrumentality: All first level outcomes have equal probability of leading the individual to the second level outcome The individual has subjective estimates of these probabilities ranging from -1 to +1 which are called instrumentalities. -1 indicates a belief that second level outcome is certain without the first level outcome 0 indicates a belief that second level outcome is impossible without first level outcome 1 indicates a belief that second level outcome is certain with first level outcome outcome 1 indicates a belief that second level outcome is certain with first level outcome 1 indicates a belief that second level outcome is certain with first level outcome 1 indicates a belief that second level outcome is certain with first level outcome
 - **Expectancy:** is the probability estimate which joins the individual's efforts to first level outcome. Expectancy values are always positive ranging from 0 to 1.
 - Motivation: Motivation is the multiplicative function of the valence of each firstlevel outcome (V1) And the believed expectancy (E) that given effort will be followed by a particular first level outcome, That is M=f(V1*E)
- **V.** Adams equity theory: In this theory, Equity is defined as the ratio between The individual's job inputs (such as effort, skill, experience, education and seniority) to the

Job rewards (such as pay or promotion) it is believed that the individuals motivation, performance and satisfaction will depend on his on his or her subjective evaluation of his or her effort/reward ratio and the effort/reward ratio of others in similar situations

COMMUNICATION - MEANING AND IMPORTANCE

The process of communication is as old as man himself. It is hard to name human activity in which communication does not play an important role. This is truer in formal reorganizations in which people assemble to achieve their common objectives through their coordinated efforts. Individuals placed in various departments may perform different activities but they are functionally interrelated. The working and maintenance of these relationships is possible only through communication. In addition, communication establishes connections of the organization with external community. The purpose of communication is to effect change, to influence action towards the welfare of the enterprise. Communication is essential because, it integrates the managerial function. It is through information exchange that manager become aware of the needs of the customer, the availability of suppliers, the claims of stakeholders etc.

COORDINATION - MEANING AND IMPORTANCE

The basic function of coordination in an enterprise is the same as that of an orchestra conductor who directs the activities of the orchestra party in such a manner that it produces harmony in music. Likewise the coordinator of an enterprise also directs the activities of the group in such a manner that it brings harmonious and unified actions to achieve common purpose. Like the orchestra conductor, a manager also performs the function of securing and maintaining unity of direction throughout the organization. The management of a modern enterprise is based on the principles of division of labour and specialization. Jobs are broken down into single repetitive tasks and are entrusted to individuals either working in the same department or in different department of the enterprise. Mere application of specialization is not enough. With the jobs specialized and jobs divided among units, coordination becomes necessary. Coordination is the management of interdependence in work situations. It is an orderly synchronization of the interdependent efforts of individuals. An organization is a consciously coordinated system of cooperative human endeavor focused towards achievement of certain goals. Coordination is intended to channelize cooperative efforts and behaviour of people along organizationally determined lines and to contain the possibilities of conflict within tolerable limits. An

organization represents a pooling of diverse resources and facilities, adopted of diverse skills, techniques, processes and practices determination and achievement of diverse goals and initiation of diverse activities. Diversity demands unity. To manage diversity means to bring about unity or unification. Otherwise diversity is likely to lead to disintegration. The managerial function of coordinator, strives for desired degree of unity, without destroying diversity. Apart from differentiation of activities and authority, organization goals are differentiated into sub goals among various units and levels of organization. Organizational goals are also operationalised into strategies, policies, plans and programmes. There is a means- end chain in the organization. At every level goals are operationalised into means of achieving them. Means of higher level units become the goals of next lower unit. There is need for consistency and compatibility among the various elements in the means- ends chain. Sub-goals are to contribute to the overall goals. Means are to match ends. Short term goals are to mesh in with long-term goals. The coordination is important to achieve correlation between means and ends.

TECHNIQUES OF CO-ORDINATION

Managers can use a number of techniques to enlist coordination. Some of the techniques of coordination are discussed below:

- Clearly Defined Objectives: Each and every organization has its own objectives. These objectives would be clearly defined. Then the employees of all the organization should understand the objectives of the organization well. Unity of purpose is a must for achieving proper coordination.
- Effective Chain of Command: There is a line of authority in every enterprise which indicates as to who is accountable to whom. The line of authority and responsibility should be clearly defined to achieve coordination. Clear cut authority relationship help in reducing conflicts among different positions, particularly line and staff which is essential for sound coordination.
- **Precise and Comprehensive Programmes and Policies:** Laying down well defined programmes and policies is another measure for achieving effective coordination. This brings uniformity of actions because everybody understands the programmes and policies in the same sense.Planning: Planning ensures coordinated efforts. Under planning, target of each department dovetail with the targets of all other departments

- **Cooperation:** Cooperation is the result of better relations among employees of the organization. Cooperation can be brought about by keeping harmonious relations among the people in the organization by encouraging informal contacts to supplement formal communication and using committees for exchange of ideas and views at the top level.
- Liaison of Officers/Departments: A person who acts as a link between two persons is called a liaison officer. The external coordination is obtained through him. Many large organizations depend on this officer to maintain cordial relations with government and outsiders. In some cases, where there is a large volume of contact between two departments, a liaison department evolves to handle the transactions. This typically occurs between sales and production departments. For example, a packaging company that is processing a large order of containers might have a liaison department to make sure that the production department is meeting the clients specifications and that the delivery will take place on time.
- **Induction:** Inducting the new employee into the new social setting of his work is also a coordinating mechanism. This device familiarizes the new e rules and regulations, its dominant norms of behavior, values and beliefs and integrates his personnel goals with the organizational goals.
- **Incentives:** Incentives may be in the form of increments in the scale of pay, bonus, profit sharing etc. These schemes of incentives promote better team spirit which subsequently ensures better coordination. In particular, profit sharing promotes team spirit and better cooperation between superiors and subordinates, between employees and employers. Mutuality of interest reduces stride and ensures better coordination.
- Workflow: A workflow is the sequence of steps by which the organization acquires inputs and transforms them into outputs and exports these to the environment. It is largely shaped by technological, economic and social considerations and helps in coordination.

OUTCOMES

- Will learn meaning and characteristics of Organization
- Understands the nature and purpose of organization
- Understands departmentation and to know the process of staffing
- Will learn about the supervision, motivation, leadership and communication

- Explain the process of controlling by establishing of standard performance
- Measurement of actual performance and comparing with standard performance any deviation leads to corrective action
- Will achieve leadership qualities

QUESTION BANK

- 1. Explain the nature and purpose of organization.
- 2. State and explain the principles of organization.
- 3. Explain the various types of organization.
- 4. Explain departmentation and committees.
- 5. What is MBO and MBE?
- 6. Explain the nature and importance of staffing.
- 7. Explain various elements of importance of staffing.
- 8. Explain various sources of recruitment.
- 9. Differentiate between recruitment and selection.
- 10. Explain meaning and nature of directing.
- 11. Define motivation and explain motivation theory.
- 12. Explain the meaning and importance of coordination.
- 13. Explain various techniques of coordination.
- 14. Differentiate between coordination and cooperation.
- 15. State and explain the steps in controlling.
- 16. Explain the methods of establishing sound controlling.
- VTU Question Paper Dec-2017
- 1. Briefly explain the Principles of organization.
- 2. What is recruitment? Explain the recruitment process.
- 3. Explain the different leadership Styles.
- 4. Explain the essentials of a sound control System.

MODULE 3

INTRODUCTION: ENGINEERING AND ECONOMICS

LESSON STRUCTURE:

- **1.1. Introduction to Economics**
- **1.2.** Definition and Scope of Engineering Economics
- 1.3. Law of Supply and Demand
- 1.4. Factors influencing demand
- 1.5. Factors influencing supply
- 1.6. Time Value Of Money
- **1.7.** Interest Formulas

OBJECTIVES:

- Study engineering and Economics, basic laws of Economics, simple and compound interest.
- This chapter discusses the elements of economics and the interaction between its various components. This is followed by an analysis of the need and scope of engineering economics.

This chapter discusses the elements of economics and the interaction between its various components. This is followed by an analysis of the need and scope of engineering economics. Later, elements of cost and break-even analysis are presented.

1.1. Introduction To Economics

Economics is the science that deals with the production and consumption of goods and services and the distribution and rendering of these for human welfare.

The following are the economic goals.

- 1. A high level of employment
- 2. Price stability
- 3. Efficiency
- 4. An equitable distribution of income
- 5. Growth

Some of the above goals are interdependent. The economic goals are not always complementary; in many cases they are in conflict.

For example, any move to have a significant reduction in unemployment will lead to an increase in inflation.

1.2. Definition and Scope of Engineering Economics

As stated earlier, efficient functioning of any business organization would enable it to provide goods/services at a lower price. In the process of managing organizations, the managers at different levels should take appropriate economic decisions which will help in minimizing investment, operating and maintenance expenditures besides increasing the revenue, savings and other related gains of the organization.

Definition

Engineering economics deals with the methods that enable one to take economic decisions towards minimizing costs and/or maximizing benefits to business organizations.

Scope

The issues that are covered in this book are elementary economic analysis, interest formulae, bases for comparing alternatives, present worth method, future worth method, annual equivalent method, rate of return method, replacement analysis, depreciation, evaluation of public alternatives, inflation adjusted investment decisions, make or buy decisions, inventory control, project management, value engineering, and linear programming.

1.3. Law of Supply and Demand

An interesting aspect of the economy is that the demand and supply of a product are interdependent and they are sensitive with respect to the price of that product. The interrelationships between them are shown in Fig. 1.2.

From Fig. 1.2 it is clear that when there is a decrease in the price of a product, the demand for the product increases and its supply decreases. Also, the product is more in demand and hence the demand of the product increases. At the same time, lowering of the price of the product makes the producers restrain from releasing more quantities of the product in the market. Hence, the supply of the product is decreased. The point of intersection of the supply curve and the demand curve is known as the *equilibrium point*. At the price corresponding to this point, the quantity of supply is equal to the quantity of demand. Hence, this point is called the *equilibrium point*.

1.4. Factors influencing demand

The shape of the demand curve is influenced by the following factors:

- 1. Income of the people
- 2. Prices of related goods
- 3. Tastes of consumers

If the income level of the people increases significantly, then their purchasing power will naturally improve. This would definitely shift the demand curve to the north-east direction of Fig. 1.2. A converse situation will shift the demand curve to the south-west direction. If, for instance, the

price of television sets is lowered drastically its demand would naturally go up. As a result, the demand for its associated product, namely VCDs would also increase. Hence, the prices of related goods influence the demand of a product. Over a period of time, the preference of the people for a particular product may increase, which in turn, will affect its demand. For instance, diabetic people prefer to have sugar-free products. If the incidence of diabetes rises naturally there will be increased demand for sugar free products.



Fig. 1.2 Demand and supply curve

1.5. Factors influencing supply

The shape of the supply curve is affected by the following factors:

- 1. Cost of the inputs
- 2. Technology
- 3. Weather
- 4. Prices of related goods

If the cost of inputs increases, then naturally, the cost of the product will go up. In such a situation, at the prevailing price of the product the profit margin per unit will be less. The producers will then reduce the production quantity, which in turn will affect the supply of the product. For instance, if the prices of fertilizers and cost of labour are increased significantly, in agriculture, the profit margin per bag of paddy will be reduced. So, the farmers will reduce the area of cultivation, and hence the quantity of supply of paddy will be reduced at the prevailing prices of the paddy.If there is advancement in technology used in the manufacture of the product in the long run, there will be a reduction in the production cost per unit. This will enable the manufacturer to have a greater profit margin per unit at the prevailing price of the product. Hence, the producer will be tempted to supply more quantity to the market. Weather also has a direct bearing on the supply of products. For example, demand for woolen products will increase during winter. This means the prices of woolen goods will be increased in winter. So, naturally, manufacturers will supply more volume of woolen goods during winter.

Again, take the case of television sets. If the price of TV sets is lowered significantly, then its demand would naturally go up. As a result, the demand for associated products like VCDs would also go up. Over a period of time, this will lead to an increase in the price of VCDs, which would result in more supply of VCDs.

1.6. Time Value Of Money

If an investor invests a sum of Rs. 100 in a fixed deposit for five years with an interest rate of 15% compounded annually, the accumulated amount at the end of every year will be as shown in Table 1.1.

Year end	(amount of deposit = Rs. 100.00)	
	Interest (Rs.)	Compound amount (Rs.)
0		100.00
1	15.00	115.00
2	17.25	132.25
3	19.84	152.09
4	22.81	174.90
5	26.24	201.14

Table 1.1 Compound Amounts

The formula to find the future worth in the third column is

$$F = P(1+i)^n$$

where

P = principal amount invested at time 0

F = future amount

i = interest rate compounded annually

n = period of deposit.

The maturity value at the end of the fifth year is Rs. 201.14. This means that the amount Rs. 201.14 at the end of the fifth year is equivalent to Rs. 100.00 at time 0 (i.e. at present). This is diagrammatically shown in Fig. 1.3. This explanation assumes that the inflation is at zero percentage.



Fig. 1.3 Time value of money.

Alternatively, the above concept may be discussed as follows: If we want Rs. 100.00 at the end of the *n*th year, what is the amount that we should deposit now at a given interest rate, say 15%? A detailed working is shown in Table 1.2.
	(rate of interest = 15%)		
End of year (n)	Present worth	Compound amount after n year(s)	
0		100	
1	86.96	100	
2	75.61	100	
3	65.75	100	
4	57.18	100	
5	49.72	100	
6	43.29	100	
7	37.59	100	
8	32.69	100	
9	28.43	100	
10	24.72	100	

Table 1.2 Present worth Amounts

The formula to find the present worth in the second column is From Table 1.2, it is clear that if we want Rs. 100 at the end of the fifth year, we should now deposit an amount of Rs. 49.72. Similarly, if we want Rs. 100.00 at the end of the 10th year, we should now deposit an amount of Rs. 24.72. Also, this concept can be stated as follows:

A person has received a prize from a finance company during the recent festival contest.But the prize will be given in either of the following two modes:

1. Spot payment of Rs. 24.72 or

2. Rs. 100 after 10 years from now (this is based on 15% interest rate compounded annually).

If the prize winner has no better choice that can yield more than 15% interest rate compounded annually, and if 15% compounded annually is the common interest rate paid in all the finance companies, then it makes no difference whether he receives Rs. 24.72 now or Rs. 100 after 10 years.

3. On the other hand, let us assume that the prize winner has his own business wherein he can get a yield of 24% interest rate (more than 15%) compounded annually, it is better for him to receive the prize money of Rs. 24.72 at present and utilize it in his business. If this option is followed, the equivalent amount for Rs. 24.72 at the end of the 10th year is Rs. 212.45. This example clearly demonstrates the time value of money.

1.7. Interest Formulas

While making investment decisions, computations will be done in many ways. To simplify all these computations, it is extremely important to know how to use interest formulas more effectively. Before discussing the effective application of the interest formulas for investment-decision making, the various interest formulas are presented first. Interest rate can be classified into *simple interest rate* and *compound interest rate*.

In simple interest, the interest is calculated, based on the initial deposit for every interest period. In this case, calculation of interest on interest is not applicable. In compound interest, the

interest for the current period is computed based on the amount (principal plus interest up to the end of the previous period) at the beginning of the current period.

The notations which are used in various interest formulae are as follows:

P = principal amount

n = No. of interest periods

i = interest rate (It may be compounded monthly, quarterly, semiannually or annually)

F = future amount at the end of year n

A = equal amount deposited at the end of every interest period

G = uniform amount which will be added/subtracted period after period to/ from the amount of deposit A1 at the end of period 1

I. Single-Payment Compound Amount

Here, the objective is to find the single future sum (F) of the initial payment (P) made at time 0 after n periods at an interest rate i compounded every period. The cash flow diagram of this situation is shown in Fig.1.4.



Fig.1.4 Cash flow diagram of single-payment compound amount

The formula to obtain the single-payment compound amount is

$$F = P(1+i)^n = P(F/P, i, n)$$

Where,

(F/P, i, n) is called as single-payment compound amount factor.

EXAMPLE 1.1 A person deposits a sum of Rs. 20,000 at the interest rate of

18% compounded annually for 10 years. Find the maturity value after 10 years.

Solution

P = Rs. 20,000

i = 18% compounded annually

n = 10 years

$$F = P(1 + i)^{n}$$

= P(F/P, i, n)
= 20,000 (F/P, 18%, 10)
= 20,000*5.234
= Rs. 1, 04,680

The maturity value of Rs. 20,000 invested now at 18% compounded yearly is equal to Rs. 1,04,680 after 10 years.

II. Single-Payment Present Worth Amount

Here, the objective is to find the present worth amount (P) of a single future sum (F) which will be received after *n* periods at an interest rate of *i* compounded at the end of every interest period. The corresponding cash flow diagram is shown in Fig. 1.5



Fig.1.5 Cash flow diagram of single-payment present worth amount.

where

(P/F, i, n) is termed as single-payment present worth factor.

EXAMPLE 1.2 A person wishes to have a future sum of Rs. 1,00,000 for his son's education after 10 years from now. What is the single-payment that he should deposit now so that he gets the desired amount after 10 years? The bank gives 15% interest rate compounded annually.

Solution

F = Rs. 1,00,000i = 15%, compounded annually n = 10 years

$$P = F/(1 + i)^{n}$$

= F(P/F, i, n)
=1,00,000 (P/F, 15%, 10)
=1,00,000*0.2472
= Rs. 24,720

The person has to invest Rs. 24,720 now so that he will get a sum of Rs. 1,00,000 after 10 years at 15% interest rate compounded annually.

III. Equal-Payment Series Compound Amount

In this type of investment mode, the objective is to find the future worth of n equal payments which are made at the end of every interest period till the end of the nth interest period at an interest rate of i compounded at the end of each interest period. The corresponding cash flow diagram is shown in Fig.1.6



Fig.1.6 Cash flow diagram of equal-payment series compound amount.

In Fig. 1.6,

A = equal amount deposited at the end of each interest period

n = No. of interest periods

i= rate of interest

F = single future amount

The formula to get F is

$$F = \underline{A (1 + i)^{n} - 1}$$
$$i$$
$$F = A(F/A, i, n)$$

where

(F/A, i, n) is termed as equal-payment series compound amount factor.

EXAMPLE 1.3 A person who is now 35 years old is planning for his retired life. He plans to invest an equal sum of Rs. 10,000 at the end of every year for the next 25 years starting from the end of the next year. The bank gives 20% interest rate, compounded annually. Find the maturity value of his account when he is 60 years old.

Solution

A = Rs. 10,000n = 25 yearsi = 20%F = ?





Fig.1.7 Cash flow diagram of equal-payment series compound amount.

$$F = A \frac{(1+i)^n - 1}{i}$$

= $A(F/A, i, n)$
= 10,000(F/A, 20%, 25)
= 10,000 '471.981
= Rs. 47,19,810

The future sum of the annual equal payments after 25 years is equal to Rs. 47, 19,810.

IV. Equal-Payment Series Sinking Fund

In this type of investment mode, the objective is to find the equivalent amount (A) that should be deposited at the end of every interest period for n interest periods to realize a future sum (F) at the end of the nth interest period at an interest rate of i.

The corresponding cash flow diagram is shown in Fig.1.8



Fig.1.8 Cash flow diagram of equal-payment series sinking fund.

In Fig. 3.6,

A = equal amount to be deposited at the end of each interest period

n = No. of interest periods

i = rate of interest

F = single future amount at the end of the n^{th} period

The formula to get F is

$$A = F = \overline{F(A/F, i, n)} (1+i)^n - 1$$

where

(A/F, i, n) is called as *equal-payment series sinking fund factor*.

EXAMPLE 1.4 A company has to replace a present facility after 15 years at an outlay of Rs.5,00,000. It plans to deposit an equal amount at the end of every year for the next 15 years at an interest rate of 18% compounded annually. Find the equivalent amount that must be deposited at the end of every year for the next 15 years.

Solution

F = Rs. 5,00,000n = 15 years

i = 18%

$$A = ?$$

The corresponding cash flow diagram is shown in Fig.1.9



Fig. 1.9 Cash flow diagram of equal-payment series sinking fund.

i $F = F(A/F, \overline{i, n}) (1+i)^{n} - 1$ = 5,00,000 (A/F, 18%, 15) $= 5,00,000 \circ 0.0164$ = Rs. 8,200

The annual equal amount which must be deposited for 15 years is Rs. 8,200.

V. Equal-Payment Series Present Worth Amount

The objective of this mode of investment is to find the present worth of an equal payment made at the end of every interest period for n interest periods at an interest rate of I compounded at the end of every interest period.

The corresponding cash flow diagram is shown in Fig.1.10 Here,

P= present worth

A = annual equivalent payment i = interest rate

n = No. of interest periods

The formula to compute *P* is

$$P = A \frac{i(1+i)^n - 1}{i(1+i)^n} = A(P/A, i, n)$$

where

(P/A, i, n) is called equal-payment series present worth factor.



EXAMPLE 1.5 A company wants to set up a reserve which will help the company to have an annual equivalent amount of Rs. 10,00,000 for the next 20 years towards its employees welfare measures. The reserve is assumed to grow at the rate of 15% annually. Find the single-payment that must be made now as the reserve amount.

Solution

A = Rs. 10,00,000i = 15%n = 20 years P = ?

The corresponding cash flow diagram is illustrated in Fig.1.11



Fig.1.11 Cash flow diagram of equal-payment series present worth amount

The amount of reserve which must be set-up now is equal to Rs. 62, 59,300.

VI. Equal-Payment Series Capital Recovery Amount

The objective of this mode of investment is to find the annual equivalent amount (A) which is to be recovered at the end of every interest period for n interest periods for a loan (P) which is sanctioned now at an interest rate of i compounded at the end of every interest period (see Fig.1.12).



Fig.1.12 Cash flow diagram of equal-payment series capital recovery amount.

In Fig.1.12,

P =present worth (loan amount)

A = annual equivalent payment (recovery amount) i = interest rate

n = No. of interest periods

The formula to compute *P* is as follows:

$$A = P \qquad \frac{i(1 + i)^{N}}{(1 + i)^{N} - 1} = P(A/P, i, n)$$

where,

(A/P, i, n) is called *equal-payment series capital recovery factor*.

EXAMPLE 1.6 A bank gives a loan to a company to purchase equipment worth Rs.10, 00,000 at an interest rate of 18% compounded annually. This amount should be repaid in 15 yearly equal installments. Find the installment amount that the company has to pay to the bank.

Solution

P = Rs. 10, 00,000 i = 18% n = 15 yearsA = ?

The corresponding cash flow diagram is shown in Fig.1.13

10,00,000 i = 18%0 1 2 3 4 A A A A A

Fig.1.13 Cash flow diagram of equal-payment series capital recovery amount

The annual equivalent installment to be paid by the company to the bank is Rs. 1, 96,400

VII. Uniform Gradient Series Annual Equivalent Amount

The objective of this mode of investment is to find the annual equivalent amount of a series with an amount A1 at the end of the first year and wth an equal increment (*G*) at the end of each of the following n - 1 years with an interest rate *i* compounded annually.

The corresponding cash flow diagram is shown in Fig.1.14





$$A = A1 + G$$
 $(1 + i)^n - in - 1$
 $i(1 + i)^n - i = A1 + G(A/G, i, n)$

where

(A/G, i, n) is called uniform gradient series factor.

EXAMPLE 1.7 A person is planning for his retired life. He has 10 more years of service. He would like to deposit 20% of his salary, which is Rs. 4,000, at the end of the first year, and thereafter he wishes to deposit the amount with an annual increase of Rs. 500 for the next 9 years with an interest rate of 15%. Find the total amount at the end of the 10th year of the above series.

Solution Here,

A1 = Rs. 4,000 G = Rs. 500 i = 15% n = 10 yearsA = ?& F = ?

The cash flow diagram is shown in Fig.1.15

Fig.1.15 Cash flow diagram of uniform gradient series annual equivalent amount

This is equivalent to paying an equivalent amount of Rs. 5,691.60 at the end of every year for the next 10 years. The future worth sum of this revised series at the end of the 10th year is obtained as follows:

$$F = A (F/A, i, n)$$
$$= A (F/A, 15\%, 10)$$

At the end of the 10th year, the compound amount of all his payments will be Rs. 1, 15,562.25.

OUTCOMES:

At the end of the unit, the students are able to:

- > Define engineering, economics and identify their relation between them.
- Analyze basic laws of economics.
- > Define and derive simple and compound interest.
- Solve numerical problems.

SELF-TEST QUESTIONS:

- 1. Define engineering economics.
- 2. Brief about 'Problem solving technique' used in engineering economics.
- **3.** Define law of demand.
- 4. Define law of supply.
- 5. Derive interest formula for Single-Payment Compound Amount factor
- 6. Derive interest formula for Single-Payment Present Worth Amount factor
- 7. Derive interest formula for Equal-Payment Series Compound Amount factor
- 8. Derive interest formula for Equal-Payment Series Present Worth Amount factor
- 9. Derive interest formula for Equal-Payment Series Capital Recovery Amount factor
- **10.** An engineer has his last 10 years of service. Determine the amount to be deposited at the end of every year, if he wishes to withdraw Rs 15,000/- every year for 8 years after his requirement. The amount deposited earns an interest of 10% compounded annually. Also calculate the savings of his depositions if interest is compounded half yearly.
- **11.** 'Mr. X' deposits Rs 1,000/- at the end of each year which pays an interest 6% compounded annually. How long does it take to accumulate Rs 20,000/-. What is the actual amount accumulated?

FURTHER READING:

- 1. Engineering Economy, Tarachand, 2000.
- 2. Industrial Engineering and Management, OP Khanna, Dhanpat Rai & Sons. 2000
- 3. Financial Mangement, Prasanna Chandra, 7th Ed., TMH, 2004
- 4. Finacial Management, IM PANDEY, Vikas Pub. House, 2002

MODULE 4

PRESENT, FUTURE, ANNUAL WORTH AND RATE OF RETURNS

OBJECTIVES

- To study Present Worth comparison; assets having equal, unequal and infinite lives. Future Worth comparison, Pay-back method
- To equivalent Annual Worth comparison method, assets with equal, unequal and infinite lives
- To learn Rate of return and its types

Introduction

In this method of comparison, the cash flows of each alternative will be reduced to time zero by assuming an interest rate *i*. Then, depending on the type of decision, the best alternative will be selected by comparing the present worth amounts of the alternatives. The sign of various amounts at different points in time in a cash flow diagram is to be decided based on the type of the decision problem.

In a cost dominated cash flow diagram, the costs (outflows) will be assigned with positive sign and the profit, revenue, salvages value (all inflows), etc. will be assigned with negative sign.

In a revenue/profit-dominated cash flow diagram, the profit, revenue, salvage value (all inflows to an organization) will be assigned with positive sign. The costs (outflows) will be assigned with negative sign.

In case the decision is to select the alternative with the minimum cost, then the alternative with the least present worth amount will be selected. On the other hand, if the decision is to select the alternative with the maximum profit, then the alternative with the maximum present worth will be selected.

Revenue-Dominated Cash Flow Diagram

A generalized revenue-dominated cash flow diagram to demonstrate the present worth method of comparison is presented in Fig. 4.1.



Fig. 4.1 Revenue-dominated cash flow diagram

In Fig. 4.1, P represents an initial investment and Rj the net revenue at the end of the j^{th} year. The interest rate is *i*, compounded annually. *S* is the salvage value at the end of the *n*th year. To find the present worth of the above cash flow diagram for a given interest rate.

In this expenditure is assigned a negative sign and revenues are assigned a positive sign.

If we have some more alternatives which are to be compared with this alternative, then the corresponding present worth amounts are to be computed and compared. Finally, the alternative with the maximum present worth amount should be selected as the best alternative.

Cost-Dominated Cash Flow Diagram

A generalized cost-dominated cash flow diagram to demonstrate the present worth method of comparison is presented in Fig. 4.2.



Fig. 4.2 Cost-dominated cash flow diagram

In Fig. 4.2, P represents an initial investment, Cj the net cost of operation and maintenance at the end of the j^{th} year, and S the salvage value at the end of the nth year. In this expenditure is assigned a positive sign and the revenue a negative sign. If we have some more alternatives which are to be compared with this alternative, then the corresponding present worth amounts are to be computed and compared. Finally, the alternative with the minimum present worth amount should be selected as the best alternative.

EXAMPLES

EXAMPLE 1 Alpha Industry is planning to expand its production operation. It has identified three different technologies for meeting the goal. The initial outlay and annual revenues with respect to each of the technologies are summarized in Table. Suggest the best technology which is to be implemented based on the present worth method of comparison assuming 20% interest rate, compounded annually.

		Initial outlay (Rs.)	Annual revenue (Rs.)	Life (years)
Technology	1	12,00,000	4,00,000	10
Technology	2	20,00,000	6,00,000	10
Technology	3	18,00,000	5,00,000	10

Solution In all the technologies, the initial outlay is assigned a negative sign and the annual revenues are assigned a positive sign.

TECHNOLOGY 1

Initial outlay, P = Rs. 12, 00,000

Annual revenue, A = Rs. 4, 00,000

Interest rate, i = 20%, compounded annually

Life of this technology, n = 10 years

The cash flow diagram



1 The present worth expression for this technology is

$$PW(20\%)1 = -12,00,000 + 4,00,000 * (P/A, 20\%, 10)$$
$$= -12,00,000 + 4,00,000 * (4.1925)$$
$$= -12,00,000 + 16,77,000$$
$$= Rs. 4, 77,000$$

TECHNOLOGY 2

Initial outlay, P = Rs. 20,00,000

Annual revenue, A = Rs. 6,00,000

Interest rate, i = 20%, compounded annually

Life of this technology, n = 10 years

The cash flow diagram



The present worth expression for this technology i

PW(20%)2 = - 20,00,000 + 6,00,000 * (P/A, 20%, 10) =- 20,00,000 + 6,00,000 ´ (4.1925) =- 20,00,000 + 25,15,500 =Rs. 5,15,500

TECHNOLOGY 3

Initial outlay, P = Rs. 18,00,000

Annual revenue, A = Rs. 5,00,000

Interest rate, i = 20%, compounded annually

Life of this technology, n = 10 years

The cash flow diagram



The present worth expression for this technology is

PW (20%)3 = -18,00,000 + 5,00,000 * (P/A, 20%, 10)=-18,00,000 + 5,00,000 \checkmark (4.1925) =-18,00,000 + 20,96,250 =Rs. 2,96,250

From the above calculations, it is clear that the present worth of technology 2 is the highest among all the technologies. Therefore, technology 2 is suggested for implementation to expand the production.

EXAMPLE 2 An engineer has two bids for an elevator to be installed in a new building. The details of the bids for the elevators are as follows:

Bid	Engineer's estimates			
	Initial cost	Service life (years)	Annual operations & maintenance	
	(Rs.)	2,852,32	cost (Rs.)	
Alpha Elevator Inc.	4,50,000	15	27,000	
Beta Elevator Inc.	5,40,000	15	28,500	

Determine which bid should be accepted, based on the present worth method of comparison assuming 15% interest rate, compounded annually.

Solution

Bid 1: Alpha Elevator Inc.

Initial cost, P = Rs. 4,50,000

Annual operation and maintenance cost, A = Rs. 27,000 Life = 15 years

Interest rate, i = 15%, compounded annually.

The cash flow diagram



The present worth of the above cash flow diagram is computed as follows:

PW(15%) = 4,50,000 + 27,000(P/A, 15%, 15)=4,50,000 + 27,000 $\stackrel{\prime}{5}.8474$ =4,50,000 + 1,57,879.80 =Rs. 6,07,879.80

Bid 2: Beta Elevator Inc.

Initial cost, P = Rs. 5,40,000

Annual operation and maintenance cost, A = Rs. 28,500

Life = 15 years

Interest rate, i = 15%, compounded annually.

The cash flow diagram



The present worth of the above cash flow diagram is computed as follows:

$$PW(15\%) = 5,40,000 + 28,500(P/A, 15\%, 15)$$
$$=5,40,000 + 28,500 \cdot 5.8474$$
$$=5,40,000 + 1,66,650.90$$
$$=Rs. 7,06,650.90$$

The total present worth cost of bid 1 is less than that of bid 2. Hence, bid 1 is to be selected for implementation. That is, the elevator from Alpha Elevator Inc. is to be purchased and installed in the new building.

EXAMPLE 3 Investment proposals A and B have the net cash flows as follows:

Proposal		E	and of year:	2	
	0	1	2	3	4
A (Rs.)	-10,000	3,000	3,000	7,000	6,000
B(Rs.)	-10,000	6,000	6,000	3,000	3,000

Compare the present worth of A with that of B at i = 18%. Which proposal should be selected? **Solution**

Present worth of A at i = 18%. The cash flow diagram of proposal A



The present worth of the above cash flow diagram is computed as

$$PWA (18\%) = -10,000 + 3,000 (P/F, 18\%, 1) + 3,000 (P/F, 18\%, 2) + 7,000 (P/F, 18\%, 3) + 3,000 (P/F, 18\%, 3)$$

6,000(P/F,18%,4)

$$=10,000 + 3,000 (0.8475) + 3,000(0.7182) + 7,000(0.6086) + 6,000(0.5158)$$

Present worth of B at i = 18%. The cash flow diagram of the proposal B



The present worth of the above cash flow diagram is calculated as

$$PWB(18\%) = -10,000 + 6,000(P/F, 18\%, 1) + 6,000(P/F, 18\%, 2) + 3,000(P/F, 18\%, 3) + 3,000(P/F, 18\%, 4)$$
$$= -10,000 + 6,000(0.8475) + 6,000(0.7182) + 3,000(0.6086) + 3,000(0.5158)$$
$$= Rs. 2,767.40$$

At i = 18%, the present worth of proposal B is higher than that of proposal A. Therefore, select proposal B.

EXAMPLE 4 A granite company is planning to buy fully automated granite cutting machine. If it is purchased under down payment, the cost of the machine is Rs. 16,00,000. If it is purchased under installment basis, the company has to pay 25% of the cost at the time of purchase and the remaining amount in 10 annual equal installments of Rs.2, 00,000 each. Suggest the best alternative for the company using the present worth basis at i= 18%, compounded annually.

Solution There are two alternatives available for the company:

1. Down payment of Rs. 16,00,000

2. Down payment of Rs. 4,00,000 and 10 annual equal installments of Rs. 2,00,000 each

Present worth calculation of the second alternative. The cash flow diagram of the second

PWA(18%) = -10,000 + 3,000(P/F, 18%, 1) + 3,000(P/F, 18%, 2) + 7,000(P/F, 18%, 3) + 1000(P/F, 18%, 3) +

6,000(*P*/*F*, 18%, 4)

=-10,000 + 3,000 (0.8475) + 3,000(0.7182) + 7,000(0.6086) + 6,000(0.5158)

=Rs. 2,052.10

Present worth of B at *i* = 18%. The cash flow diagram



B The present worth of the above cash flow diagram is calculated as

$$PWB(18\%) = -10,000 + 6,000(P/F, 18\%, 1) + 6,000(P/F, 18\%, 2) + 3,000(P/F, 18\%, 3) + 3,000(P/F, 18\%, 4)$$
$$= -10,000 + 6,000(0.8475) + 6,000(0.7182) + 3,000(0.6086) + 3,000(0.5158)$$
$$= Rs. 2,767.40$$

At i = 18%, the present worth of proposal B is higher than that of proposal A. Therefore, select proposal B.

EXAMPLE 5 A granite company is planning to buy a fully automated granite cutting machine. If it is purchased under down payment, the cost of the machine is Rs. 16,00,000. If it is purchased under installment basis, the company has to pay 25% of the cost at the time of purchase and the remaining amount in 10 annual equal installments of Rs. 2,00,000 each. Suggest the best alternative for the company using the present worth basis at I = 18%, compounded annually.

Solution There are two alternatives available for the company:

Down payment of Rs. 16,00,000

Down payment of Rs. 4,00,000 and 10 annual equal installments of Rs. 2,00,000 each

Present worth calculation of the second alternative. The cash flow diagram of the second



The present worth of the above cash flow diagram is computed as

$$PW(12\%) = -1,000 + 4,000(P/F, 12\%, 10) + 4,000(P/F, 12\%, 15)$$
$$= -1,000 + 4,000(0.3220) + 4,000(0.1827)$$
$$= Rs. 1,018.80$$

The present worth of plan 1 is more than that of plan 2. Therefore, plan 1 is the best plan from the investor's point of view.

EXAMPLE 6 Novel Investment Ltd. accepts Rs. 10,000 at the end of every year for 20 years and pays the investor Rs. 8,00,000 at the end of the 20th year. Innovative Investment Ltd. accepts Rs. 10,000 at the end of every year for 20 years and pays the investor Rs. 15,00,000 at the end of the 25th year. Which is the best investment alternative? Use present worth base with i = 12%.

Solution: Novel Investment Ltd's plan. The cash flow diagram of NovelInvestment Ltd's plan is shown below



The present worth of the above cash flow diagram is computed as

$$PW(12\%) = -10,000(P/A, 12\%, 20) + 8,00,000(P/F, 12\%, 20)$$
$$= -10,000(7.4694) + 8,00,000(0.1037)$$
$$= Rs. 8,266$$

Innovative Investment Ltd's plan. The cash flow diagram



The present worth of the above cash flow diagram is calculated as

$$PW(12\%) = -10,000(P/A, 12\%, 20) + 15,00,000(P/F, 12\%, 25)$$
$$= -10,000(7.4694) + 15,00,000(0.0588)$$
$$= \text{Rs. } 13,506$$

The present worth of Innovative Investment Ltd's plan is more than that of Novel Investment Ltd's plan. Therefore, Innovative Investment Ltd's plan is the best from investor's point of view.

EXAMPLE 7 A small business with an initial outlay of Rs. 12,000 yields Rs. 10,000 during the first year of its operation and the yield increases by Rs. 1,000 from its second year of operation up to its 10th year of operation. At the end of the life of the business, the salvage value is zero. Find the present worth of the business by assuming an interest rate of 18%, compounded annually.

Solution

Initial investment, P = Rs. 12,000Income during the first year, A = Rs. 10,000Annual increase in income, G = Rs. 1,000 n = 10 years

i = 18%, compounded annually

The cash flow diagram



business The equation for the present worth is

PW (18%) = -12,000 + (10,000 + 1,000 * (A/G, 18%, 10)) * (P/A, 18%, 10)= -12,000 + (10,000 + 1,000 ` 3.1936) ` 4.4941= -12,000 + 59,293.36

=Rs. 47,293.36 The present worth of the small business is Rs. 47,293.36.

ANNUAL EQUIVALENT METHOD

Introduction

In the annual equivalent method of comparison, first the annual equivalent cost or the revenue of each alternative will be computed. Then the alternative with the maximum annual equivalent revenue in the case of revenue-based comparison or with the minimum annual equivalent cost in the case of cost-based comparison will be selected as the best alternative.

Revenue-Dominated Cash Flow Diagram

A generalized revenue-dominated cash flow diagram to demonstrate the annual equivalent method of comparison is presented in Fig. 3.1.



Fig. 3.1 Revenue-dominated cash flow diagram

In Fig. 3.1, *P* represents an initial investment, Rj the net revenue at the end of the j^{th} year, and *S* the salvage value at the end of the *n*th year.

The first step is to find the net present worth of the cash flow diagram using the following expression for a given interest rate, *i*:

$$\begin{split} PW(i) &= -P + R1/(1+i)^1 + R2/(1+i)^2 + \dots \\ &+ Rj/(1+i)^j + \dots + Rn/(1+i)^n + S/(1+i)^n \end{split}$$

In the above formula, the expenditure is assigned with a negative sign and the revenues are assigned with a positive sign.

If we have some more alternatives which are to be compared with this alternative, then the corresponding annual equivalent revenues are to be computed and compared. Finally, the alternative with the maximum annual equivalent revenue should be selected as the best alternative.

Cost-Dominated Cash Flow Diagram

A generalized cost-dominated cash flow diagram to demonstrate the annual equivalent method of comparison is illustrated in Fig. 3.2.



Fig. 3.2 Cost-dominated cash flow diagram

In Fig. 3.2, P represents an initial investment, Cj the net cost of operation and maintenance at the end of the *j*th year, and S the salvage value at the end of the *n*th year. The first step is to find the net present worth of the cash flow diagram using the following relation for a given interest rate, *i*.

$$\begin{split} PW(i) &= P + C1/(1+i)^1 + C2/(1+i)^2 + \dots \\ &+ Cj/(1+i)^j + \dots + Cn/(1+i)^n - S/(1+i)^n \end{split}$$

In the above formula, each expenditure is assigned with positive sign and the salvage value with negative sign. Then, in the second step, the annual equivalent cost is computed using the following equation:

$$A = PW(i) \frac{i(1+i)^{n}}{(1+i)^{n}} - 1 = PW(i) (A/P, i, n)$$

where (A/P, i, n) is called as equal-payment series capital recovery factor.

As in the previous case, if we have some more alternatives which are to be compared with this alternative, then the corresponding annual equivalent costs are to be computed and compared. Finally, the alternative with the minimum annual equivalent cost should be selected as the best alternative.

If we have some non-standard cash flow diagram, then we will have to follow the general procedure for converting each and every transaction to time zero and then convert the net present worth into an annual equivalent cost/ revenue depending on the type of the cash flow diagram. Such procedure is to be applied to all the alternatives and finally, the best alternative is to be selected.

Alternate Approach

Instead of first finding the present worth and then figuring out the annual equivalent cost/revenue, an alternate method which is as explained below can be used. In each of the cases presented in Sections 3.2 and 3.3, in the first step, one can find the future worth of the cash flow diagram of each of the alternatives. Then, in the second step, the annual equivalent cost/revenue can be obtained by using the equation:

$$A = F \frac{i}{(1+i)^n} - 1 = F(A/F, i, n)$$

where (A/F, i, n) is called *equal-payment series sinking fund factor*.

EXAMPLES

EXAMPLE 1: A company provides a car to its chief executive. The owner of the company is concerned about the increasing cost of petrol. The cost per litre of petrol for the first year of operation is Rs. 21. He feels that the cost of petrol will be increasing by Re.1 every year. His experience with his company car indicates that it averages 9 km per litre of petrol. The executive expects to drive an average of 20,000 km each year for the next four years. What is the annual equivalent cost of fuel over this period of time?. If he is offered similar service with the same quality on rental basis at Rs. 60,000 per year, should the owner continue to provide company car for his executive or alternatively provide a rental car to his executive? Assume i = 18%. If the rental car is preferred, then the company car will find some other use within the company.

Solution

Average number of km run/year = 20,000 km Number of km/litre of petrol = 9 km Therefore, Petrol consumption/year = 20,000/9 = 2222.2 litre Cost/litre of petrol for the 1st year = Rs. 21 Cost/litre of petrol for the 2nd year = Rs. 21.00 + Re. 1.00 = Rs. 22.00Cost/litre of petrol for the 3rd year = Rs. 22.00 + Re. 1.00 = Rs. 23.00Cost/litre of petrol for the 4th year = Rs. 23.00 + Re. 1.00 = Rs. 24.00Fuel expenditure for 1st year = 2222.2 * 21 = Rs. 46,666.20Fuel expenditure for 2nd year = 2222.2 * 22 = Rs. 48,888.40 Fuel expenditure for 3rd year = 2222.2 * 23 = Rs. 51,110.60

Fuel expenditure for 4th year = 2222.2 * 24 = Rs. 53,332.80

The annual equal increment of the above expenditures is Rs. 2,222.20 (*G*). The cash flow diagram for this situation is depicted



Series cash flow diagram.

In Fig. 6.3, *A*1 = Rs. 46,666.20 and *G* = Rs. 2,222.20

A = A1 + G(A/G, 18%, 4)

=46,666.20 + 2222.2(1.2947)

=Rs. 49,543.28

The proposal of using the company car by spending for petrol by the company will cost an annual equivalent amount of Rs. 49,543.28 for four years. This amount is less than the annual rental value of Rs. 60,000. Therefore, the company should continue to provide its own car to its executive.

EXAMPLE 2: A company is planning to purchase an advanced machine centre. Three original manufacturers have responded to its tender whose particulars are tabulated as follows:

Manufacturer	Down payment	Yearly equal installment	No. of installments
	(Rs.)	(Rs.)	
1	5,00,000	2,00,000	15
2	4,00,000	3,00,000	15
3	6,00,000	1,50,000	15

Determine the best alternative based on the annual equivalent method by assuming i = 20%, compounded annually.

Solution

Alternative 1

Down payment, P = Rs. 5,00,000

Yearly equal installment, A = Rs. 2,00,000

n = 15 years

i = 20%, compounded annually

The cash flow diagram for manufacturer 1 is shown in Fig. 3.4.



Fig. 3.4 Cash flow diagram for manufacturer 1

The annual equivalent cost expression of the above cash flow diagram is

AE1(20%) = 5,00,000(A/P, 20%, 15) + 2,00,000

=5,00,000(0.2139) + 2,00,000

=3,06,950

Alternative 2

Down payment, P = Rs. 4,00,000

Yearly equal installment, A = Rs. 3,00,000

n = 15 years

i = 20%, compounded annually

The cash flow diagram



The annual equivalent cost expression of the above cash flow diagram is

AE2(20%) = 4,00,000(A/P, 20%, 15) + 3,00,000=4,00,000(0.2139) + 3,00,000

= Rs. 3,85,560.

Alternative 3

Down payment, P = Rs. 6,00,000

Yearly equal installment, A = Rs. 1,50,000

n = 15 years

i = 20%, compounded annually

The cash flow diagram



The annual equivalent cost expression of the

above cash flow diagram is AE3(20%) = 6,00,000(A/P, 20%, 15) +

1,50,000

=6,00,000(0.2139) + 1,50,000

= Rs. 2,78,340.

The annual equivalent cost of manufacturer 3 is less than that of manufacturer 1 and manufacturer 2. Therefore, the company should buy the advanced machine centre from manufacturer 3

EXAMPLE 3: A company invests in one of the two mutually exclusive alternatives. The life of both alternatives is estimated to be 5 years with the following investments, annual returns and salvage values.

	Alternative	
	А	в
Investment (Rs.)	-1,50,000	-1,75,000
Annual equal return (Rs.)	+ 60,000	+ 70,000
Salvage value (Rs.)	+15,000	+ 35,000

Determine the best alternative based on the annual equivalent method by assuming i = 25%.

Solution:

Alternative A

Initial investment, P = Rs. 1,50,000

Annual equal return, A = Rs. 60,000

Salvage value at the end of machine life, S = Rs. 15,000

Life = 5 years

Interest rate, i = 25%, compounded annually

The cash flow diagram



Fig. 3.7 Cash flow diagram for alternative A

The annual equivalent revenue expression of the above cash flow diagram is as follows:

AEA(25%) = -1,50,000(A/P, 25%, 5) + 60,000 + 15,000(A/F, 25%, 5)= -1,50,000(0.3718) + 60,000 + 15,000(0.1218)

= Rs. 6,057

Alternative B

Initial investment, P = Rs. 1,75,000

Annual equal return, A = Rs. 70,000

Salvage value at the end of machine life, S = Rs. 35,000

Life = 5 years

Interest rate, i = 25%, compounded annually

The cash flow diagram for alternative B is shown in Fig. 3.8.



The annual equivalent revenue expression of the above cash flow diagram is AEB(25%) = -1,75,000(A/P, 25%, 5) + 70,000 + 35,000(A/F, 25%, 5) = -1,75,000(0.3718) + 70,000 + 35,000(0.1218)= Rs. 9,198

The annual equivalent net return of alternative B is more than that of alternative A. Thus, the Company should select alternative B.

EXAMPLE 4: A certain individual firm desires an economic analysis to determine which of the two machines is attractive in a given interval of time. The minimum attractive rate of return for the firm is 15%. The following data are to be used in the analysis:

	Machine X	Machine Y
First cost	Rs. 1,50,000	Rs. 2,40,000
Estimated life	12 years	12 years
Salvage value	0	Rs 6,00
Annual maintenance cost	0	Rs 4,50

Which machine would you choose? Base your answer on annual equivalent cost.

Solution

Machine X

First cost, P = Rs. 1,50,000 Life,

n = 12 years

Estimated salvage value at the end of machine life, S =

Rs. 0. Annual maintenance cost, A = Rs. 0.

Interest rate, i = 15%, compounded annually.

The cash flow diagram



The annual equivalent cost expression of the above cash flow diagram is AEX(15%) = 1,50,000(A/P, 15%, 12)

=1,50,000(0.1845)

=Rs. 27,675

Machine Y

First cost, P = Rs. 2,40,000 Life,

n = 12 years

Estimated salvage value at the end of machine life, S = Rs.

60,000 Annual maintenance cost, A = Rs. 4,500

Interest rate, i = 15%, compounded annually.

The cash flow diagram



The annual equivalent cost expression of the above cash flow diagram is AEY(15%) = 2,40,000(A/P, 15%, 12) + 4,500-6,000(A/F, 15%, 12)

=2,40,000(0.1845) + 4,500 - 6,000(0.0345)

= Rs. 48,573

The annual equivalent cost of machine X is less than that of machine Y. So, machine X is the more cost effective machine.

OUTCOMES:

At the end of the module, the students are able to:

- > Define present worth comparison and identify conditions for using it.
- > Apply present worth comparison method to identify better alternatives when the assets

have equal, unequal and infinite lives.

- Apply future worth and pay-back comparison methods to identify better investment alternatives.
- Solve the numerical problems.
- > Define Equivalent Annual Worth and its comparison with present worth.
- Apply Equivalent Annual Worth to find better alternatives for assets having equal, unequal and infinite lives.

SELF-TEST QUESTIONS:

- 1. Define how cash flows are compared based on present worth.
- 2. Differentiate between Cost-Dominated Cash Flow Diagram and Revenue-Dominated Cash Flow Diagram.
- **3.** Analyse and take decision on the following proposals based on engineering economics analysis. Proposal 1 has life of 3 years with an investment of Rs 10,000/- and proposal 2 has a life of 4 years with an investment of 12,000/-. Annual gain and operated expense in both the cases are Rs1, 000/- and Rs 500/- respectively. Assume an interest rate of 10% which gets doubled at LCM midway. Comment on the proposal using Current method.
- **4.** An investor can make 3 end of year payment of Rs 15,000/- which are expected to generate receipts of Rs 10,000/- at the end of year 4 that will increase annually by Rs 2,500/- for the following four years. If the investor can earn a rate of returns of 10% on the eight year investment is this an attractive offer?

FURTHER READING:

- 1. Engineering Economy, Tarachand, 2000.
- 2. Industrial Engineering and Management, OP Khanna, Dhanpat Rai & Sons. 2000
- 3. Financial Mangement, Prasanna Chandra, 7th Ed., TMH, 2004
- 4. Finacial Management, IM PANDEY, Vikas Pub. House, 2002

MODULE 5

COSTING AND DEPRECIATION

OBJECTIVES

- Causes of computation of depreciation, tax concepts and corporate income tax.
- The objective of this unit is to study Components of costs and estimation of selling price

Introduction

Costing can be called as a specialized branch of accounting which deals with classification, recording, allocation and control of costs. It is the technique and process of ascertaining costs (ICWA, England definition). In common terms costing can be defined as the process of determining actual cost of an item after adding different expenses incurred to bring it to the final form, ready for marketing. With the help of estimating and costing, a manufacturer finds out the total cost of each article he makes and fixes the selling price of the article in order to make a definite profit. Cost data provide a basis for important decisions on pricing, product mix, product design, process improvement and technology acquisition. Poor decisions in these areas can severely impair the ability of the company to compete.

Estimation is the assessment of the total cost in manufacturing a product even before it is manufactured. One must have a sound knowledge of material, labour, processing costs, quality and quantity of material required, selection of manufacturing method, manufacturing time required, etc. in order to do a proper estimation. The engineer must be able to state the probable cost at the stage when only sketch plans are drawn. If the available funds are known, the designer has to work backwards i.e. will have to design the building/product which may be constructed within the available sum.

Estimation involves the computation of the quantities required and expenses likely to be incurred in the construction of a work. The amount estimated should be sufficient to cover the probable expenditure on the work without revision by reason of minor unanticipated contingencies, but it should not be so excessive as to permit of extravagance in execution.

The essentials of an estimate are:

- 1. The drawings plans, elevations and sections of the work;
- 2. Specifications indicating the nature and class of work and materials to be employed;
- 3. The local rates at which different types of work can be executed. The designs of an engineer will be of little use of he is not able to give an idea of cost.

NEED FOR ESTIMATING AND COSTING:

Following points illustrate the need for estimation and costing:

- 1. For determining the cost of production: Estimating and costing provides reliable data regarding expenditure on materials, wages and other things which helps in determining the cost of production precisely.
- 2 For controlling the costs: It provides the cost for each product, process, job, department etc., which helps in identifying profitable and non-profitable areas in the organization. This guides the management to take corrective measures of their non-profitable activities. It helps in reducing the total manufacturing cost. It helps to reduce material wastages and control labour wages.
- 3. For fixing selling price: Costing provides information for fixing the selling price of the product. The cost and volume of production, profit and break-even analysis serves as a basis for determining the selling price of the product.
- 4. For preparing the quotations and submitting tenders: A quotation is the information regarding the selling price of a product or service offered to a prospective buyer. A tender is the information regarding the selling price given to a prospective buyer, but given in a sealed envelope. The principles of costing help immensely in preparing quotations and submitting tenders.
- 5. For specific managerial decisions: Costing provides invaluable information for taking the managerial decisions like make or buy, whether to own fixed assets or buy them, whether to replace the existing machinery before its useful life, etc. Costing also provides information on wage incentive plans, cost control measures for materials and supplies, budget and budgetary control, etc.
- 6 It helps in formulating the policies of the concern for changing prices of the products.
- 7. It helps in making the product more economical by incorporating suitable changes in the design.

ESTIMATING PROCEDURE:

Production planning department:

(a). Decides the specification of the product to be manufactured.

(b). Make out the drawings: Lays down the method of manufacturing and required operations Machines to be used Labour rates Accuracy and finish required Prepare a list of components of the product Make or buy decision.

Determine the material cost.

Determine the time required for various operations.

Determine labour cost.

Determine prime cost = Direct expenses + direct material cost + direct labour cost.

Determine factory overheads, depreciation, maintenance and insurance cost, power cost, etc.

Determine the administrative overheads.

Determine the packing and delivery charge.

Determine the total cost.

Determine the selling price = total cost + profit.

Decide the discount allowed to the distributors.

Decide delivery time

Components or Elements Of Cost:

The total cost of a product is the sum of several elementary costs that are involved in its manufacture. The major costs in manufacturing a product consist of:

1. Material cost

(a). Direct material cost (b). Indirect material cost

2. Labour cost

(a). Direct labour cost (b). Indirect labour cost

3. Expenses

(a). Direct expenses (b). Indirect expenses or overheads or on cost

Figure 1 shows the elements of product cost.

Direct Material Cost:

It is the cost of materials with which the product is made of. In other words, it is the cost of materials which are processed through various stages to form a part of the product or the whole product itself. Example: mild steel rods for making shafts, sheet metal for making cupboards, etc.

Indirect Material Cost:

It is the cost of materials which are essentially needed for helping the direct materials to be converted into finished products. It includes the cost of materials that are necessary for the production process, but are not directly used in the product itself. Example: cost of grease,

lubricating oil, coolant, cotton waste, etc.



Figure 5.1: Elements of Product cost

Calculation of material cost:

The method is as follows:

- i. Calculate the volume of each component by applying mensuration. Volume of the material is calculated after adding due allowance for machining purpose on those sides which need machining.
 - ii. Calculate the total volume of the product by adding all the volumes of components.
 - iii. Determine the weight of the material by multiplying total volume and density of the material.
 - iv. Determine the cost of the material by multiplying cost per unit weight with the total volume

of the material required.

Direct Labour Cost:

Direct or productive labours are the workers who actually involve either manually or with the aid of machines in manufacturing components using different materials. The nature of their duties is such that their wages may be directly related to the job they are manufacturing. Direct labour include the workers operating various production machines in machine shop, welding shop, fitting shop, assembly shop, etc. Direct labour cost consists of wages paid to the workers directly engaged in the manufacturing of a product. It also includes the wages paid to the workers engaged in handling the product within the department. Example: wages paid to the machinist, turner, fitter, welder, moulder, etc.

Indirect Labour Cost:

It consists of wages paid to the workers who are indirectly helpful for the production. In other words, it is the wages paid to the labour who help the direct labour in performing their duties.

Indirect labour cost cannot be associated directly to a particular job, but are charged on the whole log of products produced in the plant during a particular period. Example: wages paid to supervisor, inspector, sweeper, helper, loader, watchman, store keeper, crane driver, etc.

Calculation of Direct labour cost:

For calculating the labour cost, the estimator should know about the types of tools and machines required operations to be carried out to bring the raw material into final product. He should consult the production department to get the details on the estimated time for each operation. Some of the time estimates are given below:

a) Set up time: It is the time required to set and fix the tools and jobs on the machine. It includes time to study drawings, blue prints, to set machines, to study job, etc. It is independent of the number of jobs produced.

b) Operation time or cutting time or floor to floor time: It is the time required to carry out specific operations on machines. It includes both work handling and machining times.

c) Tear-down time: It is the time considered from the moment, the last operation has been completed.

d) Miscellaneous allowances:

- i. Personal allowances: It is the time allowance given to a worker to attend his personal needs. It is about 5% of the total working time.
- **ii.** Fatigue allowances: Excessive and continuous work, improper illumination, excessive machine noise, etc. lead to fatigue. To maintain the efficiency of the worker, about 5% of the total working time is allotted as fatigue allowance.
- iii. Tool changing and grinding allowances: It is the time allowance given to remove the tool from holder, to fix another tool, etc. It is nearly 5-10% of the total working time.

e) Measurement and checking allowances: It includes time taken for measuring and checking different dimensions of the product. It is generally taken as 2-3% of the total working time.

f) Other allowances: They include time taken for periodic cleaning, oiling and lubrication, procuring inventory, disposing scraps and surplus stocks, etc. This allowance may sometimes as high as 15-20% of the operation time.

Expenses:

Apart from direct material cost and direct labour cost, there are several other expenditures involved in the manufacture of a product. They are known as expenses. They include building rent, depreciation charges of plant and factory building, administrative, selling and distribution expenses, etc.

i. Direct expenses:

These are the expenses which are directly charged to a particular job and are incurred for that specific job only. Direct expenses are identified and allocated to persons and materials involved in that job.

Example: cost of preparing designs and drawings, cost of manufacturing jigs and fixtures for a particular product, cost of patterns, moulding boxes, dies, cost of consultancy charges for the design and manufacture of a specific product, etc.

ii. Indirect expenses:

They are also called as overheads, on-costs, indirect charges or burden. These expenses cannot be charged directly to a particular product manufactured. All expenses other than the direct material cost, direct labour cost and direct expenses are considered as indirect expenses.

Indirect expenses can be classified as given below:

iii. Production or Factory overheads:

They include all the expenditure made on the actual operation of the product in the plant like indirect material and indirect labour. They are also known as works on cost. Some of the expenses charged under factory overheads are as follows:

i. Cost of indirect materials or consumables such as grease, coolants, cotton waste, etc.

- ii. Indirect labour wages paid to foreman, inspectors, sweepers, helpers, watchman, etc.
- iii. Factory rent and lighting, water, fuel, power, internal transport, maintenance charges.
- iv. Insurance of plant and factory.
- v. Depreciation on machinery, factory, plant.
- vi. Stationery consumed in the factory.
- vii. Works canteen and labour welfare activities expenses.

iv. Administrative expenses:

These expenses include the following:

i. Salaries to MD, GM, personal manager, medical officer, finance manager, secretary and staff.

- ii. Expenses incurred on legal, banking and audit charges.
- iii. Telephone, telegraph, postal charges.
- iv. Printing and stationary for office.
- v. Office rent, repair and depreciation charges.
- vi. Office lighting and power charges.
- vii. Insurance of office building and equipment.

v. Selling and distribution overheads:

These expenses include the following:

- i. Salaries of sales manager, sales representatives, agents
- ii. Cost of advertisement and publicity.
- iii. Travelling expenses, commission and other facilities to salesman.
- iv. Showroom expenses.
- v. Packing, loading and unloading expenses and carriage charges.
- vi. Printing of pricelist and catalogue.
- vii. Expenses for the preparation of quotations and tenders.
- viii. Insurance for finished goods, showrooms, goods in transit and in go downs.
- ix. Delivery van maintenance, repair, depreciation and running expenses.
- x. Entertainment expenses, telephone and postal expenditure of sales department.
- xi. Rebate to customers, legal charges incurred for debt recovery.
- xii. Salaries to store keepers, stores officers and their assistants.

vi. R & D overheads:

These expenses include the following:

- i. Salaries to R & D staff.
- ii. Costs of R & D equipments and activities, etc.

Selling Price Of The Product:

The selling price of the product is derived as shown below:

a) Prime cost or Direct cost: It is the sum of all direct costs.

Prime cost or Direct cost = Direct material cost + Direct labour cost + Direct Expenses

b). Factory cost or Works cost: It consists of prime cost and factory expenses.

Factory cost or Works cost = Prime cost + factory expenses (production overheads)

c).Office cost or Manufacturing cost or Production cost or Gross cost:

It consists of factory and administrative overheads.

Office cost or Gross cost = Factory cost + Office and Administrative overheads.

d). Total cost or Selling cost:

It consists of office cost and selling and distribution expenses.

Total cost or selling cost = Office cost or Gross cost + selling and distribution Overheads

e). Selling Price:

The customers buy the product by paying the price which is known as selling price. It consists of total cost and profit.

Selling price = Total cost + Profit

Figure 2 shows the various elements of cost and determination of selling price of a product.
· 1 ·						·1
					PROFIT	
				Selling and Distribution Expenses		
			Office and Administrative Expenses			
		Factory Expenses or Works On-cost		OFFICE COST or MANUFACTURIN G COST	TOTAL COST or	PRICE
-	Direct Material Cost	PRIME COST or DIRECT COST	FACTORY COST or WORKS COST	or PRODUCTION COST or GROSS COST	COST	
-	Labour Cost Direct					
	Expenses					

Figure 5.2 : Determination of selling price of the product

Fixed and Variable Costs:

Fixed costs remain constant irrespective of the volume of production. They remain the same whether the production is smaller, larger or nil. Examples for fixed costs are: costs on land, building, salaries to top management, rent of building and insurance, depreciation, taxes on property, interest on the invested capital, etc. Variable costs vary with the volume of production. Variable costs are the function of the output. Higher the production, higher will be the production costs. Variable costs become zero when the production is stopped. Prime costs are generally variable costs. Examples for variable costs are: power or fuel consumed costs of raw materials, labour, packing costs, transportation of finished goods, etc.

Allocation of Overheads:

Once the total overheads are determined, the next step is to allocate this cost over the production. The variation of overheads with production volume should be essentially known from economical aspect of running the firm. Different methods of allocating overheads are as follows:

i. Percentage on Prime cost:

The total overhead or on-cost is expressed as a percentage of prime cost. This percentage is charged on each job being manufactured. This method is more suitable when both direct material and direct labour costs are almost same and where only one type of product is being manufactured.

Percentage on-cost = [Total overheads/Prime cost] x 100

This method does not consider the fact that the material cost has nothing to do with the overheads and the products which require more manufacturing time should have more overhead expenses.

ii. Percentage on direct material cost:

The allocation of overhead is based on the total direct material cost. This method is suitable when the material cost has the major share as in foundries or mines.

Percentage on-cost = [Total overheads/Total direct material cost] x 100

iii. Percentage on direct labour cost:

The allocation of overhead is based on the total direct labour cost. This method is suitable where production is mainly carried out manually (by hand).

Percentage on-cost = [Total overheads/Total direct labour cost] x 100

iv. Man hour or Labour hour rate:

On-cost is expressed in terms of total direct man hour or labour hour spent to finish a job.

Man hour rate = [Total overheads/Total direct man hours or labour hours spent]

v. Machine hour rate:

On-cost is expressed based on the total productive machine hours. The total overheads are distributed over a group of similar machines as explained below: Building rents, taxes, insurance, lighting charges, indirect material and labour costs are distributed based on the floor area occupied by the machines. Power consumed and depreciation charges are measured separately. The expenses of wages paid for the machine idle periods is separately charged from the profit and loss account and not considered in the overheads.

Machine hour rate = [Total overheads/Total productive machine hours]

vi. Combination of man hour and machine hour rate:

It is the combination of man hour and machine hour rate methods. In industries both man and machine should coordinate to finish a job. Whenever a machine is used, machine hour rate is applied and whenever work is done by hand, man hour rate is used.

vii. Unit rate method or production unit basis method:

Cost allocation is done based on number of units produced. This method is applied where only one type of production is carried out.

Overheads per unit = [Total overheads/Quantity of production]

Method of Costing:

The methods of costing that are commonly used to assist the determination of selling price of a product are listed below. The method differs according to the nature of business and types of products manufactured. Job costing and Order costing Process costing Operating cost method Departmental costing Unit cost

Job costing or Order costing:

It is concerned with finding the cost of each individual job and then fixing the selling price based on it. Each job has to be planned and its cost is determined separately. The method is adopted in job order industries, special purpose machine units, ship building, fabrication and structural construction, etc.

Process costing:

This method is employed when a standard product is made which involves a sequence of processes. It indicates the cost of a product at different stages as it passes through various processes or departments. It is used in industries like chemical, paper mills, oil refineries, paint and cement manufacturing, etc. By-products and their cost of disposal should also be taken into account while calculating the cost of each manufacturing process and the subsequent selling price.

Operating cost:

This method is used in firms providing utility services like transport, water and electricity boards, railways and airways, etc. The cost is determined on the basis of operating expenses and charges are made in terms of per km, per litre, per kWh, etc.

Departmental costing:

This method is used in industries like steel and automobile, where each department produces independently one or more components. The actual expenditures of each department on various products is entered on a separate cost sheet and the costing of each department is separately undertaken.

Unit cost:

This method is adopted by single product manufacturers who make products such as bricks, cement, milk, etc, than a variety of products. Costing is done on per unit basis.

OUTCOMES:

At the end of the unit, the students are able to:

- Identify the components of costs.
- Obtain selling price of a product based on estimates of costs.

Solve the numerical problems

SELF-TEST QUESTIONS:

- **1.** Find the production cost per crankshaft of a 22 BHP 4stroke oil engine from the followingdetails.
 - i. Forging cost per shaft= 0.25Rs
 - ii. Iron used per week at a rate of 1Rs/Kg is 3 tons.
 - iii. Pay of four operators is Rs 24/day/worker.
 - iv. Depreciation of machine is Rs 500/Month.
 - v. Transportation cost Rs25/day
 - vi. Packing charges for 12 shafts is Rs 3.
 - vii. Electrical charges Rs 30/Month.
 - viii. Salary of managers and other staff is 1400/Month.

If 500 crankshafts are produced per month and the factory runs for 26 days in a month. Whatwould be the selling price of each shaft to earn a profit of 20% on Factory cost.

- 2. Explain briefly standard cost and marginal cost.
- 3. Explain briefly the components of cost.
- 4. Explain objectives of costing.
- 5. What are the different elements of cost? Explain.

FURTHER READING:

- 1. Engineering Economy, Tarachand, 2000.
- 2. Industrial Engineering and Management, OP Khanna, Dhanpat Rai & Sons. 2000
- 3. Financial Mangement, Prasanna Chandra, 7th Ed., TMH, 2004
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