

1: What do you mean by law of demand? Explain factors influencing demand.



Demand for a commodity refers to the desire backed by ability to pay and willingness to buy it. If a person

$$D_x = f(P_x, P_s, Y, T, W)$$

Where,  $D_x$  - demand for good  $x$

$P_x$ : Price of good  $x$

$P_s$ : Price of related goods

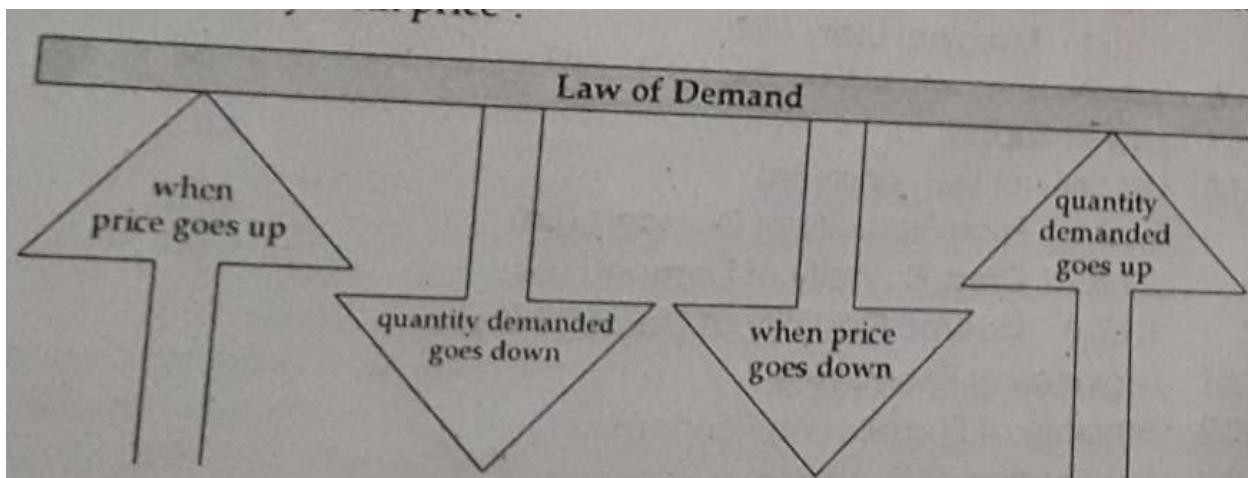
$Y$ : income

$T$ : taste and preferences of consumers

$W$ : Wealth of consumer

### Law of demand

The law of demand states that there is negative or inverse relationship between the price and quantity demanded of a commodity over period of time.



Assumption of the law:

1. No change in the consumer's income
2. No change in the consumer's tastes and preference
3. No change in the prices of other related goods.
4. No new substitutes for the goods have been discovered
5. People do not feel that the present fall in price is prelude (जागृतीकरण) होने का to further decline of Price.

The factors influencing demands are:

1. Price of commodity
2. Income of consumer ( व्यक्तिमय )
3. Price of related goods ( competitive or complementary)
4. Weather
5. customer and fashion
6. Size of Population
7. Future expectation

(contd.)

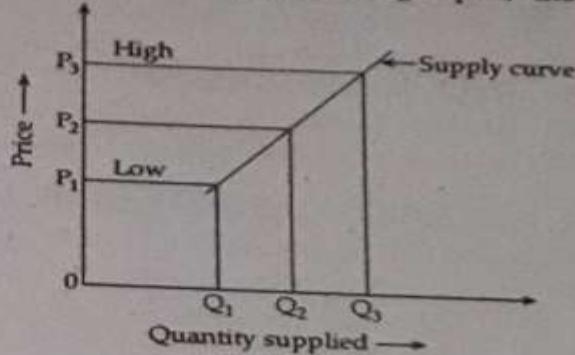
What do you mean by law of supply? Explain factors influencing supply.

Supply means the good offered for sale at a price during a specified period of time. It is the capacity and intention of the producer to produce goods and service for sale at a specific price.

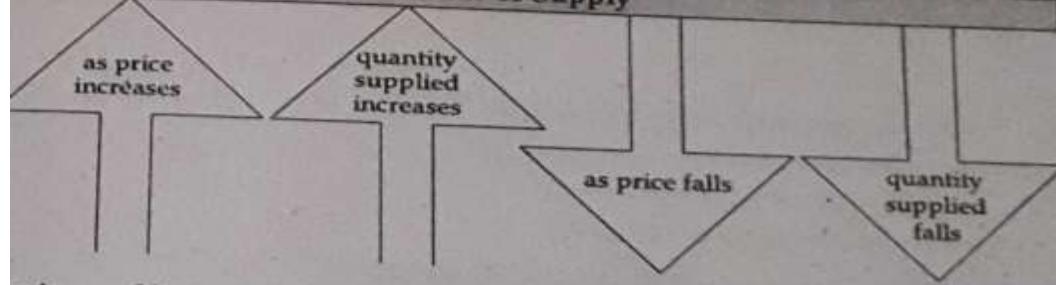
### 1.1.7 LAW OF SUPPLY

Law of supply states the relationship between quantity supplied and price of the commodity. It states "All other things being equal, the quantity supplied of commodity increases when its price increases and vice-versa". Supply bears a positive relation to the price of the commodity. Higher the price, higher will be quantity supplied and lower the price, smaller will be quantity supplied.

Price and quantity supplied have a direct relationship.



#### Law of Supply



#### Factors affecting supply:

- New inventions
- Price of related goods
- Taxes and subsidies
- Development of infrastructure state of natural resources
- Change in money income
- Price of commodity
- Production technology
- State of natural resources

## 1.1.8 ELASTICITY OF DEMAND (Ed)

The change in quantity demanded due to change in price, income etc is called elasticity of demand. It is a technical term used by the economists to describe the degree of responsiveness of the demand for the commodity to change in price and so on. The elasticity of demand is a measure of change in the quantity demanded in response to the change in the price of the commodity.

Mathematically,

$$Ed = \frac{\text{Proportionate change in quantity demanded}}{\text{Proportionate change in any one quantitative determinant of demand}}$$

The elasticity of demand is classified as:

- i) Price elasticity of demand
- ii) Income elasticity of demand
- iii) Cross elasticity of demand

### 1.1.8.1 PRICE ELASTICITY OF DEMAND

Price elasticity of demand (Ep) is defined as the degree of responsiveness of quantity demanded to a change in its price.

$$Ep = \frac{\text{Proportionate change in quantity demanded of the commodity}}{\text{Proportionate change in the price of the commodity}}$$
$$= \frac{\Delta Q/Q}{\Delta P/P}$$

$$\therefore Ep = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

where,

$\Delta Q$  = change in quantity demanded

$\Delta P$  = change in price

P = Initial price

Q = Initial quantity demanded

### 1.1.8.2 CROSS ELASTICITY OF DEMAND (Ec)

Cross elasticity of demand measures the responsiveness of demand for good x following a change in the price of good y (a related good). If the change in the price of one commodity brings the change in demand for the other commodity, then it is called cross elasticity of demand mathematically,

$$Ec = \frac{\text{Proportionate change in quantity demanded of } x}{\text{Proportionate change in price of } y}$$

$$= \frac{\Delta Q_x / Q_x}{\Delta P_y / P_y} = \frac{\Delta Q_x}{\Delta P_y} \times \frac{P_y}{Q_x}$$

where,

$\Delta Q_x$  = Change in quantity demanded for x commodity

$Q_x$  = Initial demand for x commodity

$\Delta P_y$  = Change in price of y commodity

$P_y$  = Initial price of y commodity

Types of Cross elasticity of demand  
1) Income elastic goods (positive value) because these goods are non related with each other.

### 1.8.3 INCOME ELASTICITY OF DEMAND (Ey)

Income elasticity of demand refers to the change in quantity demanded due to the result of change in income, other things remaining constant.

$$Ey = \frac{\text{Proportionate change in quantity demanded}}{\text{Proportionate change in income}}$$

$$= \frac{\Delta Q / Q}{\Delta Y / Y} = \frac{\Delta Q}{\Delta Y} \times \frac{Y}{Q}$$

where,  $\Delta Q$  = change in quantity demanded

$\Delta Y$  = change in income

$Y$  = initial income

$Q$  = initial demand of quantity

3. What do you mean by utility and marginal utility? State and explain the law of diminishing marginal utility with suitable example and figure.

(i) Utility:

- The level or power of satisfaction to a consumer by consuming goods and services
- Utility is defined as the power of commodity or a service to satisfy a human want. Utility is a subjective or psychological concept

Eg: for a vegetarian, mutton has no utility.

(ii) Total utility

The sum of utilities of all units of a commodity consumed.

Ex: If a consumer consumes ten biscuits, then total utility is the sum of satisfaction of consuming all the ten biscuits.

(iii) Marginal utility

The addition made to the total utility by consuming one more unit of a commodity

Ex: If a consumer consumes 10 biscuits, the marginal utility is the utility derived from the 10th unit. It is nothing but the total utility of 10 biscuits minus the total utility of 9 biscuits.

Thus

$$MU_n = TU_n - TU_{n-1}$$

└─────────────────┘  
  ↳ total utility of  $n-1$  unit  
  ↳ Total utility of  $n$  unit  
  ↳ Marginal utility of ' $n^{\text{th}}$ ' commodity.

The Law of diminishing marginal utility states that in the process of fulfilling human wants, when a consumer consumes additional units of commodity, the utility derived from each successive unit of the commodity goes decreasing.

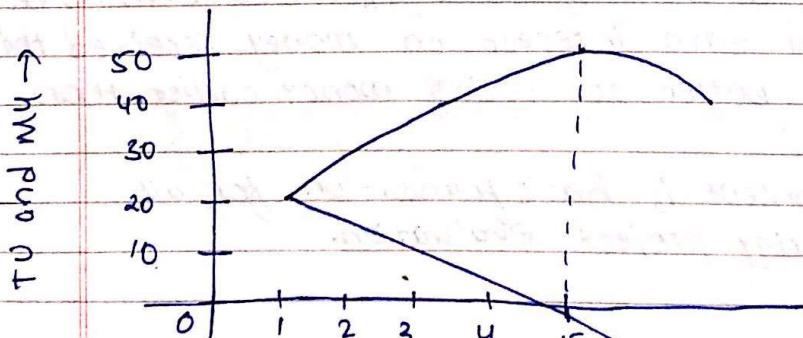
If a consumer takes more and more units of commodity the additional utility he derives from an extra unit of commodity goes on falling. Thus according to law: The marginal utility decreases, the total utility increases at diminishing rate.

Example :

Units of Apple	Total utility	Marginal utility
1	20	20
2	35	15
3	45	10
4	50	5
5	50	0
6	45	-5
7	35	-10

suppose, Mr. X is hungry, and eats apple one by one. The first apple give him great pleasure as he is hungry; when he takes second apple, the extent of his hunger will reduce, therefore he will derive less utility from the second apple.

If he continues to take additional apples, the table shows total utility and marginal utility.



4. Define Engineering Economics. What are the basic principles of Engineering economics?

→ Engineering Economics is the applications of economic techniques to the evaluation of engineering alternatives. The role of engineering economics is to assess the appropriateness of a given project, estimates its value and justify it from an engineering standpoint - John M. Watt

It deals with the concepts and techniques of analysis useful in evaluating the worth of system, products and services in relation to their cost.

The principles of Engineering Economics are

A. According to Chan S. Park

Principles unite the concepts and techniques presented in any engineering economic book, thereby allowing us to focus on the logic underlying the practice of engineering economics.

There are 4 principles

a. Time value of money

- A nearby penny is worth a distant dollar.
- Money has a time value associated with it, because we can earn interest on money received today, it is better to receive money earlier than later
- This concept is basic foundation for all engineering project evaluation.

According to W. Sullivan

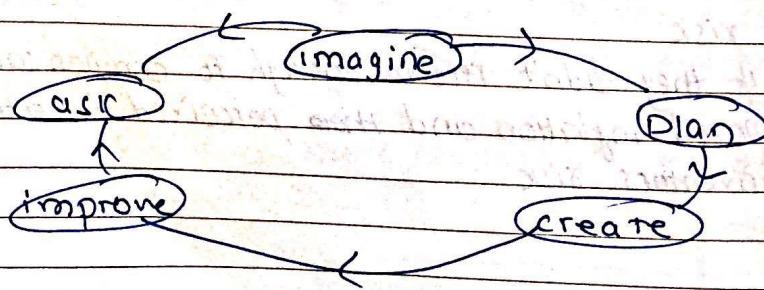
1. Develop Alternatives
  2. Focus on the differences
  3. Use a consistent viewpoint [Economic Viewpoint]
  4. Use common unit of measure
  5. Consider all relevant criteria (social and Environmental aspects)
  6. Make uncertainty explicit
  7. Revisit your decision (self evaluation)
8. Why do you think studying the course is important for engineering students? Justify.

Engineering Economy is a subset of economy for application to engineering projects. Engineers seek solutions to problems, and the economic viability of each potential alternative or design is normally considered along with the technical aspects.

Engineering economy involves the evaluation of the costs and benefits of proposed projects.



Engineers play a major role in investments by making decisions based on economic analysis and design considerations.



- Engineering economy analysis presents the best estimates of what is expected to occur

#### Steps

- understand the problem
- collect all relevant data/information
- define the feasible alternative
- evaluate each alternative
- select the best alternative
- implement and monitor

- Engineering students should prepare themselves with economic empowerment so that they could manage their wealth, help them in starting their own business or during managerial period.
  - It is because, money is one of important factor in completing a project. Furthermore, fresh graduate also need to manage their wealth well since a lot of graduates facing problem because lack of information about the loans that they have made.
  - For profit making organization have to go for more money - now and in the future
  - Not for-profit must remain financially sound.

(M11TR)

(2006A)

b. differential (incremental) cost and revenue

- All that counts are the differences among alternatives
- An economic decision should be based on the differences among the alternatives considered. All that is common is irrelevant to the decision.
- Whenever a choice is made, something is given up. The opportunity cost of a choice is the value of the best alternative given up.

c. Marginal revenues must exceed marginal cost

- Marginal revenue means the additional revenue made possible by increasing the activity by one unit (or small unit). Marginal cost has an analogous definition
- Any increased economic activity must be justified on the basis of the fundamental economic principle that marginal revenue must exceed marginal cost.

d. The trade-off between risk and reward

- Additional risk is not taken without the expected additional return.
- for delaying consumption, investors demand a minimum return that must be greater than the anticipated rate of inflation or any perceived risk
- If they didn't receive enough to compensate for anticipated inflation and their perceived investment risk, investors risk

### **1.2.3 APPLICATION OF ENGINEERING ECONOMY**

The application of engineering economy are diverse and found in most areas of an organization. Engineering economy enables Engineers to consider all aspects of investment from both the technical and financial view points. Engineering economy furnishes several pattern of analysis to determine rate of return, annual costs and payout periods which all serve as bases for decision.

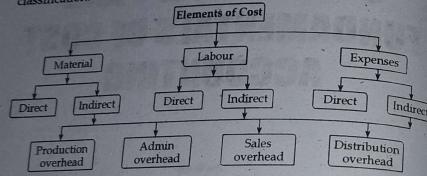
**They are typically classified as:**

- i) Equipment replacement
- ii) Equipment and process selection
- iii) Cost reduction
- iv) Capital budgets allocation
- v) Service improvement
- vi) New product and production expansion, etc.

## 2.1 COST

Cost refers to the amount of expenditure incurred in acquiring something. In general terms, cost refers to an amount to be paid or given up for acquiring any resources or services. The organization's decision of maximizing profit depends on the behavior of its cost and revenues. In economics, cost can be defined as monetary valuation of efforts, materials, resources, time and utilities consumed, risk incurred and opportunity forgone in production of a good or service.

The following chart shows the various elements of cost and their classification:



### 1. Material cost

Material implies a substance from which a product is made. This includes the cost of commodities and materials used by the organization.

- i) **Direct material cost:** Refers to a material that is directly related to specific product, job or process. *For example;* golds for making jewellery, etc.
- ii) **Indirect material cost:** Materials which cannot be identified with the individual cost centre, assist the manufacturing process and doesn't become an integral part of finished goods. *For example;* oils and lubricants, etc.

### 2. Labour cost

Labour cost is the main element of cost. An organization requires labour to convert raw materials into finished goods.

- i) **Direct labour cost:** Refers to labour that takes an active part in manufacturing a product. The costs related to direct labour are called labour costs. These costs vary directly with change in the level of output thus it is referred as a variable express.
- ii) **Indirect labour cost:** The indirect labour costs may or may not vary with the change in the volume of output.

### 3. Expenses

Refers to the costs that are incurred in production of finished goods other than material costs and labour cost.

- i) **Direct expenses:** Imply the expenses that are directly or easily allocated to a particular cost centre or cost units. These expenses are called chargeable expenses. *For example;* cost of patents, royalties, etc.
- ii) **Indirect expenses:** Refers to expenses that cannot be allocated to specific cost center or cost units. *For example;* rent, depreciation, insurance, etc.

### 4. Overheads

Overhead is defined as the aggregate of the cost of indirect materials, indirect labour and such other expenses including services as cannot conveniently be charged direct to specific cost of units. Thus overhead are all expenses other than direct expenses.

- i) **Manufacturing overheads:** It is the indirect expenses of operating manufacturing divisions of a concern and covers all indirect expenditure incurred. *For example;* repairs and maintenance of fixed assets, wages of indirect labour, etc.
- ii) **Administrative overhead:** It is the indirect expenditure incurred in formulating the policy, directing the organization, controlling and managing the operations of an undertaking which is not related directly to a research, development or production. *For example;* office rent, light, heat, credits approval, etc.
- iii) **Sales overhead:** It refers to those indirect costs which are associated with marketing and selling (excluding distribution) activities. *For example;* advertisement charges, samples and free gifts, etc.
- iv) **Distribution overhead:** It comprises all expenditure incurred from the time the product is completed in the works until it reaches its destination. *For example;* expenses on delivery van trucks, ware house staff salaries, etc.

## 2.1.1 MANUFACTURING COST

Manufacturing cost is the sum of costs of all resources consumed in the process of making a product. The manufacturing cost is defined as the costs that are incurred during the production of a product. These costs include direct material costs, direct labour costs and manufacturing overhead costs.  $\text{Manufacturing cost} = \text{cost of labor} + \text{overhead} + \text{materials}$ .

Direct material	Milk for curd, cloth in pant, plastic for toys, wood for table, etc.
Direct labour	Salary for labor, salary for security guards, salary for supervisors, etc.
Direct expenses	Tax, depreciation, insurance, cost of patents, design cost, etc.

### 2.1.2 NON-MANUFACTURING COST

Non-manufacturing costs are the cost for the company operations that are not directly related to manufacturing. It includes marketing costs and administrative costs. Marketing costs include all costs necessary to secure customer orders and get the finished product or service into hands of a customer.

For example: marketing costs-secure customer order, shipping commissions, advertisement, etc.

For example: Administrative cost-public relations cost, management salaries, office supplies, etc.

## 2.2 COST FOR BUSINESS DECISION

### 2.2.1 DIFFERENTIAL COST

Differential cost is the difference between cost of two alternative decisions or of a change in output levels. A differential cost can be a variable cost, fixed cost or a mix of the two-there is no differentiation between the types of costs.

For example: Decision regarding purchase of the machinery out of two. The differential cost is the difference in the prices paid plus the cost of operating the machines.

### 2.2.2 DIFFERENTIAL REVENUE

Differential revenue is the difference in sales that will be generated by two different courses of action. The concept is commonly used while evaluating which of two (or more) investments to make in a business.

For example: You have a job paying Rs. 30,000 per month in your hometown. You have a job offer in neighbouring city that pays Rs. 35,000 per month. The commuting cost to the city is Rs. 2,000.

Hence, differential cost = Rs. 2,000

$$\begin{aligned} \text{Differential revenue} &= \text{Rs. } 35,000 - \text{Rs. } 30,000 \\ &= \text{Rs. } 5,000 \end{aligned}$$

### 2.2.3 OPPORTUNITY COST

Opportunity cost is defined as the potential benefit that is given up as you seek an alternative course of action. In fact, virtually every alternative has some opportunity cost associated with it.

For example: The opportunity cost of starting your own business is the wages you give up by working for another company.

For example: The opportunity cost of watching TV on a weeknight is the benefit you could have gotten from studying.

### 2.2.4 SUNK COST

Sunk cost is a cost that has already been incurred and cannot be recovered. Sunk costs are not relevant to decisions, because they cannot be changed regardless of what decision is made now or in the future.

For Example:

- You bought a bike that cost Rs. 2 lakh two years ago. The 2 lakh cost is sunk because whether you drive it, park it, trade it, you cannot change that 2 lakh cost.
- Cost of marketing
- Feasibility study

### 2.2.5 MARGINAL COST

Marginal cost is defined as the added cost that would result from increasing the rate of output by a single unit. The marginal cost of production is the change in total costs that come from making one additional item. The marginal cost formula can be used in financial modeling to optimize the generation of cash flow.

$$\text{Marginal cost} = \frac{\text{Change in costs}}{\text{Change in quantity}}$$

$$\therefore MC = \frac{\Delta TC}{\Delta Q}$$

For example: if a firm produces 'X' unit at a cost of Rs. 300, 'X + 1' units at a cost of Rs. 320, then the cost of an additional unit will be Rs.  $(320 - 300) =$  Rs. 20 which is marginal cost.

### 2.2.6 FIXED COST

Fixed costs are the cost that the firm has to pay independently of whether it is operating or not. For example: rent of a building

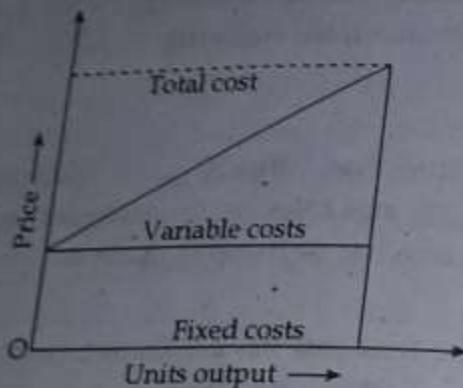
Fixed costs are expenses that have to be paid by a company, independent of any business activity.

### **2.2.7 VARIABLE COST**

Variable cost are the cost that varies with the level of output.  
For example; Wages paid to labor, cost of raw materials, etc.

### **2.2.8 TOTAL COST**

Total cost is the summation of fixed cost and the variable cost



### **2.2.9 PRIME COSTS**

The sum total of direct material, direct labor and direct expenses. For example; cost of raw materials

### **2.2.10 OVERHEAD COST**

Overhead cost refer to an ongoing expense of operating a business. There are essentially two types of business overheads-administrative overheads and manufacturing overheads.

For example; telephone bills, legal fees, supplies, repairs, etc.

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**BOARD EXAM SOLVED PROBLEMS**

1. Define interest.  
Ans: Refer topic 3.1.1 [18/F]

2. Define effective interest rate and nominal interest rate.  
Ans: Refer topic 3.1.4 and 3.1.5 [15/F, 18/S, 18/F]

3. Differentiate between effective and nominal interest rate.  
[12/F, 13/F, 16/S, 18/S]

S.N.	Effective interest rate	Nominal interest rate
i.	Represents interest that affects the real value of money after one corresponding period.	Represents the interest rate that is convertible more than once in a corresponding period.
ii.	It is greater than nominal interest rate.	It is less than effective interest rate.
iii.	$i = \left( \frac{I}{P} \right)^{\frac{1}{N}} - 1$	$R = N \left( \frac{I}{P} \right)^{\frac{1}{N}} - N$
iv.	Often referred to as the annual percentage yield (APY).	Often referred to as the annual percentage rate (APR)
v.	Effective interest rate, $i$ , is the actual rate that applies for a stated period of time which takes into account the effect of compounding.	Nominal interest rate, $r$ , is an annual interest rate without considering the effect of compounding.
vi.	Effective interest rates can be used in the time value formulas or equations.	Nominal interest rate cannot be used in the time value formulas or equations.
vii.	For example; for an interest rate of 5.6% per month, the real interest rate is $\left( 1 + \frac{0.0140}{4} \right)^4 - 1 = 1.41\% \text{ per quarter}$	For example; for an interest rate of 5.6% per month, the nominal interest rate is $\frac{5.6}{4\%} \text{ per quarter} = 1.40\% \text{ per quarter}$

4. Explain about time value of money.  
Ans: Time value of money is the idea that money that is available at the present time is worth more than the same amount in the future, due to its potential earning capacity. It is founded on time preference. [13/F, 15/F, 16/S, 18/F]

Time Value of Money → Chapter 3 | 35

The time value of money is an important concept to investors because a dollar on hand today is worth more than a dollar promised in the future. The dollar on hand today can be used to invest and earn interest or capital gains.

By receiving Rs. 10,000 today (option A), you are poised to increase the future value of your money by investing and gaining interest over a period of time. If you receive the money three years down the line (option B), you don't have time on your side, and the payment received in three years would be your future value.

5. How does compound interest differ from simple interest? Why does bank use concept of compound interest instead of simple interest?  
[18/F]

S.N.	Simple interest	Compound interest
i.	This is calculated only on original principal.	This is calculated on interest earned and the principal.
ii.	Interest earned is not reinvested. Hence, it is not used in interest calculations for the following periods.	Interest earned during the previous period is added to the principal. The total amount will become new principal and all the money will earn interest.
iii.	Principal remains constant.	Principal goes on changing during entire borrowing period.
iv.	Interest charged on principal only.	Interest charged on principal plus accumulated interest.
v.	Simple interest is linear in nature.	Compound interest is exponential in nature.

Interest can compound either frequently (daily or monthly) or infrequently (quarterly, semi-annually or yearly). The more often your interest compounds, the more interest you will earn on your investment in compound interest rate. When it comes to investing, compound interest is better since it allows funds to grow at a faster rate than they would in an account with a simple interest rate. So, bank use concept of compound interest instead of simple interest.

### 3.3 CASH FLOW DIAGRAM

The graphical representation of the cash flows i.e., both cash out flows and cash inflows with respect to a time scale is generally referred as cash flow diagram. The cash outflows (i.e., expenses) are generally represented by vertical downward arrows whereas the cash inflows (i.e., revenue or income) are represented by vertically upward arrows. The number of interest period is shown on the time scale.

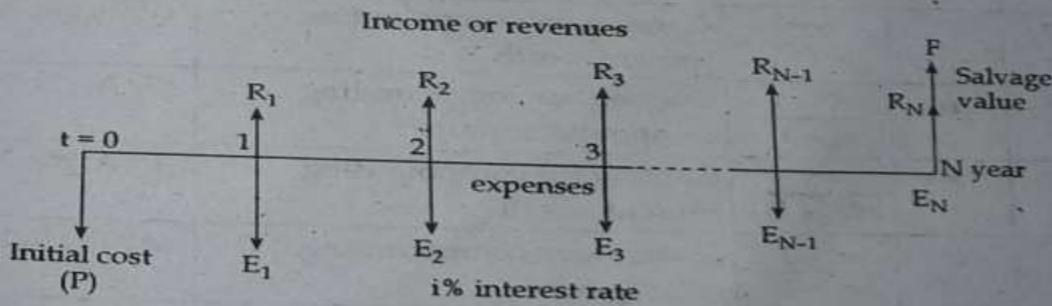


Fig: Cash flow diagram.

**4. Define life cycle cost and explain its categories. [10/F, 16/F, 17/S]**

**Ans:** Life cycle costing is a system that tracks and accumulates the actual costs and revenues attributable to cost object from its invention to its abandonment. Life cycle cost is defined as the sum of all expenditures associated with the item or project during its entire life service.

Life cycle cost consists following three categories:

- i) Initial cost
- ii) Operating and maintenance costs
- iii) Disposal costs

**i) Initial costs:**

Initial costs is the total investment required to get the item or project ready for service and such costs are non-recurring nature over the life of the item or project. The initial or first cost may consists following elements:

- Machine equipment costs
- Land and building costs
- Manufacturing costs
- Installation costs
- Development and engineering design costs etc

**ii) Operating and maintenance costs:**

Operating and maintenance costs are recurring costs that are necessary to operate and maintain an item or project during its useful life. This costs consists of following elements:

- RAW material cost
- Transportation cost
- Labour wages and salaries cost
- Cost for spares, corrective maintenance
- Overhead items cost (tax, insurance premium, overtime expenses etc)

iii) Disposal costs:

Disposal cost is the cost or gain of getting rid of assets after use. It may include the net remaining worth, as well as the cost of transferring or destroying the assets. It includes following elements:

- Labour cost for removal of the item
- Material costs (tool, fuel, packing material etc)

The salvage value is determined by deducting the cost of disposal from the market value of the asset at the time of disposal. Salvage value may be positive or negative.

$$\therefore \text{Life cycle costs} = \text{First costs}$$

+

Lifetime operating costs

+

Lifetime maintenance costs

+

Disposal costs

-

Residual value

Effective interest rate formulas for different time periods:

i <sub>time, effective</sub>	Formula	Value of m
i <sub>annually*</sub>	$(1 + r)^1 - 1$	1 year
i <sub>semiannually</sub>	$\left(1 + \frac{r}{2}\right)^2 - 1$	2 semiannual
i <sub>quarterly</sub>	$\left(1 + \frac{r}{4}\right)^4 - 1$	4 quarter
i <sub>monthly</sub>	$\left(1 + \frac{r}{12}\right)^{12} - 1$	12 months
i <sub>weekly</sub>	$\left(1 + \frac{r}{52}\right)^{52} - 1$	52 weeks
i <sub>daily</sub>	$\left(1 + \frac{r}{365}\right)^{365} - 1$	365 days
i <sub>hourly</sub>	$\left(1 + \frac{r}{8760}\right)^{8760} - 1$	8760 hours
i <sub>infinite or continuous</sub>	$e^r - 1$	-

### 3.3.1 INTEREST FACTOR AND SYMBOLS

To find	Given	Factor	Factor name	Functional symbol
F	P	$(1 + i)^N$	Single payment compound amount	$(F/P, i\%, N)$
P	F	$(1 + i)^{-N}$	Single payment present worth	$(P/F, i\%, N)$
F	A	$\frac{(1 + i)^N - 1}{i}$	Uniform series compound amount	$(F/A, i\%, N)$
A	F	$\frac{i}{(1 + i)^N - 1}$	Sinking fund	$(A/F, i\%, N)$
P	A	$\frac{(1 + i)^N - 1}{i(1 + i)^N}$	Uniform series present worth	$(P/A, i\%, N)$
A	P	$\frac{i(1 + i)^N}{(1 + i)^N - 1}$	Capital recovery	$(A/P, i\%, N)$

#### NOTE

To find F, when P, i and N are given,

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

Here,  $(1 + i)^N$  is called single payment compound amount factor. It is denoted by  $(F/P, i\%, N)$  and it is read as 'finding F given P at i% interest for N periods.'