MODULE -3 THEORY OF COST

COST & COST FUNCTION

Cost is the payments made to the factors of production which are used in the production of that commodity.

Cost function shows the functional relationship between output and cost of production. It gives the least cost combination of inputs corresponding to different levels of output. Cost function is given as:

C=f(Q)

Where C= Cost and Q=output

Differentiate Short & Long run cost curves. (6)

SHORT-RUN COST & LONG- RUN COSTS

The time factor is very important in the theory of cost. The time period divided cost into two categories short- run and long- run

SHORT-RUN COSTS	LONG-RUN COSTS
The short run costs are the costs over a period during which **some of the factors are fixed in supply, like plant, machinery** etc. It is a sum total of fixed cost and variable cost incurred by the producer in producing a commodity.	The long run costs are the costs over a period long enough to permit **changes in all factors of production.** In this period the firm can increase production by using more of all factors. Supply of a commodity can adjusted to changes in demand.

EXPLICIT COST & IMPLICIT COST

Explicit cost or direct cost is the actual **expenditure incurred by a firm to purchase or hire the inputs it needs in the production process. These inputs do not belong to the firm itself.** These include wages, rent interest payments etc.

Implicit Cost or imputed cost **is the cost of inputs owned by the firm** and used by the firm in its own production process. Besides purchasing or hiring resources from others, a producer may also use his own factor services in the process of production. For example the producer may contribute his own land, and may provide his own entrepreneurial and managerial services.

IMPLICIT COST	EXPLICIT COST
Implicit Cost is the opportunity cost, which is incurred when the entity uses the owner's resources like capital inventory etc.	Explicit Cost is incurred when the entity has to pay for the utilization of factors of production.
It helps in the calculation of only economic profit.	It helps in the calculation of both economic and accounting profit.
It is neither recorded nor reported to the management of the company.	Explicit Cost is recorded and reported to the management.
Examples :Wages of self-labor, rent for self-owned premises etc.	Example: Wages ,rent ,interest on loan etc.

Sunk Cost: A sunk cost is a cost that an entity has incurred, and which it can no longer recover by any means. Sunk costs should not be considered when making the decision to continue investing in an ongoing project, since you cannot recover the cost.

Real Cost: This is the actual pain and suffering involved in the production of a commodity.

Accounting Cost: It is the money cost that can be recorded in the books of accounts. This is same as explicit cost.

Social Cost: It is the sum of private cost and external cost. Private cost is the cost incurred by the producer in the production of a commodity. These are expenses of the producer in buying or hiring factor services.

When a commodity is produced it may cause damages to the environment in the form of air pollution, water pollution etc**.** These are external cost and are met by the society.

Replacement Cost: It is the cost incurred when an asset depreciates and is replaced with the new asset. Buying a new machine to replace the old one is an example of replacement cost.

Differentiate fixed cost & Variable cost. (6)

FIXED COST & VARIABLE COST

Fixed cost is the cost which is incurred by the firm on fixed factor. Fixed cost consists of salary of the permanent staff, rent of the building etc.

Variable cost is the cost which is incurred on variable factors. Main types of variable cost are: expenditure incurred on raw materials, wages and salaries paid to casual workers etc. Total cost is the sum of fixed and variable costs.

FIXED COST	VARIABLE COST
It is incurred on fixed factors like machines ,buildings etc	It is incurred on variable factors like labour raw materials ,transport etc.
It is independent with respect to level of output	It varies with changes in the level of output
It cannot be changed in the short run	It can be changed in the short run
It will never be zero even if there is no production	It will be zero when production is stopped
Graphically it is parallel to x-axis	It is inverse S -shaped

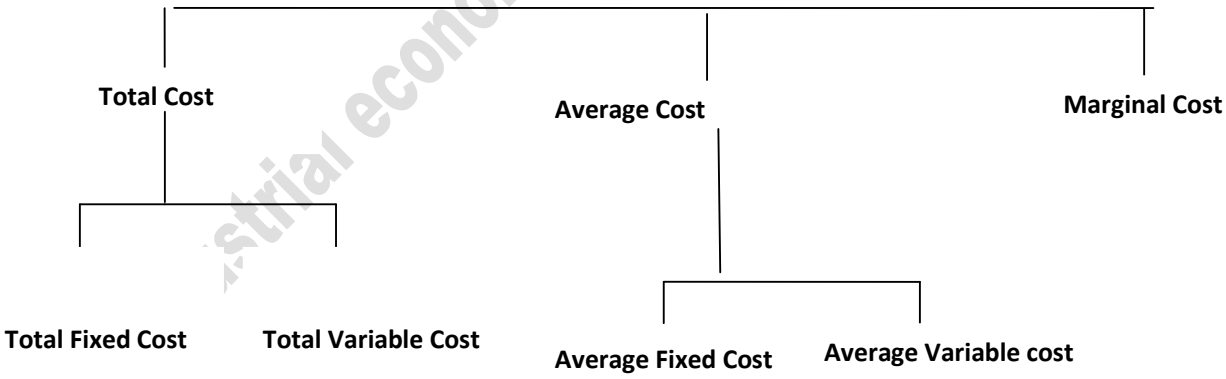
Define opportunity cost. (3)

OPPORTUNITY COST: The opportunity cost of any good is the next best alternative good that is given up to produce this good. **Here the cost of producing a quantity of a commodity is measured in terms of quantity of some other commodity that could have been obtained instead**. The opportunity cost arises because of the scarcity of resources and thereby arises problem of choice. For example, given resources may be used for the production of cloth or bread. If a given amount of resource can produce 1 metre of cloth or 20 loaves of bread, then the opportunity cost of 1 metre of cloth is 20 loaves of bread which need to be sacrificed in order of produce 1 metre of cloth. The concept of opportunity cost is fundamental to the basic economic problems.

BEHAVIOUR OF COST IN THE SHORT RUN

Theory of cost is primarily concerned with the behavior of cost in relation to the change in output .We can consider cost in term of total, average and marginal costs. Accordingly short run cost may be classified as follows.

SHORT RUN COST



State the relation between total cost, total fixed cost& total variable cost.(8)

Total cost: Total cost is defined as aggregate of all costs of producing any given level of output .**It is the total expenditure incurred by a firm for obtaining fixed factors of production required for the producing of a commodity.**

Total Cost consists of Total Fixed Cost& Total Variable Cost

Total Fixed cost: Total fixed cost refers to the total cost incurred by the firm on fixed factors. This cost is independent of output .It does not change with the change in the quantity of input. Fixed costs are fixed obligations of the firm which must be incurred by the firm whether the output is small or large. Fixed cost is often known **as *unavoidable cost.*** Fixed costs includes interest on the capital, rent of the building etc.

Total Variable cost: Total variable cost refers to the total cost incurred by a firm on the use of variable factors. This cost includes payments for raw materials; wages paid to temporary and casual workers payments for fuel and power used etc. These costs vary directly with change in the volume of output; rising as more is produced and falling as less is produced. That is why variable cost is also called **avoidable cost.**

Table:1 Total Fixed Cost, Total Variable Cost, Total Cost

OUTPUT (1) (Units)	TFC(2) (Rs)	TVC(3) (Rs)	TC(4) (Rs)
0	60	0	60
1	60	40	100
2	60	76	136
3	60	102	162
4	60	132	192
5	60	170	230
6	60	222	282

As table 1 shows total variable cost changes with change in output. It would be seen that total variable cost increases with increase in output. But the rate of increase in the total variable cost as different at different levels of output. As can be seen from the column 3 of the table, total cost increases at a decreasing rate as total output increases up to 3 units and subsequently it increases at an increasing rate with increase in output from 4^{th} unit onwards.

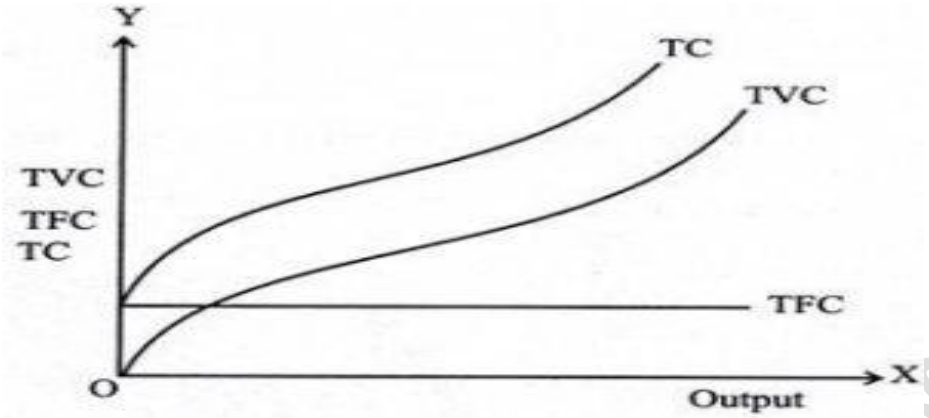


Fig: 1. Behavior of Short- run Total Costs

Figure 1 shows Total cost curve, Total fixed cost curve and Total variable cost curve. The x-axis measures output and Y-axis measures cost. The TFC curve is a straight line parallel to X –axis indicating the same amount of fixed cost at every level of output. The TFC is constant at OA. The TFC starts from point A on the Y-axis indicating that total fixed cost will be incurred even if output is zero.

The TVC curve is positively sloping curve showing that as output increases total variable cost also increases. Note that TVC curve starts from the origin which shows that when output is zero, total variable cost is also zero. **The total variable cost increases at a decreasing rate and at an increasing rate subsequently with increase in total output. This follows directly from the law of variable proportions** .Higher productivity lower cost and vice versa. The shape of TVC curve is **reverse S shaped**.

The total cost curve is obtained by adding up vertically TFC curve and TVC curve because total cost is the sum of total fixed cost and total variable cost.

AVERAGE COST or AVERAGE TOTAL COST

Average cost is the cost of producing per unit of the commodity.AC is obtained by dividing total quantity by the level of output. Average cost is ***U- shaped.***

$$\mathbf{AC}=\frac{TC}{Q}$$

Average cost consists of Average fixed cost and Average variable cost

AC=AFC+AVC

Average Fixed Cost: AFC is defined as the fixed cost of producing per unit of the commodity. It is obtained by dividing TFC by the level of output.

$$\mathbf{AFC}=\frac{TFC}{Q}$$

The AFC curve is derived from TFC curve is a ***rectangular hyperbola***. It shows declining values of fixed cost per unit of output. It slopes downward throughout its length from left to right showing continuous fall in average fixed cost with an increase in output. For every small outputs, average fixed cost is high and for large it is low.

Average Variable Cost: AVC is the variable cost of producing per unit of the commodity. It is obtained by dividing the TVC by the level of output.

$$\mathbf{AVC}=\frac{TVC}{Q}$$

The AVC curve is derived from TVC curve and is ***U-shaped***. It shows that as output increases the value of AVC falls till it reaches a minimum point. Beyond this point AVC starts rising. The reason behind the U-shape of AVC curve is the law of variable proportions.

Consider table 2. The TFC remains constant throughout. The average variable cost falls up to 4^{th} unit and then starts rising from 5^{th} unit onwards. Graphically the behavior of average variable cost is shown by AVC curve in the above figure 2. The AVC curve slopes downward up to OQ_2 level of output which is the optimum capacity and beyond that it increases. **Average variable cost is U- shaped**. It is negatively sloped over early levels of production from zero to output OQ_2 and positively sloped at higher levels of output (beyond OQ_2 level of output. It is minimum at point **A** corresponding to the optimum capacity level of output OQ_2.

TABLE: 2 .RELATIONSHIP BETWEEN VARIOUS SHORT- RUN COST CURVES

Output	TFC	TVC	TC	AFC	AVC	ATC	MC
(1)	(2)	(3)	(4) 2+3	(5) 2÷1	(6) 3÷1	(7) 5+6	(8) TCn-TCn-1
0	60	0	60	-	-	-	-
1	60	40	100	60	40	100	40
2	60	76	136	30	38	68	36
3	60	102	162	20	34	54	26
4	60	132	192	15	33	48	30
5	60	170	230	12	34	46	38
6	60	222	282	10	37	47	52

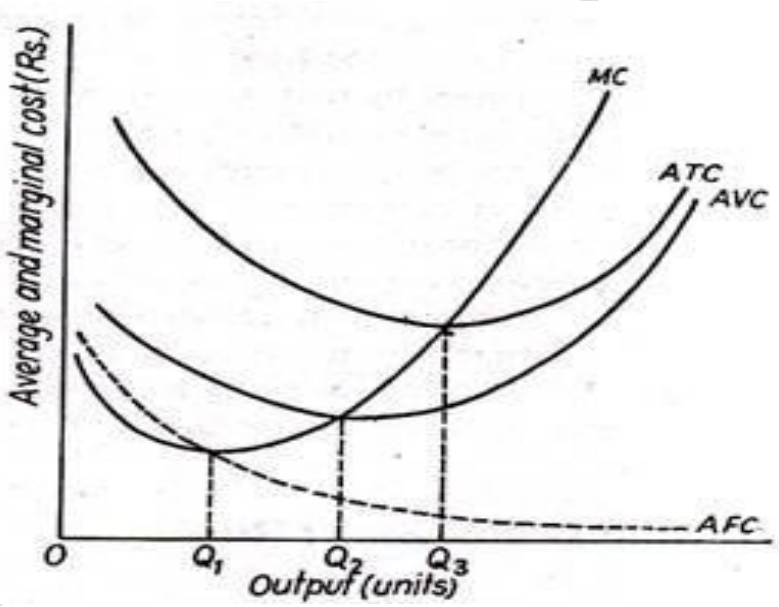


Fig: 2. Behavior of Short-run Average Cost & Marginal Cost curves

The ATC curve is U-shaped indicating that the average total cost falls initially, reaches the minimum point and then starts rising. **Remember that the level of output at which the average cost is minimum is known as the optimum level of production.**

Define marginal cost. (3)

MARGINAL COST

Marginal cost is defined as the addition made to total variable cost or total cost when one unit of output is produced. It is the addition to total cost of producing *n* units instead of *n-1* units where *n* is a given number.

$$MC_n=TC_n-TC_n-1$$

$$MC=\frac{\Delta TC}{Q} \qquad MC=\frac{\Delta TVC}{Q}$$

In the table on page the marginal cost of 4th unit is the change in total cost when the output is increased from 3 units to 4 units.The marginal cost of the 4th unit is 30.(Rs 192-162=30).

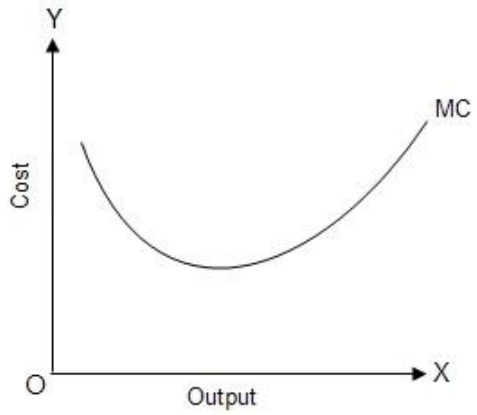


Fig:3 .Short-run Marginal Cost curves

- → Marginal cost is derived from TVC curve and it is **U-shaped**. **The reason behind its shape is law of variable proportions.** As output increases MC curve slopes downward up to OQ, reaches minimum point A and then starts upward beyond OQ level of output.
- → **Marginal cost is independent of total fixed cost. It is associated with total cost and total variable cost. Marginal cost is the addition or total cost or total variable cost when the output increases. There is no change in fixed**

cost as output incrases.MC curve is derived from TVC curve is same as derived from TC curve. Therefore MC curve is common both to AVC curve and ATC curve.

State the relation between marginal cost & average cost. (6)

RELATION BETWEEN MARGINAL COST & AVERAGE COST

There is an important relationship between a marginal cost and average cost curves. The relationship between two is shown graphically on figure 4.

- → **When marginal cost is less than average cost, average cost falls with the increase in output**. It will been seen from the figure that as long as MC curve lies below the AC curve up to OQ amount of output, AC curve is falling.
- → **When marginal cost is greater than average cost, average cost is rising**. In the figure MC lies above AC curve beyond OQ level of output and during this range, the AC curve is rising.
- → **When marginal cost is equal to average cost, the average cost is constant**. In the figure the average cost is minimum and constant for a while at point **A** on AC curve .**At this minimum point marginal cost equals average cost**.

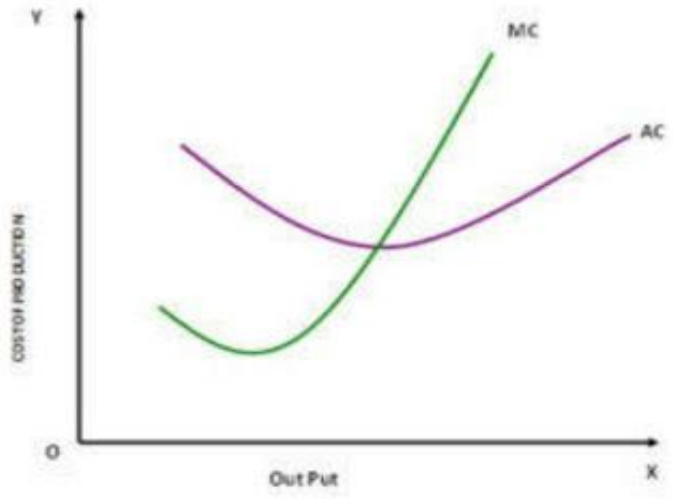


Fig: 4.Relationship between Average Cost & Marginal Cost

Using the above relationship between average cost and marginal cost, we can generalize that **when average cost is U –shaped, the corresponding marginal cost will be also U-shaped and it will always cut the average cost at its minimum point from below.**

SHUT DOWN POINT IN THE LONG RUN

Define shutdown point. (3)

In a firm if AVC<P<AC, will the firm shut down or continue to produce? Give reason. Where, P=price, AVC-Average Variable Cost, AC=Average Cost.(3)

A shut down point is a point **where the firm has no benefit for continuing operations**. This happens when the **market price for the product is equal to the Average Variable cost** in the short run. This is the minimum point of the AVC curve. At this point the firm can minimize it loss only by not producing. As long as the market price is above the AVC of the firm, in spite of making losses, the firm will cover all its variable costs and will wait until and hope to cover its fixed cost in the long run.

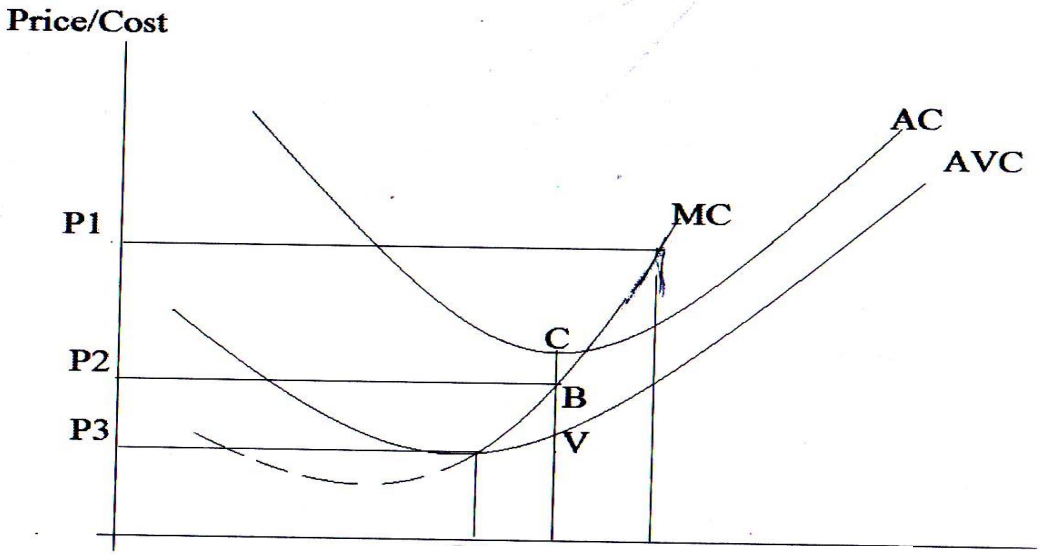


Fig: 5.Shutdown point in the Short-run

In the above figure when the price is $\mathbf{P_1}$ the firm will supply a quantity $\mathbf{Q_1}$ where price equals marginal cost. Since this price is greater than average cost the firm is getting a profit. When price falls to $\mathbf{P_2}$, it is less than AC and hence there is a loss.-**BC**. But still it is beneficial for the firm to produce in the short run because when it produces $\mathbf{Q_2}$ it is able to cover its variable cost.Q_2**V**and a part of fixed cost **VB**. Hence the loss will be **BC** only. If it stops production loss per unit will be **VC.** Once the price reaches $\mathbf{P_3}$ it may stop production because the firm is able to cover its variable cost only. Thus the supply curve of a firm is that portion of the MC curve which is over and above the AVC curve or the shutdown point

THE LONG-RUN COSTS

Long is a period which is sufficient to increase the quantities of all factors such as building, machinery, labour, raw materials etc. In the **long run all factors are variable. The long-run production function has no fixed factors and the firm has no fixed cost in the long -run. In the long-run the firm can build a new plant more suitable to layer output level**. A long run cost curve depicts the functional relationship between output and long run cost of production .**A long run cost curve is a sum of short run cost curves.**

LONGRUN RUN TOTAL COST (LTC)

It is the minimum cost at which a given level of output can be produced in the long run.LTC is derived from the short run total cost curves .Each point on LTC is taken from a short run total cost curve corresponding to the optimum output represented by that plant size.LTC is also inverse S shape and the reason is returns to scale.

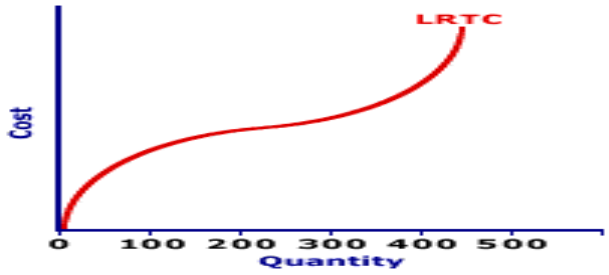


Fig: 6 Longrun Total Cost

LONG-RUN AVERAGE COST CURVE (LAC)—The Envelope Curve

Why long-run average cost curve is called envelop curve? (6)

Long-run average cost is per unit cost of factors production in the long-run. It is obtained by dividing the long-run total cost by the level of output. It shows the lowest per unit cost of producing each level of output when all inputs have been adjusted. **Long-run average cost curve is derived from the short run average cost curves.LAC curve is derived by joining all the relevant points of SAC curves when the firm can shift from one plant to another**. The derivation of LAC is graphically depicted in the figure 7 given below.

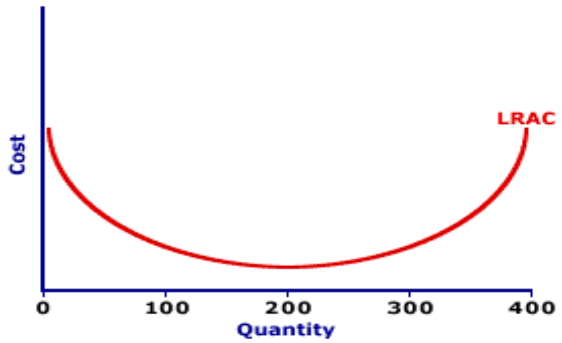


Fig: 6. Long run Average Cost

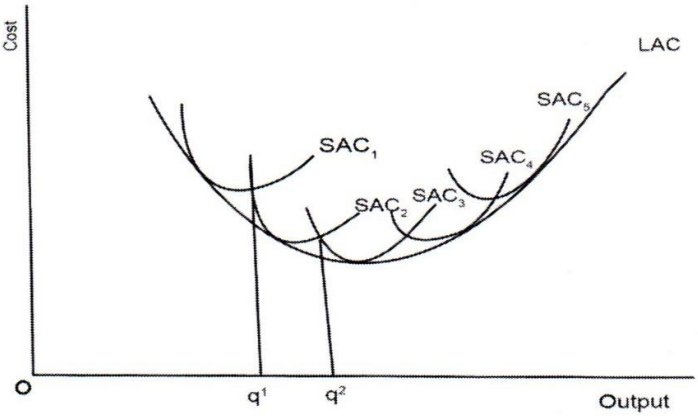


Fig: 7. Derivation of Long run Average Cost

The LAC curve is drawn so as to be tangent to each of the SAC curves. Every point on the LAC curve will be a tangency point with some short run SAC curves. It is also U shaped because of the operation of different returns to scales.**Thus, LAC is the locus of all such tangency points. It is because of this, the LAC curve is called an Envelope curve which means that it encloses the whole family of short run cost curves.** From the figure it is clear that larger output can be produced at a lower cost with larger plants and smaller output can be produced at a lower cost with smaller plants. The U-shape of LAC curve implies that long-run average cost falls first reaches the minimum and then starts rises.

LONG RUN MARGINAL COST(LMC)

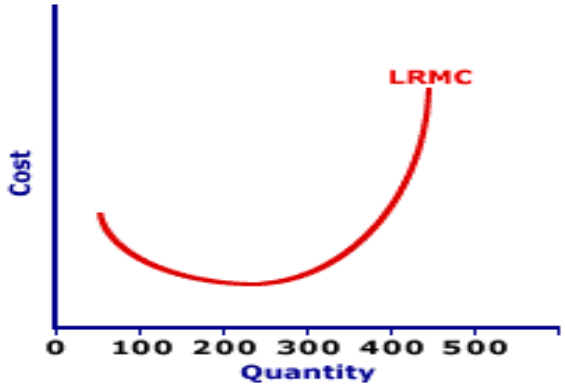


Fig:8 .Long run Marginal Cost Curve

It is the addition to total cost when one more unit of output is produced in the long run. It is derived from short run marginal cost curves.LMC curve is also U shaped because of different returns to scale in the long run.

REVENUE

Revenue is the income from the sale of output.

Total revenue (TR): It is the total receipts from the sale of a given quantity of output. It is obtained by multiplying quantity sold (Q) by price per unit (P).

TR=P×Q

Average revenue (AR): It is the revenue per unit of output sold.AR is obtained by dividing by the number of units of output sold (Q).

$$\mathbf{AR}=\frac{TR}{Q}=\frac{P\times Q}{Q}=\mathbf{P}\text{that is AR is the price}$$

Marginal revenue (MR): It is the addition to total revenue by selling one more unit of output

$$\mathbf{MRQ=TR_Q-TR_{Q-1}}$$

Relation between TR & MR

The following relations can be observed between TR and MR

- When MR is positive TR increases
- When MR is zero TR is maximum
- When MR is negative TR decreases

TR,MR & AR UNDER PERFECT COMPETITION

In Perfect competition every firm sells its output at a given price, and can sell as much as it likes at this price. Hence the firm's average and **marginal revenue** become constant and equal. The corresponding **AR and MR curve** is one and the same and horizontal to the X-axis. Thus in **perfect competition MR** = **AR** (or P).

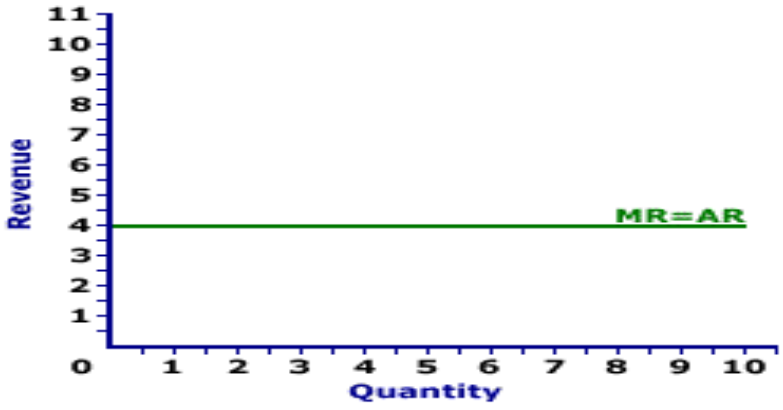


Fig: 9. Relationship between AR and MR curves under perfect competition

IMPORTANCE OF COST IN MANAGERIAL DECESION-MAKING PROCESS

MODULE: 2 SHORT RUN & LONG RUN COST CURVES

1. It is used in setting the prices of the product. The product price is decided on the basis of cost of production of a commodity.
2. It is used in determining the profit of a firm. The firm has to plan the cost first in order to attain a certain level of profit.
3. It is useful in making further investment decisions. The future capital decision of a company is dependent on its cost.
4. It is very helpful in making marketing decisions.
5. It is useful in the cost management of a firm.

QUESTIONS

1. Why should the TVC increase at decreasing rate at initial stages of production?
2. If the total cost of producing 5 units of commodity is Rs 20, and that of producing 4 units is Rs 15 what is the marginal cost?
3. State the relation between marginal cost and average cost. Why are they U-shaped?
4. a) Distinguish between fixed cost and variable cost

   b) Ina firm if AVC<P<AC, will the firm shut down or continue to produce? Give reason. Where, P=price, AVC-Average Variable Cost, AC=Average Cost.

5. Explain a)Marginal cost b)Marginal Revenue c)Sunk cost

   d) Private and social cost.

6. Can there be some fixed cost in the long run? Give reasons for your answer.
7. In which cost expenditure on raw material and wages of casual laborers will be included?
8. Why short run average cost is U- shaped?
9. Explain the various short run cost curves?
10. Why does the long run average variable cost curve is called envelope curve?
11. Explain the shutdown point?

12. How cost analysis is important in business decision making?
13. The long run average cost curve is U-shaped. Why?
14. Draw total fixed cost, total variable cost and total cost curves in a single diagram. State the relation between total variable cost and total cost curves.
15. Define average and marginal revenue. With the help of a figure demonstrate the relationship between average and marginal revenue.(6)

    b. Draw a diagram showing AFC, AVC and TC curves. (4)
16. Complete the following table

Units of Output	**TC**	**TFC**	**TVC**	**MC**
0	70			
1	80			
2	85			

17. Calculate the average cost and total cost with the help of the following data.

Output	Marginal cost
1	10
2	8
3	6

18. Complete the following schedule

No of units of Output	**TC**	**TFC**	**TVC**	**MC**
0	100	----------	----------	----------
1	150	----------	----------	50
2	----------	----------	----------	40
3	----------	----------	120	----------

19. a) What is explicit and implicit cost?

b) Draw a diagram and explain AFC, AVC, MC and AC.

20 a) Distinguish between TFC and TVC. Draw and TVC curves.

b) Suppose the average cost of a product is Rs20 and average variable cost is Rs 15.If the price of the product is Rs 18, will the firm continue its production in the short run or shutdown? Give reason

21.a) What is MC? In short run, changes in MC depend on the changes in TVC. Why?

b) Suppose the AC of a firm is greater than price and price is greater than AVC. Will the firm produce or shut down? Give reason.

22. Selling price of product is Rs 20, AC=22 and AVC =18.Will the firm continue its production or shutdown in the short run? Give reason

23. Explain Marginal revenue and Average revenue in Perfect competition and imperfect competition with graph**. (7 marks) (S3 Regular, Exam, Dec 2021)**

24. a) What is shutdown point?

b) Suppose in the short run AVC 4. Suppose in the short run AVC<P<AC. Will this firm produce or shut down? Give reason. **(KTU Model Question)**

MODULE-2

THEORY OF PRODUCTION

Production is the process by which inputs are transformed into output. Output can be a product or an intangible item like a service. In other words it is the creation of utility. When raw inputs are transformed into finished products which satisfy human wants, we are creating utility.

FACTORS OF PRODUCTION

There are four major factors of production. These are the primary factors.

1. Land: Land is the free gift of nature. In economics it includes not only the surface area but also the vegetation, air, water, minerals etc. around it. The reward of land in production is rent.

2. Labour: It is the physical or mental effort that put in production. Labour is perishable because labour power cannot be stored. If a worker is not working one day that days labour is lost forever. The reward of labour is wages.

3. Capital: It is the produced means of production. It can be in the form of machinery, equipment, building etc. The reward of capital is interest. Modern economic theory also speaks about human capital. It is the stock of knowledge, skill, experience etc. used in production. It can be increased by education and training.

4. Entrepreneurship: Entrepreneur is the person who combines the services of other factors and organizes production. Production involves risk and this risk is taken by the entrepreneur. Therefore the reward of entrepreneurship is profit.

Define Production Function. (3)

PRODUCTION FUNCTION

The term production function means **physical relationship between input used and the resulting output. It is the transformation of inputs into outputs.** A production function shows the maximum quantity of a commodity that can be produced per unit of time with the given amount of inputs, when the best production technique available is used.

$$Q=f(L, K)$$

Where ***Q*** is the production function,***L*** is **labour** and ***K*** is **capital**

TYPES OF PRODUCTION FUNCTION

Short-run production function: Short run refers to the period of time over which the amount of some inputs called **fixed factors** cannot be changed. For example the amount of plant and equipment etc. is fixed in the short run.

Long-run production function: Long run is defined as the time period during which all factors of production can be **varied**. A firm can raise a new factory building or can install a new plant.

Differentiate fixed factor & variable factor. (3)

FIXED FACTOR & VARIABLE FACTOR

A fixed factor is one which cannot be changed in the short run .Eg Capital

A variable factor can be changed in the short run .Eg Labour

TOTAL PRODUCT, AVERAGE PRODUCT&MARGINAL PRODUCT

1. **Total Physical Product or Total product (TP):** Total product refers to the total amount of a commodity produced during some period of time by combining a particular quantity of a variable with the fixed factor. In the short run TP can be increased by employing more of variable factors.

2.**Average Product (AP):**Average product refers to the amount of output produced per unit of a variable factor (labour) employed.

$$\mathbf{AP_L = \frac{TP_L}{L}}$$

For example if the TP with 5 units of variable factor is 10 units then AP will be equal to

$$\mathbf{\frac{10}{2}=5\ units}$$

3**. Marginal Product (MP):** Marginal product may be defined as the **change in total product** resulting from one additional unit of a variable factor. Marginal product can also be calculated from the values of TP by the formula

MPn=TPn-TPn-1

$$\boldsymbol{MP_L = \frac{\Delta TP}{\Delta L}}$$

State the law of variable proportion with the help of a schedule & figure. (9)

Define returns to a factor. (3)

LAW OF VARIABLE PROPORTION & FIXED PROPORTION

RETURNS TO A FACTOR –THE LAW OF VARIABLE PROPORTION

The law of variable proportion is a widely observed law of production which takes place in the **short-run.** In the short run, production can be increased by using more of the variable factor. The law of variable proportion states that***"as more and more units of a variable factor are applied to the given quantity of a fixed factor, the total product may increase at an increasing rate initially but eventually it will increase at a diminishing rate."***Expressed in terms of marginal and average product, the law states that if more and more units of a variable factor are applied to the given quantity of a fixed factor, marginal product and average product of the variable factor will eventually decrease after increasing initially.

State the law of diminishing marginal product. (3)

LAW OF DIMINISHING MARGNAL PRODUCT

It states that ***"if we keep increasing the employment of the variable input with the other fixed inputs the eventually a point will be reached after which the marginal product of that input will start falling".***

ASSUMPTIONS OF THE LAW

1. The state of the technology is given and remains unchanged.

2. It is assumed that some inputs are fixed and others are variable.

3. It is assumed that labour is single variable factor.

4. It operates in the short- run because in the long-run, fixed inputs become variable.

The behavior of output in terms of total product, average product and marginal product on account of an increase in the variable input is conventionally divided into three stages

The law can be explained with a schedule. Suppose a farmer has a fixed area of land and land is considered as the fixed factor. Labour is the variable factor and the farmer is employing more and more units of labour. The changes in TP, MP and AP are given in the schedule given below

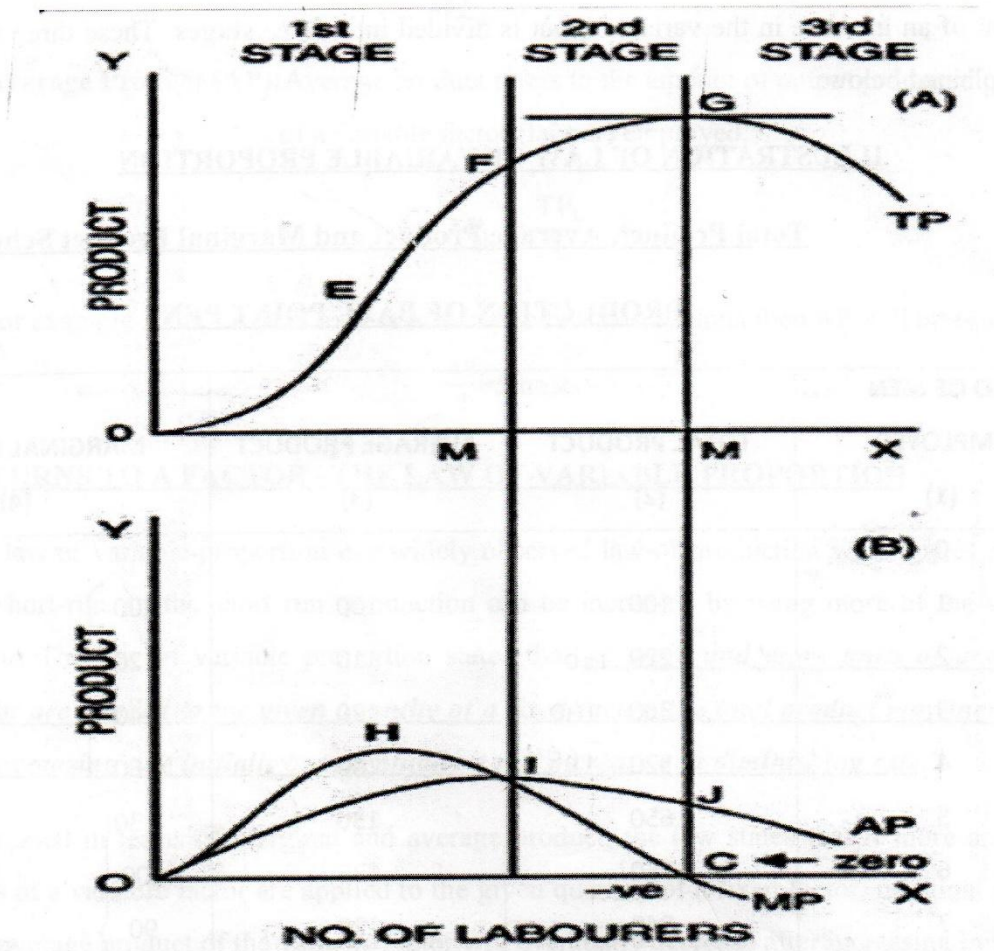
ILLUSTRATIONOF LAW OF VARIABLE PROPORTION

TOTAL PRODUCT, AVERAGE PRODUCT &MARGINAL PRODUCT SCHEDULE

NO OF MEN EMPLOYED (1)	TOTAL PRODUCT (2)	AVERAGE PRODUCT (3)	MARGINAL PRODUCT (4)	
0	-	-	-	
1	100	100	100	STAGE I
2	220	110	120	
3	360	120	140	
4	520	130	160	
5	650	130	130	STAGE II
6	750	125	100	
7	840	120	90	
8	880	110	40	
9	880	97.7	0	
10	830	83	-50	STAGE III
11	770	70	-60	

From the above schedule it is clear that

- the total product increases first and then falls (till the 5thworker).It would be also seen that total product rises or falls at different rates. When more of variable factor is used, average product rises first and then falls. Marginal product also first rises then falls.
- When total product is maximum marginal product becomes more .When total product decreases marginal product becomes zero.



STAGE 1- STAGE OF INCREASING RETURNS

The first stage starts from the point of **O** and continues till point **F** where the average product is maximum. At point **F** average product is maximum and is equal to marginal product. Marginal product increases initially and reaches at maximum at point **H**. Later on it begins to diminish and becomes equal to average product a point **I** .In this stage marginal product is greater than average product. This stage is characterized by an increase in total product throughout, but total product increases at an increasing rate up to point **E** and increase at a diminishing rate between **E** and **F**, as shown in the upper panel of figure.

STAGE 2- STAGE OF DIMINISHING RETURNS

This stage begins from point **F** where total product goes on increasing but at a diminishing rate. It reaches the maximum as shown by point **G** and marginal product

diminishes rapidly and becomes zero at point **C**. Average product is maximum at point **I** and thereafter it begins to decrease. In this stage both marginal product and average product are diminishing, but are positive. Here marginal product is less than average product.**MP<AP.** This stage ends where marginal product of the variable factor is zero. It is the **most important as the producers would like to operate in this stage**.

STAGE 3- STAGE OF NEGATIVE RETURNS

This stage begins beyond point **G** where, total product starts falling. Marginal product of the variable factor turns negative and the marginal product curve goes below the X axis as shown in the lower panel of fig. The average product also decreases in this stage but unlike the marginal product it is positive**. Law of diminishing returns firmly manifests itself .A firm will not produce at this stage .A rational producer will not operate on this stage** even with free labour, because he could increase his output by employing less labour. It is a non-economic and inefficient stage.

THREE STAGES OF PRODUCTION

STAGE	TOTAL PRODUCT	MARGINAL PRODUCT	AVERAGE PRODUCT
Stage 1	Initially increases at an increasing rate and subsequently at a diminishing rate.	Increases first, reach the maximum and then start decreasing.	Increases throughout the stage and reaches the maximum.
Stage 2	Continues to increase at a diminishing rate, and eventually reaches the maximum.	Continues to decrease and eventually becomes zero.	From the maximum begins to decrease.
Stage 3	Diminishes	Negative	Continues to decrease but is always positive.

State the relation between TP, AP & MP. (5)

THE RELATIONSHIP BETWEEN TOTAL PRODUCT, AVERAGE PRODUCT & MARGINAL PRODUCT CURVES IS AS FOLLOWS

- → When AP is maximum, MP=AP
- → When TP is maximum **,**MP=0
- → When TP is falling ,MP is negative
- → As long as TP is positive ,AP is positive
- → Both TP and MP curves are U-shaped.

RELATIONSHIP BETWEEN TP & MP CURVES

- → MP curve rises initially, reaches a maximum and declines after that.
- → When TP is maximum MP is zero.
- → When TP falls MP becomes negative.
- → MP is positive as long as TP is increasing, but becomes negative when output is decreasing.

RELATIONSHIP BETWEEN AP & MP CURVES

- → Both AP and MP derived from TP curves.
- → When both AP and MP are rising MP rises at a faster rate.
- → When both AP and MP are falling, MP curve falls a faster rate.
- → When AP curve is neither falling or rising AP=MP

CAUSES OF INCREASING RETURNS	CAUSES OF DECREASING RETURNS	CAUSES OF NEGATIVE RETURNS
Fuller utilization of resources.	Disturbing the optimum factor proportion.	Overcrowding
Division of labour.	Imperfect substitutability of factors of production.	Management problem

IMPORTANCE OF LAW OF VARIABLE PROPORTION IN BUSINESS DECESIONS

⇒ The Law of Variable Proportion has vast general applicability. This law implies as much as to industries as to agriculture.

⇒ Experiences of underdeveloped countries of the world justify the operation of this law in agriculture.

⇒ This law helps in understanding the process of production and also helps the producers how to react during different period of time. The producer will not stop at stage -1. In stage –III employment of additional factor is giving less output .**A rational producer will stop producing at stage –II, which means that a producer will find his equilibrium when MP is declining but is still positive**. Thus a producer will be able to earn maximum profit.

⇒ The law of variable proportion can be directly linked with the Indian agriculture sector.

Define law of returns to scale.(3)

PRODUCTION FUNCTION IN THE LONG-RUN

LAWS OF RETURNS TO SCALE-LAW OF FIXED PROPORTION

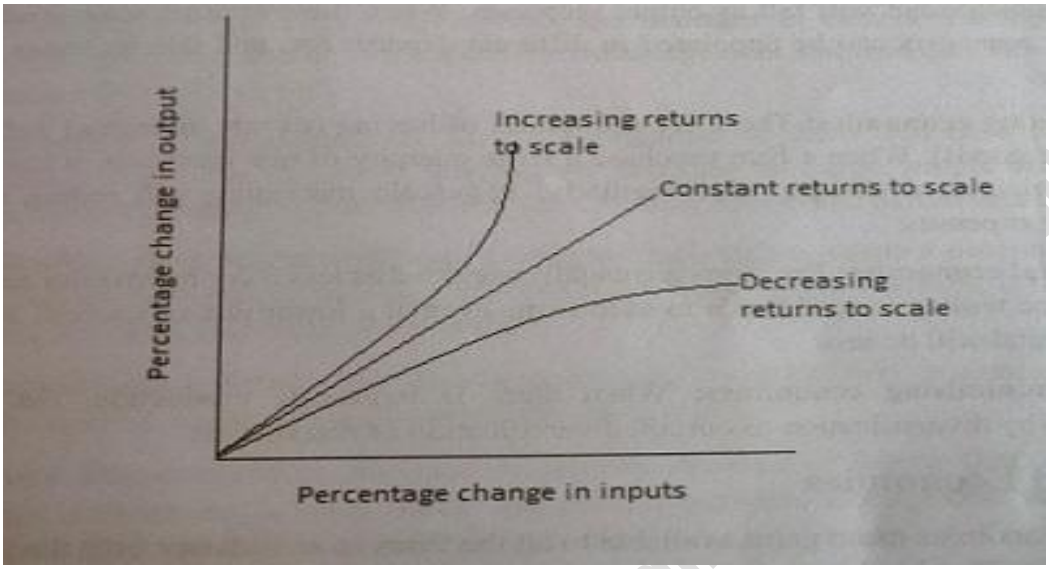
"***When all inputs are changed in the same proportion*** *we call this as change in* ***Scale of Production.*** The way total output changes due to change in scale of production is known as ***"Laws of Returns to Scale".***The returns to scale could be '***increasing',' constant'*** or ***'decreasing'***.

1. **INCREASING RETURNS TO SCALE:** If output increases in a larger proportion than the increase in inputs returns to scale are increasing. For example if all inputs are increased by 100 percent and the output increases by more than 100%, the increasing returns to scale will operate.

2. **CONSTANT RETURNS TO SCALE**: If increase in output is in the same proportion as increase in quantity of all inputs, returns to scale are said to be constant. For example if all inputs are increased by the 100% and as consequence the output also increases by 100 % returns to scale are constant.

3**. DECREASING RETURNS TO SCALE:** If output increases in a smaller proportion than the increase in inputs returns to scale are decreasing. Thus, if inputs are increased by 100%,

but the output increases by less than 100 %,(say 50%), decreasing returns to scale will operate.



Differentiate returns to factor & returns to scale **(5)**

Differentiate law of variable proportion & fixed proportion

DIFFERENCE

LAW OF VARIABLE PROPORTION		LAW OF FIXED PROPORTION
1.	It relates to returns to a factor	1. Returns to scale relate to return to the scale of production
2.	The law of variable proportion is a short run phenomenon.	2. The return to scale is a long run phenomenon.
3.	It studies the effect of change in one input on the output	3. Returns to scale studies the effect of change in all inputs on the output.

Define Economies of scale. (3)

Differentiate internal economies & external economies. (5)

ECONOMIES OF SCALE

Economies of scale mean advantages of large scale production which help in reducing the average cost of production. The economies of scale can be broadly classified as

A. Internal economies

B. External economies

A.INTERNAL ECONOMIES: Internal economies depend on the size of the firm. These advantages emerge within the firm itself as its scale of production increases. Internal economies are entirely enjoyable by the firm itself. There are different forms of internal economies.

1. Labour economies: Increased production allows division of labour and it increases efficiency and productivity of workers. Further large firms can attract more efficient labour because of the better prospects it can offer to the workers.

2. Technical economies: As a firm expands it can use the latest technology and machinery. This increases efficiency and reduces cost of production. Similarly, the firm can enjoy the economics of linked process. That is production activities can be arranged in a continues process without any loss of time.

3. Managerial economies: As a result of indivisibility of managerial factors, the cost per unit of management will fall as output increases. When there is large scale production, specialist managers can be appointed in different departments and this increases overall efficiency.

4. Marketing economies: These are economies of buying (of raw materials) and selling (produced goods). When a firm purchases a large quantity of raw materials, it can get the raw materials at a cheaper rate. Similarly, large scale marketing will reduce average marketing expenses.

5. Financial economies: Big firms are usually regarded as less risky by investor and hence they will be willing to lend funds to such firms even at a lower rate of interest. Thus, the cost of capital will be less.

6. Risk minimizing economies: When there is large scale production, risk can be minimised by diversification of output, diversification of markets etc.

B.EXTERNAL ECONOMIES: External economies mean gains available to all the firms in an industry from the growth of that industry. That is advantages accruing to a firm due to localization of the industry. The following are the important types of external economies.

1. Economies of localisation: When number of firms in the industry is located in one place, all of them derive mutual advantages. This can be in the form of availability of skilled labour, provision of better transport facilities etc.

2. **Economies of Information:** In an industry, research work can be done jointly. Statistical, technical, and other market information becomes more readily available when a large number of firms are located at one place.

3. Economies of Vertical Disintegration: Localisation of an industry may lead to the establishment of new subsidiary industry in the area to fulfil the needs of the main industry.

For example, in the area of textile industry a chemical firm may start a colour manufacturing unit.

4. **Economies of by-product:** The availability of waste material in large quantity from the industry may facilitate the starting up of firms in the area which produce by-products by using these waste materials.

Define diseconomies of scale. (3)

DISECONOMIES OF SCALE

Diseconomies of scale mean disadvantages of large production. Beyond a certain limit, diseconomies surpass internal and external economies. These diseconomies increase the average cost of production and limit the further expansion of the firm. The following are the important types of diseconomies.

1. Difficulties of management: As a firm expands problems of management arises. Beyond a limit, it will be very difficult for the manager to control the organisation. Supervision becomes complex and it leads to mismanagement and wastage. This increases the average cost of production.

2. Difficulties of coordination: In a big organization there will be a number of departments. When the size of the organization becomes too large, proper coordination between these departments will be difficult. It will affect the overall performance.

3. Difficulties in decision making: In a large firm, before taking a decision it has to consult various departments and decision making will be delayed. Hence, a firm cannot take quick decisions and make quick changes.

4. Communication Problems: In a large firm it is very difficult to communicate the decisions taken by the top management to the lower levels.

5. Labour Diseconomies: Because of extreme division of labour there will be an impersonal atmosphere in large firms and contact between management and workers. become less. This may lead to industrial disputes.

6. Scarcity of Inputs: When there are a large number big firms in a locality, scarcity of factors may be experienced. There will be competition between the firms for labour and other inputs and this will push the price up.

7. Marketing Diseconomies: When the firms expand competition becomes very stiff. It necessitates huge expenses on advertisement and other sales promotion activities.

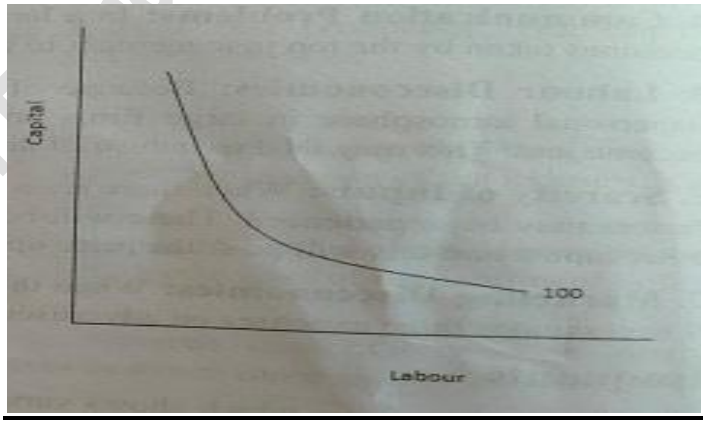
Define an isoquant. (3)

ISOQUANTS

An isoquant is a curve which shows various combinations of two inputs which give the same level of output. Iso' means equal and quant means quantity. That is equal quantity of output. Isoquants are also called iso product curves or equal product curves. The construction of an isoquant can be explained with the help of the following schedule.

Combinations of Labour and Capital	Units of Labour (L)	Units of Capital (K)	Output of Cloth (meters)
A	5	9	100
B	10	6	100
C	15	4	100
D	20	3	100

In the above schedule labour and capital are taken as the two inputs. All the given combinations of labour and capital produce the same level of output, that is 100 meters of cloth. The graphical representation of the schedule gives an isoquant. This is given below.



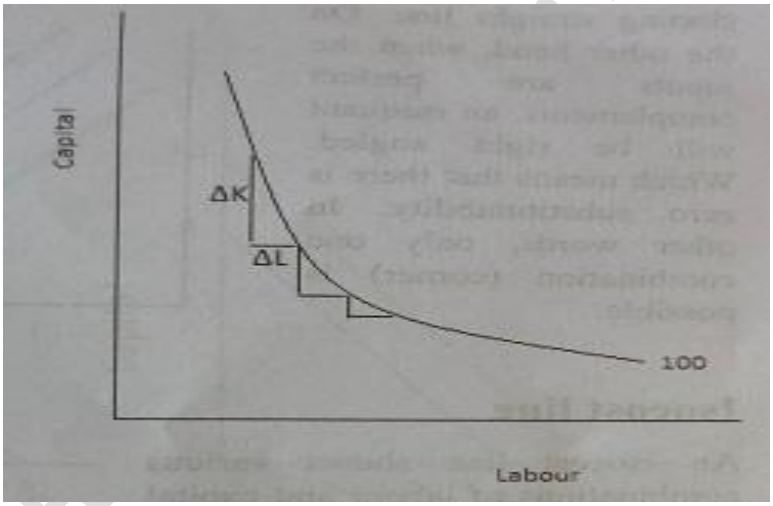
State the proprieties of isoquant.(5)

PROPERTIES OF AN ISOQUANT

The following are the important features or properties of isoquants.

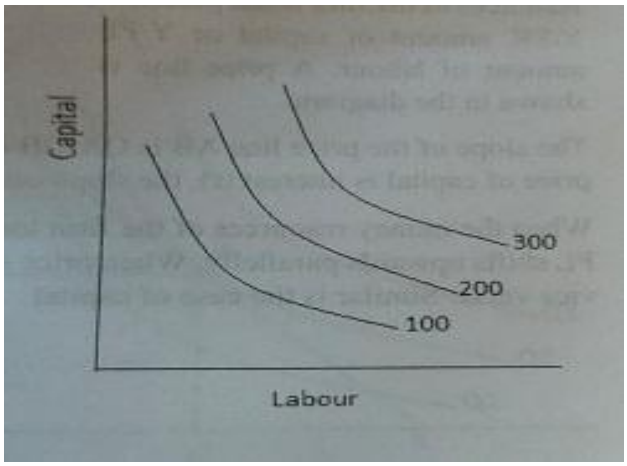
1. Isoquants are negatively sloped: An isoquant represents a particular level of output. Hence, when the quantity of one factor input is increased, the quantity of the other input has to be decreased in order to keep the output constant. Therefore, isoquants are negatively sloped.

2. Isoquants are convex to the origin: This is because along the isoquant MRTSLK (Marginal rate of technical substitution of labour for capital) goes on decreasing. MRTSLK is the rate at which one input is replaced by the employment of additional units of the other factor. In other words, how much of capital is replaced by the employment of an additional unit of labour. This is the slope of the isoquant. Slope of the isoquant is AK/AL



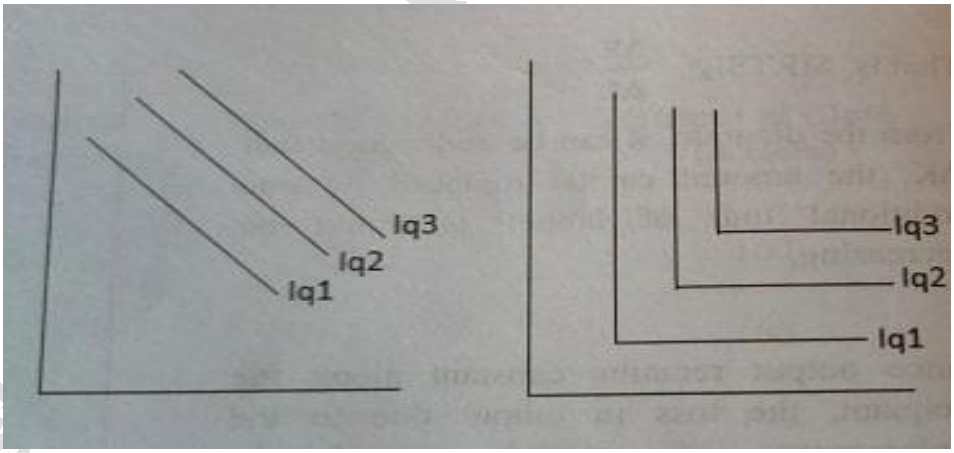
3. Two isoquants never intersect: Each isoquant represents a particular level of output. When two isoquants intersect, the intersecting point will be common and it can be two different levels of output. Logically this is not correct.

4. Higher isoquants represents higher levels of output: A set of isoquants drawn is called an Isoquants map. In isoquants map higher isoquant represents higher levels of output.



SPECIAL TYPE OF ISOQUANTS

The shape of isoquants depends on elasticity of substitution that is to what extent the inputs are substitutes. Usually, isoquants are downward sloping. However, when the inputs are perfect substitutes, an isoquant will be linear. Here, the isoquant will be a downward sloping straight line. On the other hand, when the inputs are perfect complements, an isoquant will be right angled. Which means that there is zero substitutability? In other words, only one combination (corner) is possible.

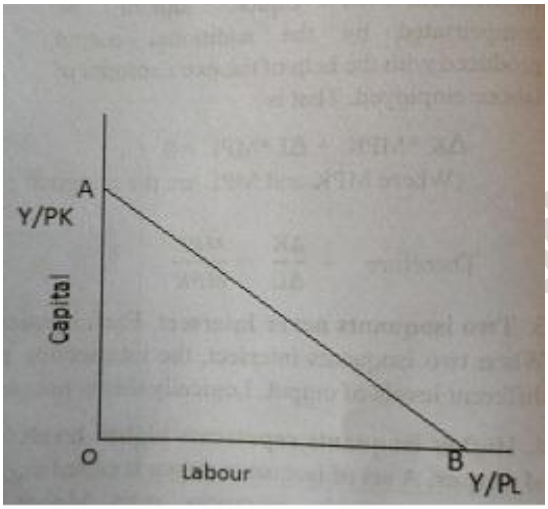


PERFECT SUBSTITUTES	PERFECT COMPLIMENTS

Define an isocostline. (3)

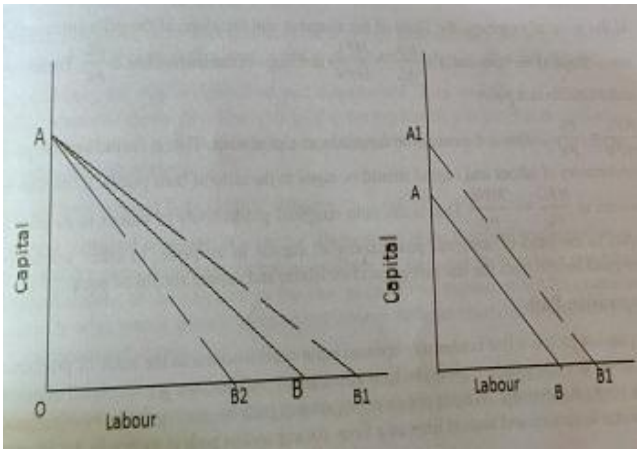
ISOCOST LINE

An isocost line shows various combinations of labour and capital (two inputs) that can be purchased for a given expenditure of the firm. In other words, it shows various combinations of labour and capital that is available to the firm at the same cost and at given prices of the inputs. If 'Y' is the total money resources of the firm it can purchase Y/PK amount of capital or Y/PL amount of labour. A price line is shown in the diagram.



The slope of the price line AB is **OA/OB** or **PL/PK.** Since price of labour is wage (w) and price of capital is interest (r), the slope can be written as w/r.

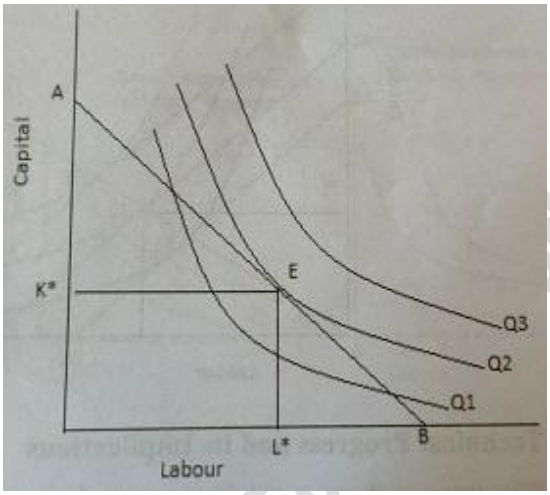
When the money resources of the firm increase, with given prices of inputs, the price line PL shifts upwards parallelly. When price of labour decreases, point B shifts rightwards and vice versa. Similar is the case of capital.



Explain producer's equilibrium or least cost combination of factors? (7)

LEAST COST COMBINATION - PRODUCER'S EQUILIBRIUM

A producer will be in equilibrium when he is able to produce a given quantity of output with least cost or when he produces maximum output with a given amount of inputs. In other words, least cost combination of inputs is that combination which cost least to the firm in producing a certain quantity of output. It is attained at that point where the isoquant is tangent to the isocost line. This is shown in the diagram.

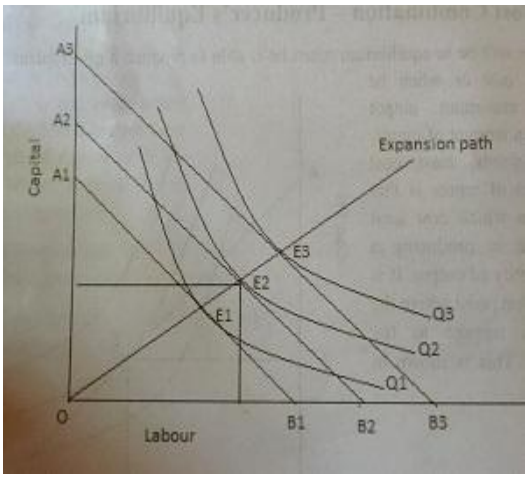


In the diagram, producer is in equilibrium at point **E**, where the highest possible isoquant is tangent to the isocost line. He is able to produce the maximum output with the available resources. In words, output $\mathbf{Q_2}$ is produced with the least cost. At the point of tangency, the slope of the isoquant and the slope of the price line are the same. That is the ratio marginal productivity of labour to its price is equal to the ratio of marginal productivity of capital to its price. In other words, the marginal benefit from the last rupee spends on labour and capital should be equal.

What do you mean by expansion path? (3)

EXPANSION PATH

Expansion path is a line connecting optimal input combinations as the scale of production expands. In other words, it gives the least cost inputs combinations at every level of output. It is a long run concept. We can obtain the expansion path by joining the point of tangency between isoquants and isocost lines of a firm. An expansion path is shown in the diagram.



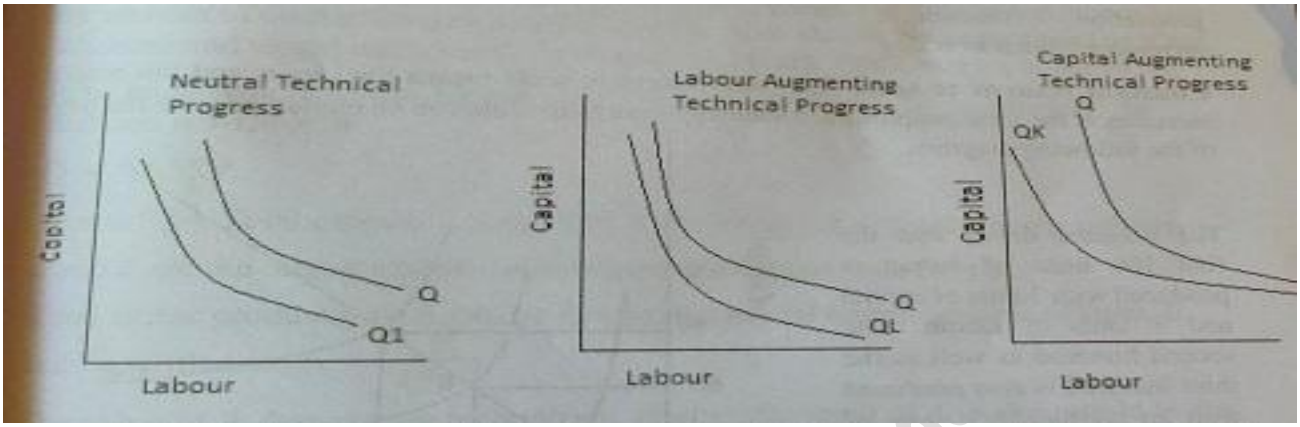
TECHNICAL PROGRESS & ITS IMPLICATIONS

When there is a change in technical progress, the production function will change. There will be an upward shift in the production function which means that more output is produced with the same level of inputs. In other words, there will be a downward shift of the isoquant which implies that same output is produced with lesser quantities of inputs. Technical progress may be embodied and disembodied. It is embodied or investment specific when new capital (machinery) is used in the production process. It is disembodied or investment neutral, when output increases without any increase in investment but by an innovation through research. There are three types of technological progress

1. Neutral technical progress: It is neutral when change in the marginal product of labour and capital is same due to the technical progress. In this case there will be a parallel downward shifting of the isoquant. In this case slope of the isoquant or $\mathbf{MRTS_{LK}}$ remains the same. In other words, there is an equal reduction in both the inputs in the production of a certain quantity of output.

2. Labour Augmenting Technical Progress: It means the marginal product of labour increases faster than the marginal product of capital. Here, the new isoquant becomes steeper.

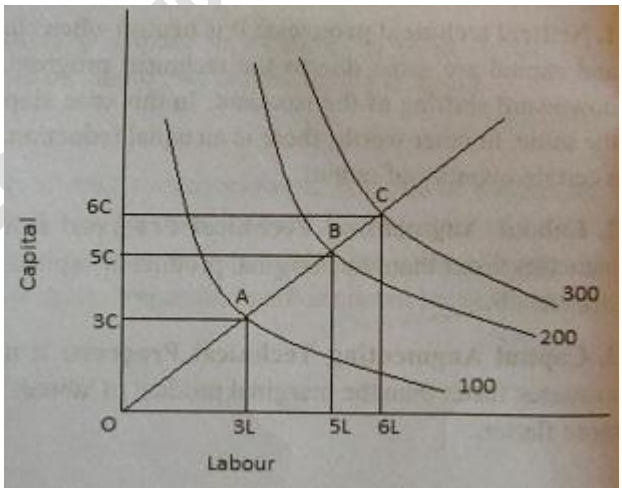
3. Capital Augmenting Technical Progress: It means the marginal product of capital increases faster than the marginal product of labour. In this case, the new isoquant becomes more flatter.



ISOQUANTS AND DIFFERENT RETURNS TO SCALES

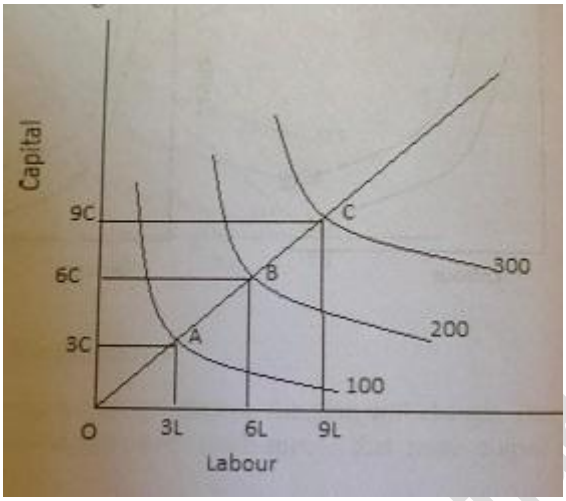
The laws of returns to scale can also be explained in terms of the isoquants.

1. Increasing returns to scale: Increasing returns to scale means that output increases at a greater proportion than the increase in inputs. The following diagram depicts increasing returns to scale.



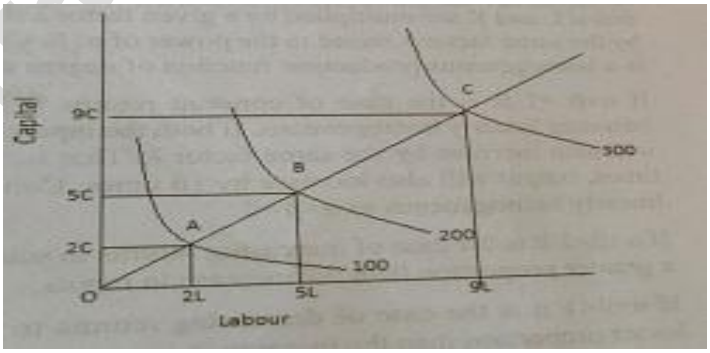
In the diagram the first 100 units of output is produced with 3 units of capital and labour. The next 100 units need only 2 additional units of labour and capital. The third 100 units of output is produced with an additional one unit of labour and capital. In the expansion path **OA>AB BC**. This kind of production function shows increasing returns to scale.

2. Constant returns to scale: Constant returns to scale means the inputs and the output increases at the same proportion. Increasing returns to scale can be explained with the help of the following diagram.



The diagram shows that the first 100 units of output is produced with 3units of capital and 3 units of labour. The second hundred as well as the third hundred is also produced with an additional 3 units of labour and capital respectively. In the expansion path **OA AB-BC.** Thus, there is an equal proportionate increase in inputs and output.

5. **Decreasing returns to scale**: Decreasing returns to scale means output increases at a lesser proportion than the increase in inputs. A production function with decreasing returns to scale is depicted in the following diagram.



In the diagram the first 100 units of output is produced with 2 units of labour and capital. But the next 100 units is produced by employing an additional 3 units of labour and capital. The third 100 units of output is produced by using 4 units of labour and capital. In the expansion

path **OA<AB<BC**. Thus, a larger amount of inputs are needed to produce additional units of output. Hence, the production. function shows decreasing returns to scale.

COBB-DOUGLAS PRODUCTION FUNCTION

This is the most widely used production function in empirical work today. This production function is the outcome of the empirical studies of P.H. Douglas and C.W Cobb about the American manufacturing industry. The general form of this production is;

$$Q=AL^{\alpha}K^{\beta}$$

Where **Q is the manufacturing output**,

L is the quantity of labour employed,

K is the quantity of capital employed and

A, α and β are parameters of the function. 'A' represents efficiency of the firm as determined by the use of technology. This *A* is nothing but K/L ratio. As technology progresses the value of A increases over time.

- ⇒ **α** and **β** are the output elasticity of labour and capital respectively. The value of α and β determines the share of labour and capital in total production. This production function assumes **α+β=1.**This implies **constant returns to scale**.
- ⇒ This production function is linear homogenous. It means that if inputs are increased output will also increase in the same proportion.
- ⇒ Cobb- Douglas production function is used in empirical studies as whether they are increasing, constant or decreasing. Further Cobb -Douglas production function is also frequently used to estimate output elasticities of labour and capital. Output elasticity of a factor shows the percentage change in output as result of a given change in the quantity of a factor.
- → The sum of the exponents of factors in Cobb-Douglas production function that is a+b measures returns to scale.

If a+b=1 returns to scale are constant

If a+b>1, returns to scale are increasing

If a+b<1, returns to scale are decreasing

QUESTIONS

1. Define production function and bring out its usefulness in managerial decision making.
2. Diagrammatically explain the Law of Variable Proportions
3. Explain Cobb-Douglas production function and bring out its importance in business decision making process.
4. Discuss Variable Proportion Production? How is it different from Fixed Proportion Production?
5. Differentiate between returns to scale and returns to variable factor.

6. Complete the following table

Units of labour	Total product	Average product	Marginal product
1		40	
2			48
3	138		
4		44	
5			24
6	210		
7		29	
8			(-27)

7. The following is known about a firm

Units of Labour Input	**Total Output (Units)**
1	50
2	110
3	150

4	180
5	180
6	150

State and briefly explain the law underlying changes in output as the input is changed. Also identify the various stages in the change in total product.

8. Explain the causes for increasing and decreasing returns to a variable factor
9. Explain the relation between marginal product and total product with the help of diagram?
10. When the total product is increasing at an increasing rate marginal product is decreasing? Substainate your answer with the help of a table and diagram.
11. Suppose the production function is

$$Y=2K^{1/4}L^{3/4}$$

AndK=L=1.How much output is produced ?If we reduce L by 10% ,how much would K need to be increased to produce the same output

12. a) In a production function $Q=2L^{1/2}\ K^{1/2,}$ if L=36 how many units of capital are needed to produce 60 units of output?

b) In the production function $Q=2L^{1/2}\ K^{½}$ determine the percentage increase in output if labour is increased by 10 percent assuming capital is held constant.13.Assume the production function $Q=2L^{1/2}\ K^{½}$

i) If L=100,K=200, what is the maximum quantity that can be produced

ii) If the firm changes the amount of labour and capital by 10 times what will happen to the output?

14.Given below is the production function of firm A

$$Q=100L^{0.3}\ K^{0.7}$$

The firm uses 20units of Labour (L) and 10 units of Capital (K).Calculate the output?

15 a) State the law of variable proportions. Explain the law with the help of a diagram.

b) i) A production function is given as $Q = 3\ L^{1/4}\ K^{3/4}$. This is a linearly homogeneous production function. Why? ii) If L=16 and K=6, what will be the output?

16.a) What is a production function? Explain Cobb-Douglas production function?**)**

b) A firm's production function is given as $Q=L^{1/2}\ K^{1/2}$.What will be the output when L=25 and K=9.Suppose the firm increases the number of units of capital to 16 and

they want to produce 80 units of output. What should be the number of units of labour.

17. In the Cobb-Douglas production function $Q=AL^{\alpha}K^{\beta}$, define α and β.
If $\alpha+\beta=1$,what does it mean?

18.a) Explain the law of variable proportion with a diagram? **(7 marks)**
(S5 Regular Exam 2021)

19. Define Isoquant curve. Explain the properties of Isoquant curve. **(7 marks)**
(S5 Regular Exam 2021)

20.What do you mean by producer equilibrium? **(KTU Model question)**
Suppose a chemical factory is functioning in a residential area. What are the external costs? **(KTU Model question)**

21 a) What are the advantages of large-scale production? **(KTU Model question)**

b) Explain Producer equilibrium with the help of isoquants and isocost line. What is expansion path? **(KTU Model question)**

c) Define expansion path. **(KTU Model question)**

MODULE -2

BREAK-EVEN ANALYSIS

Define Breakeven analysis. (3)

State its merits & demerits. (4)

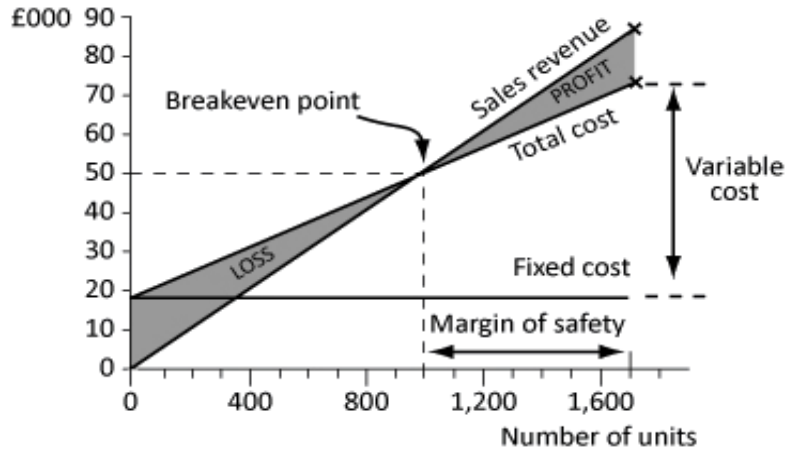
Break-even analysis is the study of relationship between cost, volume and profit at different levels of sales or production. It refers to a technique of determining that level of operations **where total revenue equals total expenses; that is the point of no profit, no loss.** The break-even point of a company is the level of sales income which will equal to the sum of its fixed and variable costs.At break-even, **sales are equal to fixed cost plus variable cost.**

"BREAK-EVEN POINT=FIXED COST +VARIABLE COST"

ASSUMPTIONS

1. Variable cost remains constant per unit of output irrespective of the level of output.
2. Fixed cost remains constant at all volumes of output.
3. There is coordination between production and sales.
4. Volume of production is the only factor that influences cost
5. There will be no change in general price level.

BREAK-EVEN CHART



"Break-even chart is the graphical representation of break-even point. It shows the relationship between cost, volume of output and profit". It can be

seen from the figure that no of units produced is shown on the X-axis and costs and sales revenue is shown along the Y-axis. The fixed cost line is drawn parallel to X-axis which indicates that fixed expense remains the same with any volume of production. Total cost line starts with fixed cost line where variable cost line is zero. Sales line is drawn starting from the origin, which means that sales moves in relation to the level of output. **The sales cost line will cut the total cost line at a point where the total costs are equal to total revenue** .Thus **point Q is the Break-even point** where there is no profit and no loss. Thus a break-even chart helps a management to understand their business in relation to profit, requirements of capital and financial stability.

KEY DECISIONS TO BE TAKEN BY THE MANAGER

⇒ How many units do we need to sell to break-even?

⇒ What is the margin of safety?

⇒ How many units to be sold to achieve a targeted profit?

⇒ What should be the profit or loss if x quantity is sold in a month?

⇒ What price should be the selling price if x quantity can be sold in a month?

1. BREAK-EVEN POINT

$$\mathbf{BEP=\frac{FixedCost}{Sellingprice-Variablecostperunit}}$$

Breakeven in sales value=Breakeven units ×Selling price

2. MARGIN OF SAFETY

It is the difference between actual sales and breakeven sales. It denotes the level of safety that company enjoys before company incurring losses. Higher margin of safety provides freedom to the management of the company to change the selling price of their product in order share market share from its competitors.

Margin of Safety=Actual sales –Break-even sales

3. HOW MANY UNITS TO BE SOLD TO ACHIEVE A TARGETED PROFIT?

$$\mathbf{BEP} = \frac{\mathbf{Fixedcost + Requiredprofit}}{\mathbf{Sellingprice - Variablecostperunit}}$$

CONTRIBUTION

The difference between selling price and variable cost is called Contribution. It is the contribution which is available to meet the fixed expense of the business and provide profit for the business.

Contribution=Selling Price –Variable cost per unit

PROFIT VOLUME RATIO: Profit volume ratio is usually called $\frac{P}{V}$ratio indicates the relationship between contribution and sales .It shows the rate at which profit increases with the increase in the volume of output.

$$\frac{P}{V}ratio = \frac{\mathbf{Contribution}}{\mathbf{Sales}} \times 100$$

$$\frac{P}{V}ratio = \frac{\mathbf{Sales - Variable\ Cost}}{\mathbf{Sales}}$$

P/V ratio is a useful tool available to management for solving many of its problems in profit planning.A high $\frac{P}{V}$ratio for the business indicates that a slight increase in the volume of output without any increase in fixed cost would result higher profit. Similarly a low $\frac{P}{V}$ ratio indicates low profitability to the firm.**If we take total revenue and total variable cost to estimate the ratio it will not make any difference.**

If selling price is not given BEP can be find out by using the following formula.

$$\textbf{BEP} = \frac{\textit{Total Fixed Cost}}{\textit{P/V Ratio}} \textbf{ or BEP} = \frac{\textit{Total Fixed Cost} \times \textit{Sales}}{\textit{Sales} - \textit{Variable cost}}$$

Value of sales to earn a desired profit using P/V ratio and Total Fixed Cost

$$\textbf{BEP} = \frac{\textbf{Total Fixed Cost} + \textbf{Desired Profit}}{\textbf{P/V Ratio}}$$

ALGEBRAIC METHOD

Let, P be the price of the product and Qb the break-even level of output .At the break-even point total revenue equals total cost.The difference between price and average variable cost (P-AVC) is the contribution margin per unit of output sold. It is that part of the price which contributes to cover the fixed cost of the firm.

TR= TC (TR=P×Qb and TC=TFC+TVC

Therefore P×Qb=TFC+TVC (TVC=AVC×Qb)

P×QB=TFC+AVC×Qb

P×Qb-AVC×Qb=TFC

$$\textbf{Qb} = \frac{\textit{TFC}}{\textit{P} - \textit{AVC}}$$

	Merits	Demerits
1. 2. 3.	It explains the relationship between cost, volume and returns. It indicates the lowest amount of business activity to prevent losses. It helps a firm in making its short –run tactical decisions	1. It may give misleading decisions of production capacity changes. 2. The total fixed cost may not remain constant after a certain level of output as assumed by break-even analysis. 3. The assumption that variable cost per unit remains constant is unrealistic.

IMPORTANCE OF BREAK-EVEN ANALYSIS IN MANAGERIAL DECESION MAKING PROCESS

⇒ It is helpful in forecasting the profit accurately which is essential to determine the relationship between cost and revenue.

⇒It helps the management in the evaluation of performances for control purposes.

⇒ It may be helpful in formulating pricing policies by studying the effect of prices on cost and profits.

⇒It is helpful in making short term goals for the business.

⇒ It helps a firm in formulating future business investment decisions.

QUESTIONS

1. The financial details of a company are as below.
   Variable cost per unit is Rs30;selling price per unit is Rs 40.Fixed expenses are Rs 1, 00,000.Calculate

i) the break-even point

ii)margin of safety considering actual sales is 15000 units

iii) the selling price per unit ,if BEP is brought down to 8000 units.

2. From the following calculate the break-even point

Sales price	20 per unit
Variable manufacturing cost	11 per unit
Variable Selling Cost	3 per unit
Fixed factory overheads	5,40,000 per year
Fixed selling costs	2,52,000 per year

3. From the following data you are required to calculate
   a) $\frac{P}{V}$ ratio b) Break-even sales with the help of $\frac{P}{V}$ ratio
   c) Sales required to earn a profit of 4,50,000
      Fixed expenses:90,000

Variable cost per unit:

Direct material=Rs 5, Direct Labour=Rs 2,Direct overheads=100% of Direct labour

Selling price per unit =Rs 12

4. From the following information ascertain by how much the value of sales must be increased by the company to break-even:

Sales:3,00,000,Fixed cost:1,50,000,Variable cost:2,00,000

(Hint: Break-even point $=\frac{\text{Fixed cost} \times \text{Sales}}{\text{Sales} - \text{Variable Cost}}$)

5.A company sells their product at Rs 520 per unit.Fixed cost is Rs 75000and variable cost is Rs 310 per unit.

a) What is the break-even point?

b) What volume is needed to generate a profit of Rs 12,520?

6. a) Explain breakeven analysis with diagram.

b) If a company has the following details

Fixed cost=Rs 40, 00,000,Variable cost per unit =Rs 100

Selling price per unit=Rs 200

Calculate i) Break-even quantity

ii) If the actual production quantity is 1, 20,000, what will be the profit?

7. A company sells their product at Rs 650 per unit, the fixed cost is Rs82000 and variable cost is Rs 240 per unit

a) What is BEP?

b) What volume is needed to generate a profit of Rs 10,250?

8. a) Suppose a firm makes candles and very month it has to pay Rs.3000 as rent and Rs.3000 as interest charge. If the selling price of a candle is Rs 5 and cost per candle is Rs 2

i) Estimate the break-even level of output

ii) If the sales are 5000 candles, what will be the profit?

iii) To get a profit of Rs 15000 how many candles are to be produced?

iv) If the sales is 5000 candles what is the margin of safety?

v) Estimate profit volume ratio and break-even sales.

9. a) Calculate the Break-Even Quantity from the following data

Fixed Cost: Rs25000;Average Variable Cost: Rs12;Selling Price Rs17

b) What will be the break-even quantity if selling price increases by Rs3?

10. The breakeven point helps a manager in deciding their future investment plans. Do you agree? Give reasons.

11. From the following details, calculate BEP.

Sales=Rs 1, 00,000

Variable cost=Rs 60,000

Fixed Cost=Rs 15,000

12. Explain the importance of breakeven analysis in the decision making process of a firm?

13. Differentiate between break-even point and margin of safety.

14**.** What is Break-even analysis?

b) Suppose a company produces batteries and its fixed cost is Rs 50,000/-).It variable expense per battery is Rs 3/- and price of battery is Rs 8/- estimate

i) Break-even output.

ii) Number of batteries to be produced to get a total profit of Rs 25,000

iii) What is the margin of safety if the planned sales is12, 000 batteries?

15. The owner of an Old-fashioned Berry Pies is thinking of adding new line of pies which require leasing new equipment for a monthly payment of Rs 6000.Variable cost would be Rs 2 per pie and retail price per pie is Rs 7.

a) How many pies must be sold in order to break-even?

b) What would be the profit or loss if 1000 pies are made and sold in a month?

c) How many pies must be sold to earn a profit of Rs 4,000?

d) If 2000 can be sold and profit target is Rs 5000, what price should be charged per pie?**(KTU Model Question)**.

16. A small-scale company, engaged in the production of manufacturing biodegradable carry bags has total sales of Rs. 20000. Its fixed cost is Rs. 6000, while its variable cost is at Rs.12000. Calculate

(i) the P/V ratio

(ii)break-even point

MODULE 2: BREAK-EVEN ANALYSIS

(iii) Margin of safety at this level of sales

(iv) If it sells each bag for Rs.5, how many bags should the company sell to break even?

(v)Find out the sales required to earn a profit of Rs.4000.

17. Suppose PV ratio is 0.2 and fixed cost is Rs 10000.What is the breakeven sales? If the price per unit is Rs 50 what is the breakeven level of output?

18. Suppose contribution per unit of output sold is Rs 10 and TFC is Rs 10000.What is the break-even output. If actual sales are Rs 1200 units estimate margin of safety.

19. Suppose the fixed expense of a firm includes rent Rs 10000 and interest payment Rs 5000.It produces note books and sells it a price of Rs 20.If the average variable cost per note book is Rs 10, estimate break-even level of output and the profit earned when it sells 2000 books.

20. The total sales of a manufacturing firm is Rs 20000 in this year. It's variable costs are Rs 8000 while its fixed costs are Rs 6000 for that year. Find the breakeven point of this firm.**(7 marks) (S5 Regular Exam, Dec 2021)**

21. a) Explain break-even analysis with the help of a diagram.

b) Suppose the monthly fixed cost of a firm is Rs. 40000 and its monthly total variable cost is Rs. 60000.

i. If the monthly sale is Rs. 120000 estimate contribution and break-even sales.

ii. If the firm wants to get a monthly profit of Rs.40000, what should be the sales? **(KTU Model Question)**

c) Explain break-even point**(KTU Model Question)**

22 What is margin of safety .What happens when margin of safety is low?

(3 marks) (S5 Regular Exam, Dec 2021)

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