SYLLABUS

B.Com I Year

Subject – Business Mathematics

UNIT – I	Ratio – Gaining and Sacrificing Ratio, Proportion, Percentage, Commission, Discount and Brokerage.
II	ing, Characteri tion, Invoic
UNIT – III	Elementary Matrices – Definition and Calculations, Types of Matrices.
	thms and Ant alculations, S est.
V	verage atistical Ave A ean, Geomet

UNIT-I

Chapter -1 – RATIO

A ratio can exist only between two quantities of the same type. If x and y are any two numbers and y $\neq 0$ then the fraction $\frac{x}{y}$ is called the ratio of x and y is written as x:y.

Characteristics of Ratio –

The following characteristics are attributed to ratio relationship:

i) Ratio is a cross relation found between two or more quantities of same type.

ii) It must be expressed in the same units.

iii) By the fraction laws a ratio can be expressed as below:

$$\frac{y}{x} = \text{x: y}$$

$$\frac{10}{5} = 10:5 \text{ or } 2:1$$

iv) A ratio expresses the number of times that one quantity contains another.

v) Two or more ratios may be compared by reducing their equivalent fractions to a common denominator.

Different types of Ratio –

Ratio can be divided into following ways –

1) Unit Ratio – When homogeneous items are same on the basis of unit, it is called unit ratio.
   For example – Ram and Shyam are getting Rs. 5 each.
   $$\frac{x}{y} = \frac{5}{5} \text{ } or \text{ } 5:5 \text{ } or \text{ } 1:1$$
2) Duplicate Ratio – When the homogeneous items are shown in unit with square, it is called duplicate ratio.
   For Example, 2:3 square means $2^2:3^2$ or 4:9
3) Triplicate ratio – When homogenous item is multiplied by 3, it is known as triplicate ratio.
   For example, $2^3:3^3$ = x2x2x2:3x3x3 8:27
4) Sub triplicate ratio – When ratio is expressed in cube root it is known as sub triplicate ratio.
   For example, $\sqrt[3]{8}: \sqrt[2]{27} = 2:3$
5) Ratio of greater in equality – In this type of ratio the first item of given ratio is greater than other items.
   For example, 8:3, 13:8.
6) Ratio of less in equality – When first item of given ratio is less than the other items of ratio, it is called ratio of less of equality.
   For example, 2:7, 5:12, 1:3
7) Equality ratio – In this type of ratio first item is equal to other item of ratio.
   For example, 5:5, 8:8, 12:12

Proportion

Relationship between the two ratio's is called proportion. Here, quantity ratio of first two items is equality to rest two terms.

For example, 2:5::6:15

Proportion is expressed by four parallel points (::).

In the simple proportion here its not necessary that two items of first ratio and the items of second ratio should be homogeneous. But the items of second set of ratio has the same relationship which is found between the items of first ratio. For example 2:5::6:15. Here 5 is 2.5 times of 2 in case of first ratio. In the same 15 is 2.5 times of 6 in the second set of ratio.

Characteristics of Proportion –

i) Proportion is given in four parts. So first number is known as first item, second number is second item, third number is third item and fourth number is known as fourth item.

ii) First and fourth items are known as extremes items and second and third items are known as mean items.

iii) It is not necessary in proportion that all four items should be homogenous. But the ratios of first and second and third and fourth should be the same.

Types of Proportion –

1) **Continued proportion** –
If ratio of items is going on continuously, e.g., ratio of first and two is equal to two and three and ratio of two and three is equal to three and fourth item and so on, thus, ratio is known as continued ratio.
For example, $\frac{A}{B} = \frac{B}{C} = \frac{C}{D} = \frac{D}{E} = \frac{E}{F}$ ....
Here A, B, C, D, E and F are in continued ratio.

2) **Direct Proportion** –
In this type of ratio, two different items has the such relation that if the one is increased or decreased, another will change accordingly in the same ratio.

Difference Between Ratio and Proportion –

S.No.	Ratio	Proportion
1	There are two terms in a ratio.	There are four terms in a proportion.
2	Comparison of two quantities of same type.	Comparison of two ratios.
3	Two quantities must be of same type.	All four quantities are not of same type but the first two are of one type and the last two may be of another type.
4	There is not a product rule	The product of extremes is equal to product of the means.

Chapter -2 - PERCENTAGE

Percent and Percentage

When we take of percentage, we usually refer to "for every one hundred."
Actually percentage can be defined as a fractional expression with 100 as its denominator.

When we talk of 10 percentage of a number, we mean 10 parts put of one hundred parts of the number in consider action the word "percentage" can be denoted by the sign (%).

In the above example 10 percentages can be written as 10% or even $\frac{10}{100}$. When written in the form $\frac{10}{100}$, it is in a fraction form whereby the upper number is the numerator and the bottom the denominator. It can further be simplified as –

$$\frac{10}{100} = \frac{1}{10}$$

From the above discussion we can conclude that when dealing with percentage, a number can be expressed as a fraction of percentage, i.e.,
$\frac{10}{100} = \frac{1}{10}$; or it can be written just in percentage form, i.e., 10 percent = 10%.

Change fractions into percentage –
When changing a fraction into a percentage, we just multiply it by 100 and put the sign %.
Example: Express $\frac{1}{10}$ as a percentage = $\frac{1}{10} X \frac{100}{1} = 10\%$

Change percentage into fraction –
To change a percentage given into a fraction, we divide the fraction by 100.
Example: Express 10% as a fraction = $\frac{10}{10} = \frac{1}{10}$

To find percentage of quantity with another quantity –
Let x and y be two quantities of same type and rate percentage r, such that

$$r\ \%\ of\ x = y$$

or

x. $\frac{r}{100} = y$
r=$\frac{y\ X\ 100}{x}$
i.e., Rate percent = $\frac{The\ quantity\ \ which\ represent\ \ in\ percent}{Second\ \ quantity}\ X\ 100$
Example: What percent Rs. 20 of Rs. 350?
Solution: r% $\frac{20X100}{350} = 5\frac{5}{7}$

To find the quantity when rate percent and percentage value are known –
If rate percent value are given then
Quantity = $\frac{Percent\ \ value\ \ X\ 100}{Rate\ \ percent}$

Chapter -3 – COMMISSION

The terms commission and discount are commonly applicable in the business world. We should clearly understand the terminologies before solving questions related with them.

Who is an Agent?
Usually businessman may not be directly doing the business transactions themselves because of expanded area of business. They may employe persons to be doing the selling or buying on their behalf. Such person are known as agents. Agents get commission against their works performance.

Commission –
Having transacted the business transactions, the agents will require remuneration from their principal such as remuneration is known as commission. Usually the commission is calculated on the basis of the percentage of total sales done by the agent.

Who is a Broker?
The buyer and seller may not come into contact face to face. Their transaction may be made possible by a middleman. He negotiates the sales and purchase proceeds between the buyer and seller such a negotiator is known as broker.

Brokerage –
This is the remuneration paid to the broker. It is actually a commission paid to the broker. It is calculated on the basis of percentage of the total value of the business transacted by the broker.

Del Credere Agent –
A del-credere agent is a person who guarantees collection of dues for the principal from the customers. They got a special type of commission known as del-credere commission. Usually they deduct the commission on the dues collected and remit the remaining amount to the principal.

Travelling Agent –
This is a person who moves round the trading zone of the principal doing the selling proceeds.

Important formulae –

i) Amount of commission $= \frac{Rate\ of\ commission\ \ X\ Amount\ \ of\ sales}{100}$

ii) Rate of commission $= \frac{Rate\ of\ commission\ \ X\ 100}{Amount\ \ of\ Sales}$

iii) Amount of Sales $= \frac{Rate\ of\ commission\ \ X\ 100}{Rate\ of\ commission}$

iv) Amount of Del-cradere commission $= \frac{Credit\ \ Sales\ X\ Rate\ \ of\ \ del-credare\ \ commission}{100}$

DISCOUNT

The allowance or deduction from the market price of goods sold given by the vendor (Seller) to the purchaser (Buyer) is called discount. Discount is also known as allowance. The objective of allowing discount are –

- To increase the sales
- To retain the customership
- To encourage the customers to make the payment early

Kinds of Discount –
General there are two types of discounts are allowed to the customers –
Trade Discount and Cash Discount

1) **Trade Discount –** The Discount which is allowed by the seller according to the customs and traditions of the Business and which is allowed to all the customers irrespective of the payments conditions is called Trade Discount. The objective allowing Trade Discount is to increase the sales.

2) **Cash Discount –** The deduction on the marked price or invoice price or the selling price to the customer to encourage them to pay in cash or to make earlier cash payments is called cash discount.

   In general Trade discount is given on marked price and cash discount is given on the remaining amount after deducting trade discount. In this way the purchaser in cash is entitled to get both type of discount.

   Apart from these two discounts, there are some more types of discount.

Bulk discount or Quantity discount – It is allowed to the customers on purchasing on good in big quantity or bulk quantity.

Successive discount – When another discount is given after a discount, then the combination of these two discounts are known as successive discounts.

Equivalent Rate of Discount – The discount for which the amount due is equal o the amount due for successive discount is called their equivalent discount. Equivalent discount rate is also called single rate of equivalent discount.

It is to be noted that the total amount of successive discount is equal to the among of equivalent discount.

For example:
If a trader allows successive discount of 20% and 5% then the single rate/equivalent rate of discount will be –
D = 20+5 – 20x5 / 100 = 24%

NINE-VALUE TABLE

It is a method of calculating discount on a certain sum of list price/marked price. In this method on the basis of rate given first of all we have to calculate the discount for Rupee 1 and accordingly for Rupees 2, 3, 4, 5, 6, 7, 8 and 9.

With the help of this table we can calculate the commission or discount on any quantity.

Questions to be prepared on Unit-I :

1) Give the definition and characteristics of Ratio and also explain its types.
2) Describe the various type of Proportion.
3) Distinguish between Ratio and Proportion.
4) Explain the importance/significance of Percentage.
5) Explain the terms Commission, Discount & Brokerage.
6) What is successive discount?
7) Explain equivalent rate of discount with example.
8) Explain Nine-Values Table with example.

UNIT-III

Definition of Matrix –
A matrix (plural of matrices) is an array of real numbers (or other suitable elements) arranged in row and columns is called as a matrix. Consider a set of real numbers *m* and *n* when multiplied together we get *mxn* or *mn*. These can be used to define a matrix.

1) **Row Matrix or Row Vector –**
A matrix having only one row is known as a row matrix or a row vector. It is in the form (1x*n*).
Example –

$$(3),\ (7\ -10),\ (\tfrac{1}{2}\ 3\ -6),\ (a\ b\ c\ d)$$

2) **Column Matrix or Column Vector –**
This is a type of Matrix which has only one column. It is in the form (*m* x 1).
Example –

$$(5),\ \begin{bmatrix} 8 \\ 4 \\ -2 \end{bmatrix},\ \begin{pmatrix} a \\ b \\ c \\ d \end{pmatrix}$$

3) **Zero or Null Matrix –**
This is a type of Matrix whose every element is zero. It is usually denoted by bold face zero **(0)**.
Example –

Examples :

$$(0),\ \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix},\ \begin{pmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{pmatrix},\ \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix},\ [0\ 0\ 0\ 0\ 0]$$

4) **Diagonal Matrix –**
Some matrix are such that all their elements are zero apart from the diagonal extending from the upper left hand corner to the lower right hand corner. These are known as diagonal matrix.
Examples are -

$$\begin{bmatrix} 4 & 0 & 0 \\ 0 & 6 & 0 \\ 0 & 0 & 6 \end{bmatrix},\ \begin{bmatrix} 3 & 0 \\ 0 & 7 \end{bmatrix},\ \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 7 & 0 & 0 \\ 0 & 0 & 9 & 0 \\ 0 & 0 & 0 & -2 \end{bmatrix}$$

5) **Square Matrix –**
In this matrix, the number of rows and columns are the same.
Examples –

$$(3),\ \begin{bmatrix} 6 & -7 \\ 2 & 2 \end{bmatrix},\ \begin{bmatrix} 3 & 5 & 1/2 \\ 7 & 6 & 3 \\ 2 & 7 & -1 \end{bmatrix},\ \begin{bmatrix} 1/2 & 2 & 7 & -5 \\ 3 & 6 & 8 & 2 \\ 5 & 3/4 & -6 & 5 \\ 7 & 8 & -1 & 4 \end{bmatrix}$$

6) Unit or Identity Matrix –

This is a type of matrix where diagonal elements have values of 1. A unit matrix is usually denoted by bold face **(I)**. Examples of unit matrix are as follows –

$$I_1 = [\,1\,],\; I_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix},\; I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix},\; I_4 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

7) Scalar Matrix –

This is a diagonal matrix whose diagonal elements are all equal. See examples given below –

$$\begin{bmatrix} 4 & 0 \\ 0 & 4 \end{bmatrix},\; \begin{bmatrix} 5 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 5 \end{bmatrix},\; \begin{bmatrix} \sqrt{2} & 0 & 0 & 0 \\ 0 & \sqrt{2} & 0 & 0 \\ 0 & 0 & \sqrt{2} & 0 \\ 0 & 0 & 0 & \sqrt{2} \end{bmatrix}$$

8) Upper Triangular Matrix –

A square matrix in which every element below the principal diagonal are zero is known as an upper triangular matrix. Examples –

$$\begin{bmatrix} 6 & 2 & 4 \\ 0 & 5 & 7 \\ 0 & 0 & 3 \end{bmatrix},\; \begin{bmatrix} 7 & 5 & 4 & 6 \\ 0 & 8 & 3 & 7 \\ 0 & 0 & 2 & 5 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

9) Lower Triangular Matrix –

A square matrix in which every element above the principal diagonal are zero is known as the lower triangular matrix. Examples –

$$\begin{bmatrix} 6 & 0 & 0 \\ 2 & 4 & 0 \\ 5 & 3 & 5 \end{bmatrix},\; \begin{bmatrix} 8 & 0 & 0 & 0 \\ 4 & 7 & 0 & 0 \\ 3 & 4 & 2 & 0 \\ 9 & 3 & 6 & 5 \end{bmatrix}$$

10) Transpose Matrix –

A matrix obtained by interchanging the row and columns of a matrix is called transpose of A and is denoted by A^T or A'. Example given below –

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \qquad A_T = A' = \begin{bmatrix} a_{11} & a_{21} & a_{31} \\ a_{12} & a_{22} & a_{32} \\ a_{13} & a_{23} & a_{33} \end{bmatrix}$$

$$A = \begin{bmatrix} 7 & 6 & 4 \\ 8 & 5 & 3 \\ 9 & 2 & 1 \end{bmatrix} \qquad A_T = A' = \begin{bmatrix} 7 & 8 & 9 \\ 6 & 5 & 2 \\ 4 & 3 & 1 \end{bmatrix}$$

UNIT-IV

FUNDAMENTAL LAWS OF LOGARITHM

The laws of logarithm which are valid for any base a (> 0 but ≠ 1) are as follows:

Law 1 : The logarithm of the product of two numbers is equal to the sum of the logarithms of these numbers to the same base, *i.e.*,

$$\log_a(m \times n) = \log_a m + \log_a n$$

Proof : Let $\log_a m = x \Rightarrow a^x = m$

and $\log_a n = y \Rightarrow a^y = n$

Hence $a^x \times a^y = m \times n$

or $a^{x+y} = m \times n$

$\therefore$ $\log_a(m \times n) = x + y,$ by definition

$\Rightarrow$ $\log_a(m \times n) = \log_a m + \log_a n.$

Sub-law : The logarithm of the product of two or more numbers is equal to the sum of the logarithms of these numbers to the same base, *i.e.*,

$$\log_a(m \times n \times p \times \ldots\ldots) = \log_a m + \log_a n + \log_a p + \ldots$$

Law 2 : The logarithm of the quotient of two numbers is equal to the difference of the logarithm of the numerator and the logarithm of the denominator to the same base, *i.e.*,

$$\log_a\left(\frac{m}{n}\right) = \log_a m - \log_a n$$

Proof : Let $\log_a m = x \Rightarrow a^x = m$

and $\log_a n = y \Rightarrow a^y = n$

Hence $\frac{m}{n} = \frac{a^x}{a^y} = a^{x-y},$ by law of indices

$\Rightarrow$ $\log_a\left(\frac{m}{n}\right) = x - y$

$\Rightarrow$ $\log_a\left(\frac{m}{n}\right) = \log_a m - \log_a n$

Law 3 : The logarithm of a number raised to a power is equal to the product of the index of the power and the logarithm of the number to the same base, *i.e.*,

$$\log_a(m^n) = n \log_a m$$

Proof : Let $\log_a m = x \Rightarrow a^x = m$

Hence, $(a^x)^n = m^n$, by raising to the power n on both sides.

$\Rightarrow$ $a^{nx} = m^n$

$\Rightarrow$ $\log_a(m^n) = nx = n \log_a m.$

Remark : If $n = \frac{1}{p}$, where p is a positive integer, then logarithm $\sqrt[p]{m}$ or $m^{1/p}$ is obtained by dividing the logarithm of m by p, *i.e.*,

$$\log_a(\sqrt[p]{m}) = \log_a(m^{1/p}) = \frac{1}{p}\log_a m \text{ or } \frac{\log_a m}{p}$$

Change of Base

If the logarithm of numbers are given to the base a, then the logarithms of those numbers can be obtained to another base b.

Let $\log_b n = x$

$\Rightarrow$ $b^x = n$

$\Rightarrow$ $\log_a b^x = \log_a n,$ {taking log to the base a}

$\Rightarrow$ $x \log_a b = \log_a n$

$\Rightarrow$ $x = \frac{\log_a n}{\log_a b}$ or $\log_b n = \frac{\log_a n}{\log_a b}$ ...(1)

Writing $n = a$ in (1),

$$\log_b a = \frac{\log_a a}{\log_a b} = \frac{1}{\log_a b}$$

$$\Rightarrow \quad \log_b a . \log_a b = 1 \qquad ...(2)$$

Similarly $\quad \log_b m = n$

$$\Rightarrow \quad b^n = m$$

$$\Rightarrow \quad \left(\frac{1}{b}\right)^{-n} = m$$

$$\Rightarrow \quad \log_{1/b} m = -n \qquad ...(3)$$

Common Logarithm

The logarithm of a number to the base 10 is called 'common logarithm'. In numerical calculations common logarithms are used when no base is mentioned it is understood to be 10. For example,

$\log_{10} n = x$ is simply written as $\log n = x$.

The common logarithm of a number consists of two parts : the whole part or the integral part and the decimal part. The integral part is called *characteristic* and the decimal part is called *mantissa*.

In $\log_{10} 14 = 1.1461 = 1 + .1461$

characteristic is 1 and mantissa is .1416.

To Determine Characteristic of a Common Logarithm

Consider the logarithm of those numbers which are integral powers of 10.

$$10^3 = 1{,}000 \Rightarrow \log_{10} 1{,}000 = 3$$
$$10^2 = 100 \Rightarrow \log_{10} 100 = 2$$
$$10^1 = 10 \Rightarrow \log_{10} 10 = 1$$
$$10^0 = 1 \Rightarrow \log_{10} 1 = 0$$
$$10^{-\infty} = 0 \Rightarrow \log_{10} 0 = -\infty$$
$$10^{-1} = 0.1 \Rightarrow \log_{10} 0.1 = -1$$
$$10^{-2} = 0.01 \Rightarrow \log_{10} 0.01 = -2$$
$$10^{-3} = 0.001 \Rightarrow \log_{10} 0.001 = -3$$

From the above results we observe that :

(1) The numbers which are integral powers of 10 are straight forward and it contains characteristic only.

(2) The common logarithm of a number between 1 and 10 lies between 0 and 1.

(3) The common logarithm of a number between 10 and 100 lies between 1 and 2.

(4) The common logarithm of a number between 100 and 1,000 lies between 2 and 3.

(5) The common logarithm of a number between .1 and 1 is between −1 and 0.

(6) The common logarithm of a number between .01 and 0.1 is between (− 2) and (− 1).

(7) The characteristic of a common logarithm is found out by mere inspection. In this connection the following rules should be kept in mind.

SIMPLE INTEREST

Interest – Interest is the money which the lender of a sum receives from the borrower, in consideration of the borrower using the sum.

Usually money is given out by lenders and the borrowers have to pay interest when it falls due. When it is said on this basis, we call it Simple Interest.

Definitions of Usual Words –

1) ***Interest*** – If a businessman borrows some money from a bank and in consideration for the use of money so borrowed, he pays the bank something apart from the principal amount, this consideration paid is interest.
2) ***Principal Amount*** – This is the amount which is given as credit to the borrower. It is the lent out sum of money.
3) ***Amount*** – When the interest has been added to be principal amount, the total is known as amount.
4) ***Time*** – This is the duration in which the principal amount has been taken by the borrower. It may be monthly, quarterly, half yearly, yearly etc. Interest is calculated on the basis of time.
5) ***Rate of Interest*** – This is the interest charged for one unit of principal for a specific period, e.g. 1 year.

Formula for the Calculation of Simple Interest –

When calculating simple interest, we take into account the following terms –

1) Principal - denoted as P
2) Rate of interest- denoted as R
3) Interest - denoted as I
4) Amount - denoted as A
5) Time - denoted as T

i) When calculating **Interest**,

$$I = \frac{PxRxT}{100}$$

ii) When calculating **Time**,

$$T = \frac{Ix100}{P\ x\ R}$$

iii) When calculating **Principal**,

$$P = \frac{Ix100}{R\ x\ T}$$

iv) When calculating **Rate**,

$$R = \frac{Ix100}{P\ x\ T}$$

v) When calculating **Amount**,

$$A = P + \frac{P\ x\ R\ x\ T}{100}$$

or $$A = P \times \left(1 + \frac{R\ x\ T}{100}\right)$$

or $$A = P + I$$

Meaning of Compound Interest –

By compound interest we mean when interest becomes due after a certain period, it is added to the principal amount and interest on succeeding years is based on the principal and the interest added. The difference between the amount and the original principal is called the compound interest.

It means that in compound interest, the principal doesn't remain fixed at the original sum but increase at the end of each interest period. Interest period is the period at which the interest becomes due. It may be a year, half year or quarter year.

Distinction between Simple and Compound Interest –

S.No.	Basis of Difference	Simple Interest	Compound Interest
1	Principal and Interest	Calculated on original amount	Calculated with interest included
2	calculation of interest	Calculated on overall period in single time.	Calculated yearly, half yearly, quarterly or even monthly.
3	Principal Amount	Always same on whole period.	Changes from year to year, month to month etc.
4	Difference in amount of interest	Less than that of compound interest.	It is more than that of small interest.

Methods for Calculation of Compound Interest –

The following are some of the methods used to calculate compound interest –

1) Simple interest method.
2) Interest table method.
3) Decimal point method.
4) Compound interest formula method.
5) By Logarithm method.

1) Simple Interest Method –

When the time of the interest is not so long, i.e.; when interest is calculated for only a few years then we use this method. It is just similar to that used to find out simple interest. Follow the steps below –

i) Calculate interest on principal at the end of every year.
ii) Add the interest got in step (i) above to the original principal. This amount is principal for the next year.
iii) Calculate compound interest by adding each year's interest for the entire period.
iv) Finally subtract the original from the compounded amount and this gives the compound interest.

2) Compound Interest Formula Method –

When the number of year involved to calculate the compound interest are many, we use the above method. The formula used is –

$$A = P\left(1 + \frac{R}{100}\right)^n$$

Where P denotes = Principal (original)
n = number of years (interest period)
r = rate of interest (in percentage)
A = Amount after n years.

MEANING IMPORTANT FORMULAE RELATED WITH PROFIT AND LOSS

When we are given cost price and selling price, we can formulate some formula related with them. We can abbreviate the two as below –

Cost Price = C.P.
Selling Price = S.P.

1) Gain % on cost = $\frac{S.P.-C.P.}{C.P.} x\ 100$

$\frac{Gain\ x\ 100}{Cost\ Price}$

2) Loss % on cost = $\frac{C.P.-S.P.}{C.P.} x\ 100$

$\frac{Net\ Loss}{C.P.}$ x 100

3) Gain % on sales = $\frac{S.P.-C.P.}{S.P.}$ x 100

$\frac{Gain}{S.P.}$ x 100

4) Loss % on sales = $\frac{C.P.-S.P.}{S.P.}$ x 100

$\frac{Loss}{S.P.}$ x 100