ENGINEERING ECONOMY

Subject Code: 10ME71 **IA Marks : 25**

Hours/Week: 04 **Exam Hours : 03**

Total Hours: 52 **Exam Marks : 100**

PART – A

UNIT – 1 **08 Hours**

Introduction: Engineering Decision-Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy. Engineering Economic Decision, Maze. Law of demand and supply, Law of returns, Interest and Interest factors: Interest rate, Simple interest, Compound interest, Cash - flow diagrams, Personal loans and EMI Payment, Exercises and Discussion.

UNIT – 2 **06 Hours**

Present-Worth Comparisons: Conditions for present worth comparisons, Basic Present worth comparisons, Present-worth equivalence, Net Presentworth, Assets with unequal lives, infinite lives, Future-worth comparison, Pay-back comparison, Exercises, Discussions and problems.

UNIT – 3 **06 Hours**

Equivalent Annual-Worth Comparisons: Equivalent Annual-Worth Comparison methods, Situations for Equivalent Annual-Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, Exercises, Problems.

UNIT – 4 **06 Hours**

Rate-Of-Return Calculations And Depreciation: Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Cost of capital concepts. **96** Causes of Depreciation, Basic methods of computing depreciation charges, Tax concepts, corporate income tax.

PART – B

UNIT – 5 **05 Hours**

Estimating and Costing: Components of costs such as Direct Material Costs, Direct Labor Costs, Fixed Over-Heads, Factory cost, Administrative Over-Heads, First cost, Marginal cost, Selling price, Estimation for simple components.

UNIT – 6 **08 Hours**

Introduction, Scope Of Finance, Finance Functions: Statements of Financial Information: Introduction, Source of financial information, Financial statements, Balance sheet, Profit and Loss account, relation between Balance sheet and Profit and Loss account. Simple Numericals

UNIT – 7 **06 Hours**

Financial Ratio Analysis: Introduction, Nature of ratio analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Evaluation of a firm's earning power. Comparative statements analysis. Simple numerical

UNIT – 8 **07 Hours**

Financial And Profit Planning: Introduction, Financial planning, Profit planning, Objectives of profit planning, Essentials of profit planning, Budget administration, type of budgets, preparation of budgets, advantages, problems and dangers of budgeting. Introduction to Bench Marking of Manufacturing Operation.

TEXT BOOKS:

1. **Engineering Economy,** Riggs J.L., 4TH ed. , McGraw Hill, 2002

2. **Engineering Economy,** Thuesen H.G. PHI , 2002

REFERENCE BOOKS:

1. **Engineering Economy,** Tarachand, 2000.

2. **Industrial Engineering and Management**, OP Khanna, Dhanpat

Rai & Sons. 2000

3. **Financial Mangement,** Prasanna Chandra, 7th Ed., TMH, 2004

4. **Finacial Management,** IM PANDEY, Vikas Pub. House, 2002

Course Outcomes:

On completion of this subject students will be able to:

1. **Can choose the best alternative from various available alternatives.**
2. **Can understand and implement various rate of interest methods.**
3. **Can judge various depreciation values of commodities**
4. **Can learn in making investments in order to get good returns.**
5. **Can get the help from various financial institutions supporting entrepreneurs.**
6. **Can make the project reports effectively.**

CONTENTS

UNIT-1
INTRODUCTION

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

ECONOMICS

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

The following are the economic goals.

- A high level of employment
- Price stability
- Efficiency
- An equitable distribution of income
- Growth

Some of the above goals are interdependent. The economic goals are not always complementary; in many cases they are in conflict. For example, any move to have a significant reduction in unemployment will lead to an increase in inflation.

Flow in an Economy

The flow of goods, services, resources and money payments in a simple economy are shown in Fig. 1.1. Households and businesses are the two major entities in a simple economy. Business organizations use various economic resources like land, labour and capital which are provided by households to produce consumer goods and services which will be used by them. Business organizations make payment of money to the households for receiving various resources. The households in turn make payment of money to business organizations for receiving consumer goods and services. This cycle shows the interdependence between the two major entities in a simple economy.

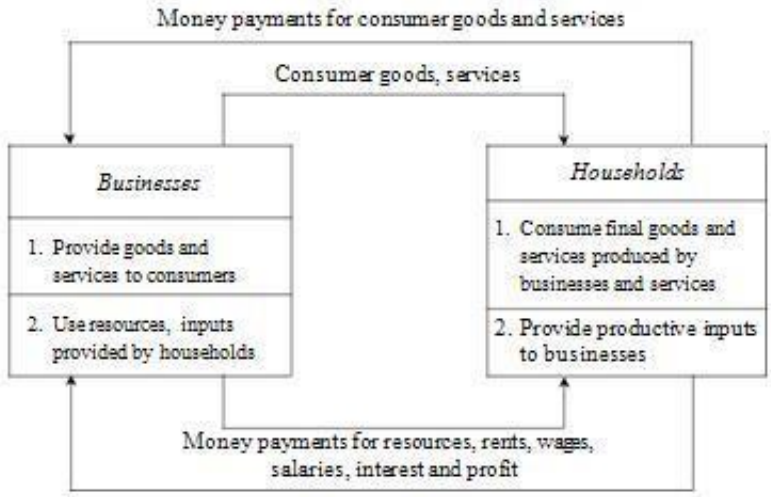

Fig. 1.1 Flow of goods, services, resources and money payments in a simple economy

Definition and Scope of Engineering Economics

As stated earlier, efficient functioning of any business organization would enable it to provide goods/services at a lower price. In the process of managing organizations, the

managers at different levels should take appropriate economic decisions which will help in minimizing investment, operating and maintenance expenditures besides increasing the revenue, savings and other related gains of the organization.

Definition

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

Scope

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

Law of Supply and Demand

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

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

Factors influencing demand

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

- Income of the people
- Prices of related goods
- Tastes of consumers

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

If, for instance, the price of television sets is lowered drastically its demand would naturally go up. As a result, the demand for its associated product, namely VCDs would also increase. Hence, the prices of related goods influence the demand of a product.

Over a period of time, the preference of the people for a particular product may increase, which in turn, will affect its demand. For instance, diabetic people prefer to have sugar-free products. If the incidence of diabetes rises naturally there will be increased demand for sugar-free products.

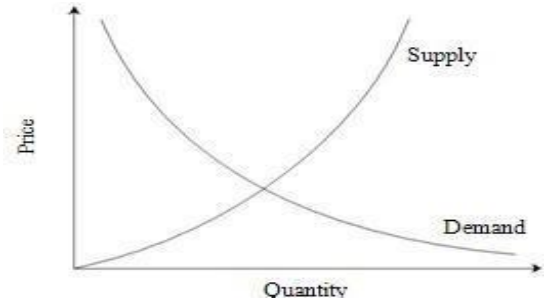

Fig. 1.2 Demand and supply curve

Factors influencing supply

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

- Cost of the inputs
- Technology
- Weather
- Prices of related goods

If the cost of inputs increases, then naturally, the cost of the product will go up. In such a situation, at the prevailing price of the product the profit margin per unit will be less. The producers will then reduce the production quantity, which in turn will affect the supply of the product. For instance, if the prices of fertilizers and cost of labour are increased significantly, in agriculture, the profit margin per bag of paddy will be reduced. So, the farmers will reduce the area of cultivation, and hence the quantity of supply of paddy will be reduced at the prevailing prices of the paddy.

If there is advancement in technology used in the manufacture of the product in the long run, there will be a reduction in the production cost per unit. This will enable the manufacturer to have a greater profit margin per unit at the prevailing price of the product. Hence, the producer will be tempted to supply more quantity to the market.

Weather also has a direct bearing on the supply of products. For example, demand for woolen products will increase during winter. This means the prices of woolen goods will be increased in winter. So, naturally, manufacturers will supply more volume of woolen goods during winter.

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

TIME VALUE OF MONEY

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

Table 1.1 Compound Amounts

(amount of deposit = Rs. 100.00)

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

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

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

where

P = principal amount invested at time 0, F = future amount, i = interest rate compounded annually, n = period of deposit.

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

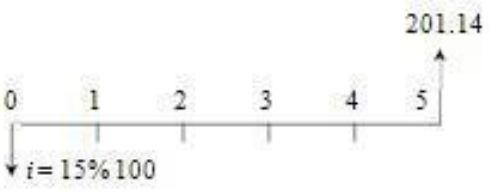

Fig. 1.3 Time value of money.

Alternatively, the above concept may be discussed as follows: If we want Rs. 100.00 at the end of the *n*th year, what is the amount that we should deposit now at a given interest rate, say 15%? A detailed working is shown in Table 1.2.

Table 1.2 Present worth Amounts

(rate of interest = 15%)

End of year (n)	*Present worth*	*Compound amount after n year(s)*
0		100
1	86.96	100
2	75.61	100
3	65.75	100
4	57.18	100
5	49.72	100
6	43.29	100
7	37.59	100
8	32.69	100
9	28.43	100
10	24.72	100

The formula to find the present worth in the second column is

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

From Table 1.2, it is clear that if we want Rs. 100 at the end of the fifth year, we should now deposit an amount of Rs. 49.72. Similarly, if we want Rs. 100.00 at the end of the 10th year, we should now deposit an amount of Rs. 24.72.

Also, this concept can be stated as follows:

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

1. Spot payment of Rs. 24.72 or
2. Rs. 100 after 10 years from now (this is based on 15% interest rate compounded annually).

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

Rs. 100 after 10 years.

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

INTEREST FORMULAS

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

Interest rate can be classified into *simple interest rate* and *compound interest rate*.

In simple interest, the interest is calculated, based on the initial deposit for every interest period. In this case, calculation of interest on interest is not applicable. In compound interest, the interest for the current period is computed based on the amount (principal plus interest up to the end of the previous period) at the beginning of the current period.

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

P = principal amount

n = No. of interest periods

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

F = future amount at the end of year *n*

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

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

Single-Payment Compound Amount

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

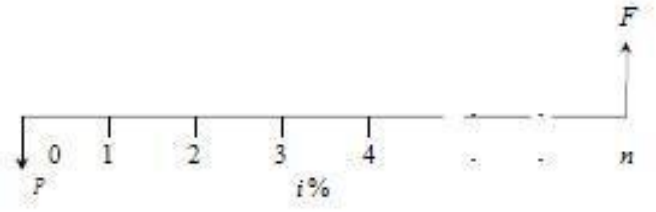

Fig.1.4 Cash flow diagram of single-payment compound amount

The formula to obtain the single-payment compound amount is

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

where

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

EXAMPLE 1.1 A person deposits a sum of Rs. 20,000 at the interest rate of 18%compounded annually for 10 years. Find the maturity value after 10 years.

Solution

P = Rs. 20,000

i = 18% compounded annually n = 10 years $F = P(1 + i)^n$ = $P(F/P, i, n)$

= 20,000 (F/P, 18%, 10)

= 20,000 ´ 5.234 = Rs. 1,04,680

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

Single-Payment Present Worth Amount

Here, the objective is to find the present worth amount (P) of a single future sum (F) which will be received after n periods at an interest rate of i compounded at the end of every interest period.

The corresponding cash flow diagram is shown in Fig. 1.5

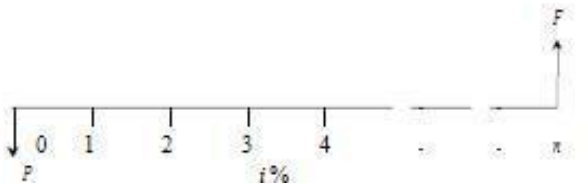

Fig.1.5 Cash flow diagram of single-payment present worth amount

where

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

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

Solution

F = Rs. 1,00,000

i = 15%, compounded annually n = 10 years

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

= 1,00,000 (P/F, 15%, 10)

= 1,00,000 ´ 0.2472

= Rs. 24,720

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

Equal-Payment Series Compound Amount

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

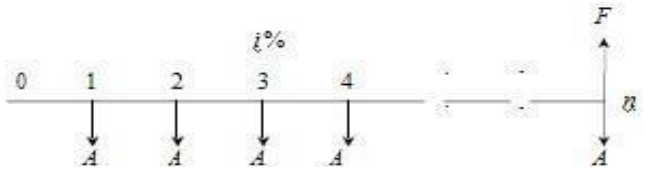

Fig.1.6 Cash flow diagram of equal-payment series compound amount.

In Fig. 1.6,

A = equal amount deposited at the end of each interest period *n* = No. of interest periods *i* = rate of interest

F = single future amount

The formula to get *F* is

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

where

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

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

Solution

A = Rs. 10,000 *n* = 25 years *i* = 20% *F* = ?

The corresponding cash flow diagram is shown in Fig.1.7

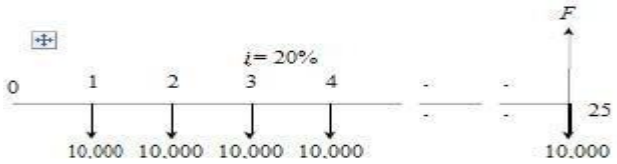

Fig.1.7 Cash flow diagram of equal-payment series compound amount.

$$F = A\left[\frac{(1+i)^n - 1}{i}\right]$$
$$= A(F/A, i, n)$$
$$= 10{,}000(F/A, 20\%, 25)$$
$$= 10{,}000 \times 471.981$$
$$= \text{Rs. } 47{,}19{,}810$$

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

Equal-Payment Series Sinking Fund

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

The corresponding cash flow diagram is shown in Fig.1.8

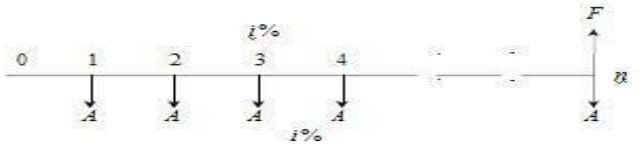

Fig.1.8 Cash flow diagram of equal-payment series sinking fund.

In Fig. 3.6,

A = equal amount to be deposited at the end of each interest period *n* = No. ofinterest periods

i = rate of interest

F = single future amount at the end of the *n*th periodThe formula to get *F* is

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

where

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

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

Solution

F = Rs. 5,00,000 *n* = 15 years *i* = 18% *A* = ?

The corresponding cash flow diagram is shown in Fig.1.9

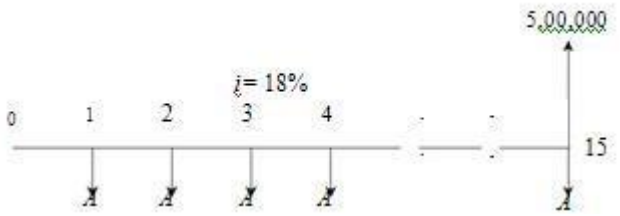

Fig. 1.9 Cash flow diagram of equal-payment series sinking fund.

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

= 5,00,000(*A*/*F*, 18%, 15)

= 5,00,000 ´ 0.0164

= Rs. 8,200

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

Equal-Payment Series Present Worth Amount

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

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

P= present worth

A = annual equivalent payment *i* = interest rate

n = No. of interest periods

The formula to compute *P* is

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

where

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

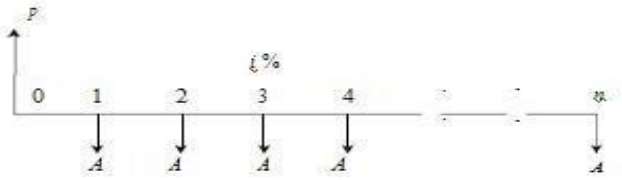

Fig.1.10 Cash flow diagram of equal-payment series present worth amount

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

Solution

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

The corresponding cash flow diagram is illustrated in Fig.1.11

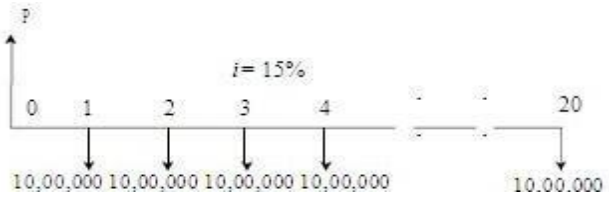

Fig.1.11 Cash flow diagram of equal-payment series present worth amount

= 10,00,000 ´ (*P*/*A*, 15%, 20)

= 10,00,000 ´ 6.2593

= Rs. 62,59,300

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

Equal-Payment Series Capital Recovery Amount

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

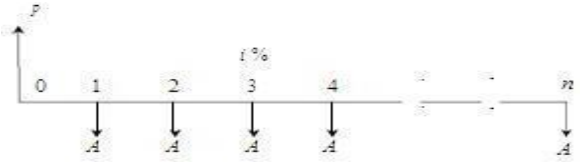

Fig.1.12 Cash flow diagram of equal-payment series capital recovery amount.

In Fig.1.12,

P = present worth (loan amount)

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

n = No. of interest periods

The formula to compute *P* is as follows:

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

where,

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

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

Solution

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

The corresponding cash flow diagram is shown in Fig.1.13

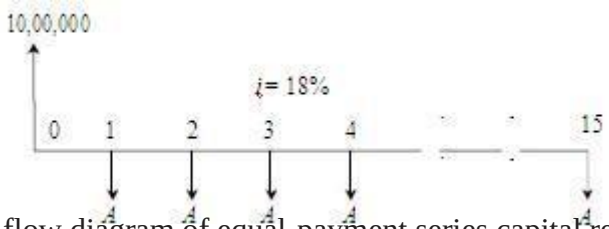

Fig.1.13 Cash flow diagram of equal-payment series capital recovery amount

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

= 10,00,000 ´ (A/P, 18%, 15) = 10,00,000 ´ (0.1964)

= Rs. 1,96,400

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

Uniform Gradient Series Annual Equivalent Amount

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

The corresponding cash flow diagram is shown in Fig.1.14

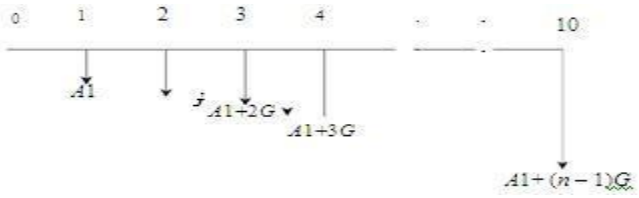

Fig.1.14 Cash flow diagram of uniform gradient series annual equivalent amount

The formula to compute A under this situation is

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

where

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

EXAMPLE 1.7 A person is planning for his retired life. He has 10 more years of service. Hewould like to deposit 20% of his salary, which is Rs. 4,000, at the end of the first year, and

thereafter he wishes to deposit the amount with an annual increase of Rs. 500 for the next 9 years with an interest rate of 15%. Find the total amount at the end of the 10th year of the above series.

Solution Here,

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

The cash flow diagram is shown in Fig.1.15

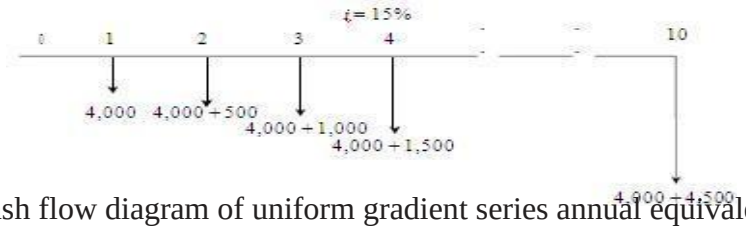

Fig.1.15 Cash flow diagram of uniform gradient series annual equivalent amount

$$A = A1 + G\frac{(1+i)^n - in - 1}{i(1+i)^n - i}$$

$= A1 + G(A/G, i, n)$
$= 4{,}000 + 500(A/G, 15\%, 10)$
$= 4{,}000 + 500 \times 3.3832$
$=$ Rs. 5,691.60

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

$F = A(F/A, i, n)$
$= A(F/A, 15\%, 10)$
$= 5{,}691.60(20.304)$
$=$ Rs. 1,15,562.25

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

UNIT 2
PRESENT WORTH COMPARISON

INTRODUCTION

In this method of comparison, the cash flows of each alternative will be reduced to time zero by assuming an interest rate *i*. Then, depending on the type of decision, the best alternative will be selected by comparing the present worth amounts of the alternatives.

The sign of various amounts at different points in time in a cash flow diagram is to be decided based on the type of the decision problem.

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

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

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

REVENUE-DOMINATED CASH FLOW DIAGRAM

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

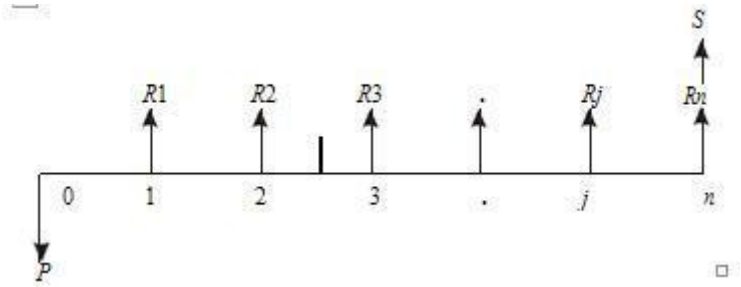

Fig. 4.1 Revenue-dominated cash flow diagram

In Fig. 4.1, *P* represents an initial investment and *Rj* the net revenue at the end of the *j*th year. The interest rate is *i*, compounded annually. *S* is the salvage value at the end of the *n*th year.

To find the present worth of the above cash flow diagram for a given interest rate, the formula is

$$PW(i) = -P + R1[1/(1+i)^{1}] + R2[1/(1+i)^{2}] + \ldots$$
$$+ Rj[1/(1+i)^{j}] + Rn[1/(1+i)^{n}] + S[1/(1+i)^{n}]$$

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

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

COST-DOMINATED CASH FLOW DIAGRAM

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

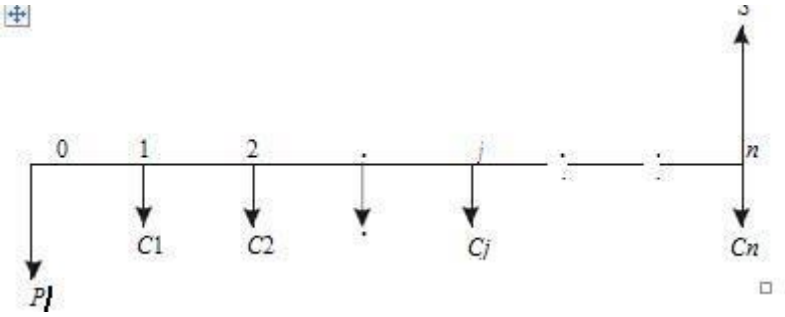

Fig. 4.2 Cost-dominated cash flow diagram

In Fig. 4.2, *P* represents an initial investment, *Cj* the net cost of operation and maintenance at the end of the *j*th year, and *S* the salvage value at the end of the *n*th year.

To compute the present worth amount of the above cash flow diagram for a given interest rate *i*, we have the formula

$$PW(i) = P + C1[1/(1+i)^1] + C2[1/(1+i)^2] + \ldots + Cj[1/(1+i)^j] + Cn[1/(1+i)^n] - S[1/(1+i)^n]$$

In the above formula, the expenditure is assigned a positive sign and the revenue a negative sign. If we have some more alternatives which are to be compared with this alternative, then the corresponding present worth amounts are to be computed and compared. Finally, the alternative with the minimum present worth amount should be selected as the best alternative.

EXAMPLES

In this section, the concept of present worth method of comparison applied to the selection of the best alternative is demonstrated with several illustrations.

EXAMPLE 4.1 Alpha Industry is planning to expand its production operation. It hasidentified three different technologies for meeting the goal. The initial outlay and annual revenues with respect to each of the technologies are summarized in Table 4.1. Suggest the best technology which is to be implemented based on the present worth method of comparison assuming 20% interest rate, compounded annually.

Table 4.1

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

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

TECHNOLOGY 1

Initial outlay, P = Rs. 12,00,000 Annual revenue, A = Rs. 4,00,000

Interest rate, i = 20%, compounded annually Life of this technology, n = 10 years

The cash flow diagram of this technology is as shown in Fig. 4.3.

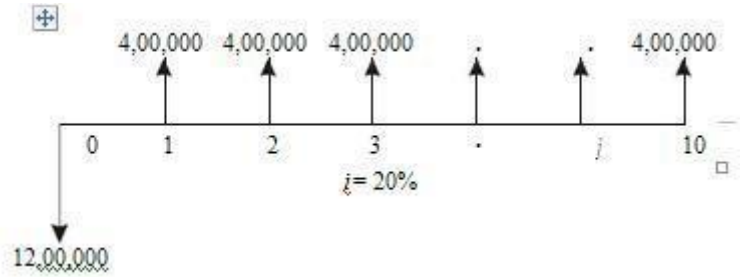

Fig. 4.3 Cash flow diagram for technology 1

The present worth expression for this technology is

$$PW(20\%)_1 = -12,00,000 + 4,00,000 \times (P/A, 20\%, 10)$$
$$= -12,00,000 + 4,00,000 \times (4.1925)$$
$$= -12,00,000 + 16,77,000$$
$$= \text{Rs. } 4,77,000$$

TECHNOLOGY 2

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

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

Interest rate, i = 20%, compounded annually

Life of this technology, n = 10 years

The cash flow diagram of this technology is shown in Fig. 4.4.

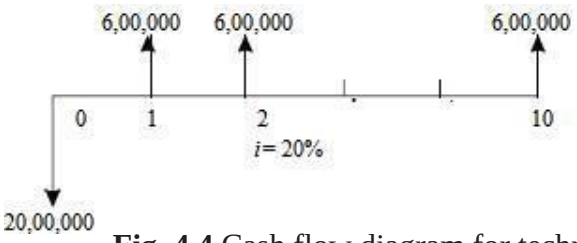

Fig. 4.4 Cash flow diagram for technology 2

The present worth expression for this technology i

$$PW(20\%)_2 = -20,00,000 + 6,00,000 \times (P/A, 20\%, 10)$$
$$= -20,00,000 + 6,00,000 \times (4.1925)$$
$$= -20,00,000 + 25,15,500 = \text{Rs. } 5,15,500$$

TECHNOLOGY 3

Initial outlay, P = Rs. 18,00,000 Annual revenue, A = Rs. 5,00,000

Interest rate, i = 20%, compounded annually Life of this technology, n = 10 years

The cash flow diagram of this technology is shown in Fig. 4.5.

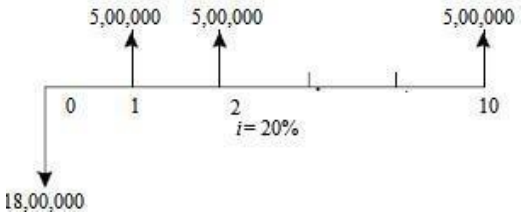

Fig. 4.5 Cash flow diagram for technology 3

The present worth expression for this technology is

$$PW(20\%)_3 = -18,00,000 + 5,00,000 \times (P/A, 20\%, 10)$$
$$= -18,00,000 + 5,00,000 \times (4.1925)$$
$$= -18,00,000 + 20,96,250$$
$$= \text{Rs. } 2,96,250$$

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

EXAMPLE 4.2 An engineer has two bids for an elevator to be installed in a new building. Thedetails of the bids for the elevators are as follows:

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

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

Solution

Bid 1: Alpha Elevator Inc.

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

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

Interest rate, i = 15%, compounded annually.

The cash flow diagram of bid 1 is shown in Fig. 4.6.

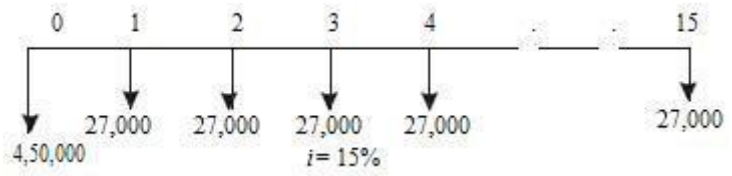

Fig. 4.6 Cash flow diagram for bid 1

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

$$PW(15\%) = 4,50,000 + 27,000(P/A, 15\%, 15)$$
$$= 4,50,000 + 27,000 \times 5.8474$$
$$= 4,50,000 + 1,57,879.80$$
$$= \text{Rs. } 6,07,879.80$$

Bid 2: Beta Elevator Inc.

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

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

Life = 15 years

Interest rate, *i* = 15%, compounded annually.

The cash flow diagram of bid 2 is shown in Fig. 4.7.

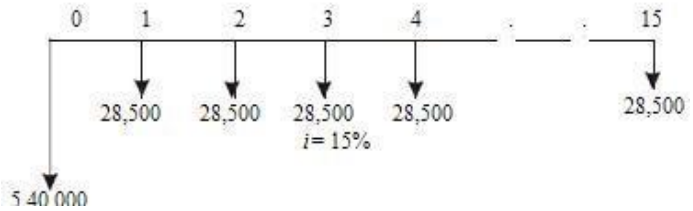

Fig. 4.7 Cash flow diagram for bid 2

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

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

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

EXAMPLE 4.3 Investment proposals A and B have the net cash flows as follows:

Proposal	*End of years*				
	0	1	2	3	4
A (Rs.)	–10,000	3,000	3,000	7,000	6,000
B (Rs.)	–10,000	6,000	6,000	3,000	3,000

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

Solution

Present worth of A at i = 18%. The cash flow diagram of proposal A is shown in Fig. 4.8.

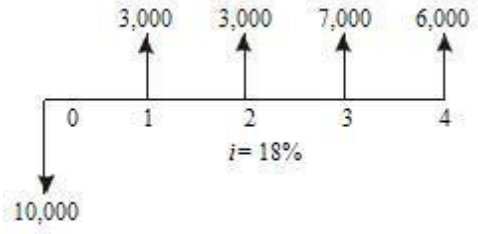

Fig. 4.8 Cash flow diagram for proposal A

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

$$PW_A(18\%) = -10,000 + 3,000(P/F, 18\%, 1) + 3,000(P/F, 18\%, 2)$$
$$+ 7,000(P/F, 18\%, 3) + 6,000(P/F, 18\%, 4)$$
$$= -10,000 + 3,000\ (0.8475) + 3,000(0.7182)$$
$$+ 7,000(0.6086) + 6,000(0.5158)$$
$$= \text{Rs. } 2,052.10$$

Present worth of B at *i* = 18%. The cash flow diagram of the proposal B is shown in Fig. 4.9

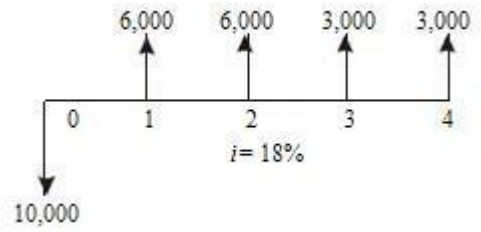

Fig. 4.9 Cash flow diagram for proposal B

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

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

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

EXAMPLE 4.4 A granite company is planning to buy a fully automated granite cuttingmachine. If it is purchased under down payment, the cost of the machine is Rs. 16,00,000. If it is purchased under installment basis, the company has to pay 25% of the cost at the time of purchase and the remaining amount in 10 annual equal installments of Rs. 2,00,000 each. Suggest the best alternative for the company using the present worth basis at *i* = 18%, compounded annually.

Solution There are two alternatives available for the company:

1. Down payment of Rs. 16,00,000
2. Down payment of Rs. 4,00,000 and 10 annual equal installments of Rs. 2,00,000 each

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

$$PW_A(18\%) = -10,000 + 3,000(P/F, 18\%, 1) + 3,000(P/F, 18\%, 2) + 7,000(P/F, 18\%, 3) + 6,000(P/F, 18\%, 4)$$
$$= -10,000 + 3,000\ (0.8475) + 3,000(0.7182) + 7,000(0.6086) + 6,000(0.5158)$$
$$= \text{Rs. } 2,052.10$$

Present worth of B at *i* = 18%. The cash flow diagram of the proposal B is shown in Fig. 4.9

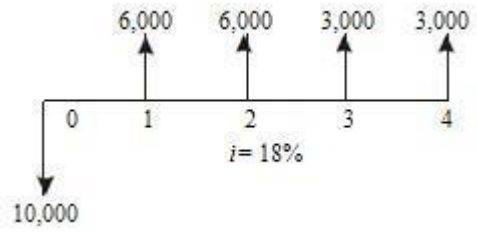

Fig. 4.9 Cash flow diagram for proposal B

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

$$PW_B(18\%) = -10,000 + 6,000(P/F, 18\%, 1) + 6,000(P/F, 18\%, 2) + 3,000(P/F, 18\%, 3) + 3,000(P/F, 18\%, 4)$$
$$= -10,000 + 6,000(0.8475) + 6,000(0.7182)$$

+ 3,000(0.6086) + 3,000(0.5158)

= Rs. 2,767.40

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

EXAMPLE 4.4 A granite company is planning to buy a fully automated granite cuttingmachine. If it is purchased under down payment, the cost of the machine is Rs. 16,00,000. If it is purchased under installment basis, the company has to pay 25% of the cost at the time of purchase and the remaining amount in 10 annual equal installments of Rs. 2,00,000 each. Suggest the best alternative for the company using the present worth basis at *i* = 18%, compounded annually.

Solution There are two alternatives available for the company:

Down payment of Rs. 16,00,000

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

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

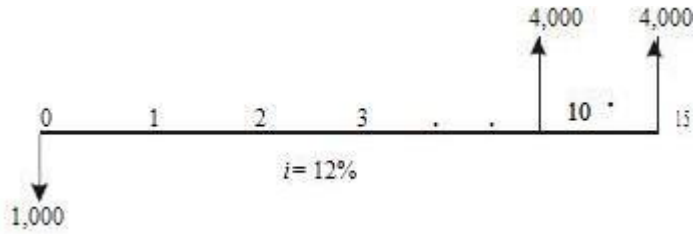

Fig. 4.12 Cash flow diagram for plan 2

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

$PW(12\%) = -1{,}000 + 4{,}000(P/F, 12\%, 10) + 4{,}000(P/F, 12\%, 15)$

$= -1{,}000 + 4{,}000(0.3220) + 4{,}000(0.1827)$

= Rs. 1,018.80

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

EXAMPLE 4.6 Novel Investment Ltd. accepts Rs. 10,000 at the end of every year for 20 yearsand pays the investor Rs. 8,00,000 at the end of the 20th year. Innovative Investment Ltd. accepts Rs. 10,000 at the end of every year for 20 years and pays the investor Rs. 15,00,000 at the end of the 25th year. Which is the best investment alternative? Use present worth base with i = 12%.

Solution: Novel Investment Ltd's plan.The cash flow diagram of NovelInvestment Ltd's plan isshown in Fig. 4.13.

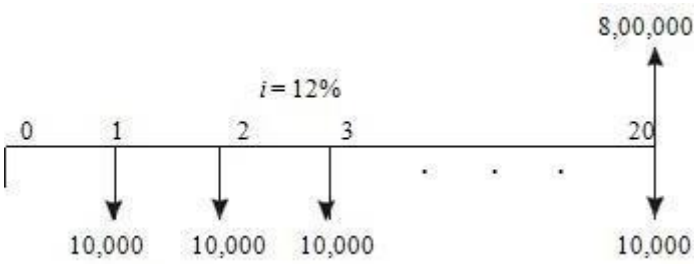

Fig. 4.13 Cash flow diagram for Novel Investment Ltd

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

PW(12%) = –10,000(P/A, 12%, 20) + 8,00,000(P/F, 12%, 20)

= –10,000(7.4694) + 8,00,000(0.1037)

= Rs. 8,266

Innovative Investment Ltd's plan. The cash flow diagram of the Innovative Investment Ltd's plan is illustrated in Fig. 4.14.

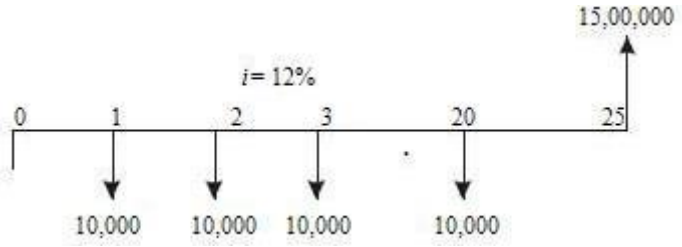

Fig. 4.14 Cash flow diagram for Innovative Investment Ltd.

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

PW(12%) =–10,000(*P*/*A*, 12%, 20) + 15,00,000(*P*/*F*, 12%, 25)

= –10,000(7.4694) + 15,00,000(0.0588)

= Rs. 13,506

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

EXAMPLE 4.7 A small business with an initial outlay of Rs. 12,000 yields Rs. 10,000 duringthe first year of its operation and the yield increases by Rs. 1,000 from its second year of operation up to its 10th year of operation. At the end of the life of the business, the salvage value is zero. Find the present worth of the business by assuming an interest rate of 18%, compounded annually.

Solution

Initial investment, P = Rs. 12,000

Income during the first year, A = Rs. 10,000

Annual increase in income, G = Rs. 1,000

n = 10 years

i = 18%, compounded annually

The cash flow diagram for the small business is depicted in Fig. 4.15.

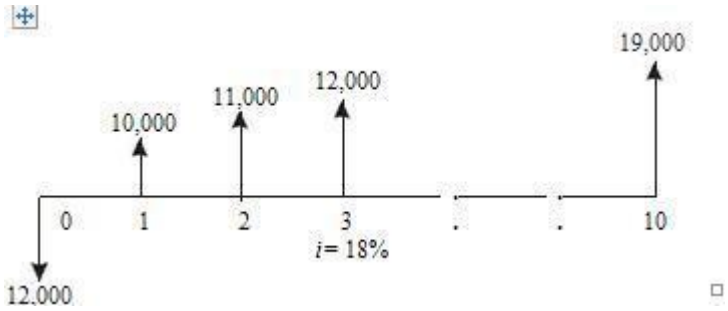

Fig. 4.15 Cash flow diagram for the small business

The equation for the present worth is

PW(18%) = –12,000 + (10,000 + 1,000 ´ (A/G, 18%, 10)) ´ (P/A, 18%, 10)

= –12,000 + (10,000 + 1,000 ´ 3.1936) ´ 4.4941

= –12,000 + 59,293.36

= Rs. 47,293.36

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

UNIT 3
ANNUAL EQUIVALENT METHOD

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

REVENUE-DOMINATED CASH FLOW DIAGRAM
A generalized revenue-dominated cash flow diagram to demonstrate the annual equivalent method of comparison is presented in Fig. 6.1.

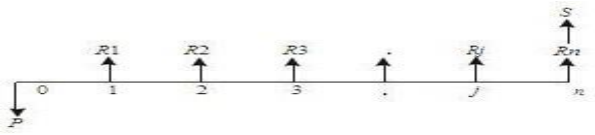

Fig. 6.1 Revenue-dominated cash flow diagram

In Fig. 6.1, *P* represents an initial investment, *Rj* the net revenue at the end of the *j*th year, and *S* the salvage value at the end of the *n*th year.

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

$$PW(i) = -P + R1/(1+i)^1 + R2/(1+i)^2 + \ldots + Rj/(1+i)^j + \ldots + Rn/(1+i)^n + S/(1+i)^n$$

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

In the second step, the annual equivalent revenue is computed using the following formula:

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

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

COST-DOMINATED CASH FLOW DIAGRAM
A generalized cost-dominated cash flow diagram to demonstrate the annual equivalent method of comparison is illustrated in Fig. 6.2.

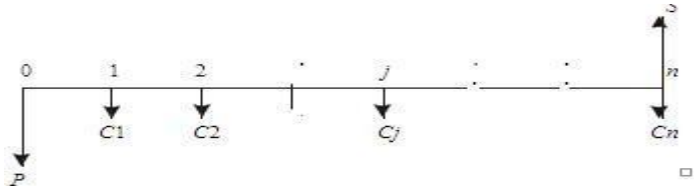

Fig. 6.2 Cost-dominated cash flow diagram

In Fig. 6.2, *P* represents an initial investment, *Cj* the net cost of operation and maintenance at the end of the *j*th year, and *S* the salvage value at the end of the *n*th year.

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

$$PW(i) = P + C1/(1+i)^1 + C2/(1+i)^2 + \ldots + Cj/(1+i)^j + \ldots + Cn/(1+i)^n - S/(1+i)^n$$

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

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

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

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

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

ALTERNATE APPROACH

Instead of first finding the present worth and then figuring out the annual equivalent cost/revenue, an alternate method which is as explained below can be used. In each of the cases presented in Sections 6.2 and 6.3, in the first step, one can find the future worth of the cash flow diagram of each of the alternatives. Then, in the second step, the annual equivalent cost/revenue can be obtained by using the equation:

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

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

EXAMPLES

EXAMPLE 6.1: A company provides a car to its chief executive. The owner of the company isconcerned about the increasing cost of petrol. The cost per litre of petrol for the first year of operation is Rs. 21. He feels that the cost of petrol will be increasing by Re.1 every year. His experience with his company car indicates that it averages 9 km per litre of petrol. The executive expects to drive an average of 20,000 km each year for the next four years. What is the annual equivalent cost of fuel over this period of time?. If he is offered similar service with the same quality on rental basis at Rs. 60,000 per year, should the owner continue to provide company car for his executive or alternatively provide a rental car to his executive? Assume i = 18%. If the rental car is preferred, then the company car will find some other use within the company.

Solution

Average number of km run/year = 20,000 km

Number of km/litre of petrol = 9 km

Therefore,

Petrol consumption/year = 20,000/9 = 2222.2 litre

Cost/litre of petrol for the 1st year = Rs. 21

Cost/litre of petrol for the 2nd year = Rs. 21.00 + Re. 1.00 = Rs. 22.00

Cost/litre of petrol for the 3rd year = Rs. 22.00 + Re. 1.00 = Rs. 23.00

Cost/litre of petrol for the 4th year = Rs. 23.00 + Re. 1.00 = Rs. 24.00

Fuel expenditure for 1st year = 2222.2 ´ 21 = Rs. 46,666.20

Fuel expenditure for 2nd year = 2222.2 ´ 22 = Rs. 48,888.40

Fuel expenditure for 3rd year = 2222.2 ´ 23 = Rs. 51,110.60

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

The annual equal increment of the above expenditures is Rs. 2,222.20 (G). The cash flow diagram for this situation is depicted in Fig. 6.3.

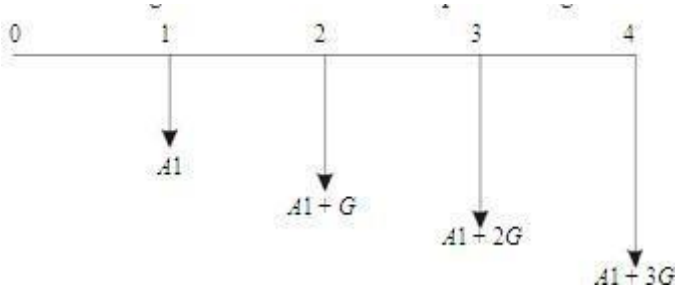

Fig. 6.3 Uniform gradient series cash flow diagram.

In Fig. 6.3, $A1$ = Rs. 46,666.20 and G = Rs. 2,222.20

$$A = A1 + G(A/G, 18\%, 4)$$
$$= 46,666.20 + 2222.2(1.2947)$$
$$= \text{Rs. } 49,543.28$$

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

EXAMPLE 6.2: A company is planning to purchase an advanced machine centre. Three originalmanufacturers have responded to its tender whose particulars are tabulated as follows:

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

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

Solution Alternative 1

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

Yearly equal installment, A = Rs. 2,00,000n = 15 years i = 20%, compounded annually

The cash flow diagram for manufacturer 1 is shown in Fig. 6.4.

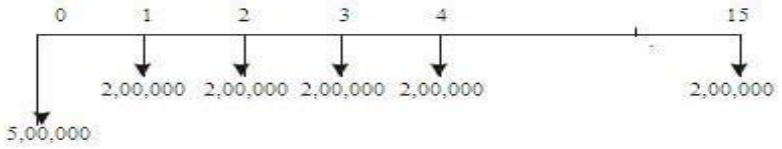

Fig. 6.4 Cash flow diagram for manufacturer 1

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

$$AE_1(20\%) = 5{,}00{,}000(A/P, 20\%, 15) + 2{,}00{,}000$$
$$= 5{,}00{,}000(0.2139) + 2{,}00{,}000$$
$$= 3{,}06{,}950$$

Alternative 2

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

Yearly equal installment, A = Rs. 3,00,000n = 15 years i = 20%, compounded annually

The cash flow diagram for the manufacturer 2 is shown in Fig. 6.5.

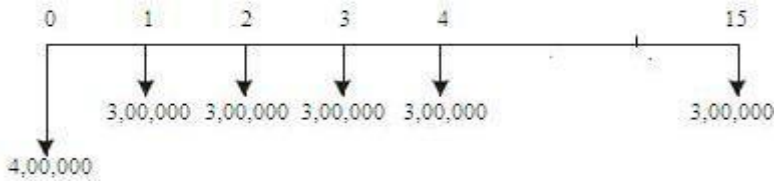

Fig. 6.5 Cash flow diagram for manufacturer 2

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

$$AE_2(20\%) = 4{,}00{,}000(A/P, 20\%, 15) + 3{,}00{,}000$$
$$= 4{,}00{,}000(0.2139) + 3{,}00{,}000$$
$$= \text{Rs. } 3{,}85{,}560.$$

Alternative 3

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

Yearly equal installment, A = Rs. 1,50,000n = 15 years i = 20%, compounded annually

The cash flow diagram for manufacturer 3 is shown in Fig. 6.6.

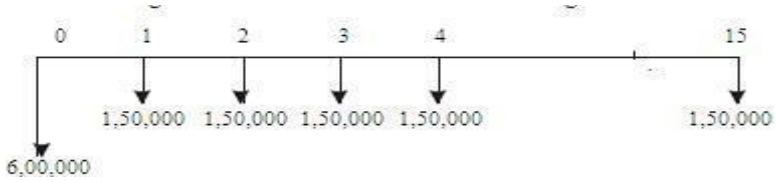

Fig. 6.6 Cash flow diagram for manufacturer 3

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

$$AE_3(20\%) = 6{,}00{,}000(A/P, 20\%, 15) + 1{,}50{,}000$$
$$= 6{,}00{,}000(0.2139) + 1{,}50{,}000$$
$$= \text{Rs. } 2{,}78{,}340.$$

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

EXAMPLE 6.3: A company invests in one of the two mutually exclusive alternatives. The lifeof both alternatives is estimated to be 5 years with the following investments, annual returns and salvage values.

	Alternative	
	A	B
Investment (Rs.)	−1,50,000	−1,75,000
Annual equal retum (Rs.)	+60,000	+70,000
Salvage value (Rs.)	+15,000	+35,000

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

Solution Alternative A

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

Annual equal return, A = Rs. 60,000

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

Life = 5 years

Interest rate, i = 25%, compounded annually

The cash flow diagram for alternative A is shown in Fig. 6.7.

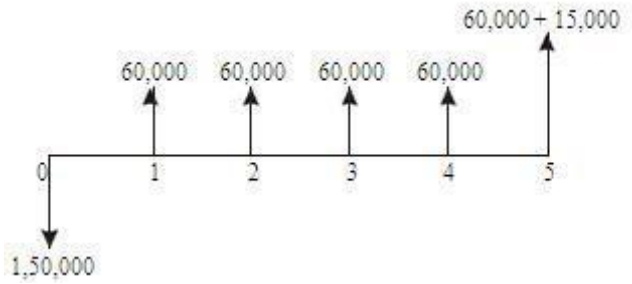

Fig. 6.7 Cash flow diagram for alternative A

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

$AE_A(25\%) = -1,50,000(A/P, 25\%, 5) + 60,000 + 15,000(A/F, 25\%, 5)$

$= -1,50,000(0.3718) + 60,000 + 15,000(0.1218)$

= Rs. 6,057

Alternative B

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

Annual equal return, A = Rs. 70,000

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

Life = 5 years

Interest rate, i = 25%, compounded annually

The cash flow diagram for alternative B is shown in Fig. 6.8.

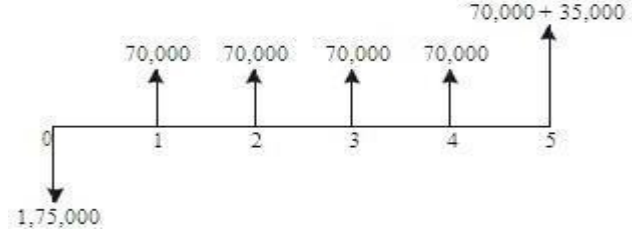

Fig. 6.8 Cash flow diagram for alternative B

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

$AE_B(25\%) = -1,75,000(A/P, 25\%, 5) + 70,000 + 35,000(A/F, 25\%, 5)$

$= -1,75,000(0.3718) + 70,000 + 35,000(0.1218)$

= Rs. 9,198

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

Company should select alternative B.

EXAMPLE 6.4: A certain individual firm desires an economic analysis to determine which ofthe two machines is attractive in a given interval of time. The minimum attractive rate of return for the firm is 15%. The following data are to be used in the analysis:

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

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

Solution Machine X

First cost, P = Rs. 1,50,000 Life, n = 12 years

Estimated salvage value at the end of machine life, S = Rs. 0. Annual maintenance cost, A = Rs. 0.

Interest rate, i = 15%, compounded annually.

The cash flow diagram of machine X is illustrated in Fig. 6.9.

Fig. 6.9 Cash flow diagram for machine X

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

$AE_X(15\%) = 1,50,000(A/P, 15\%, 12)$

$= 1,50,000(0.1845)$

= Rs. 27,675

Machine Y

First cost, P = Rs. 2,40,000 Life, n = 12 years

Estimated salvage value at the end of machine life, S = Rs. 60,000 Annual maintenance cost, A = Rs. 4,500

Interest rate, i = 15%, compounded annually.

The cash flow diagram of machine Y is depicted in Fig. 6.10.

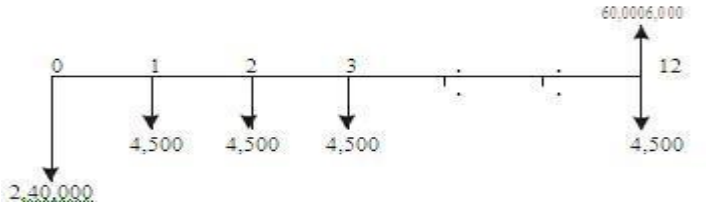

Fig. 6.10 Cash flow diagram for machine Y

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

$AE_Y(15\%) = 2,40,000(A/P, 15\%, 12) + 4,500–6,000(A/F, 15\%, 12)$

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

= Rs. 48,573

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

UNIT 4

RATE OF RETURN METHOD

INTRODUCTION

The rate of return of a cash flow pattern is the interest rate at which the present worth of that cash flow pattern reduces to zero. In this method of comparison, the rate of return for each alternative is computed. Then the alternative which has the highest rate of return is selected as the best alternative.

In this type of analysis, the expenditures are always assigned with a negative sign and the revenues/inflows are assigned with a positive sign.

A generalized cash flow diagram to demonstrate the rate of return method of comparison is presented in Fig. 7.1.

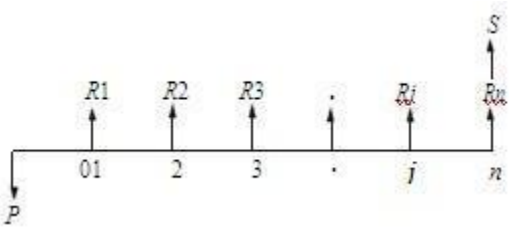

Fig. 7.1 Generalized cash flow diagram

In the above cash flow diagram, P represents an initial investment, Rj the net revenue at the end of the jth year, and S the salvage value at the end of the nth year.

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

$$PW(i) = -P + R1/(1+i)^1 + R2/(1+i)^2 + \ldots + Rj/(1+i)^j + \ldots + Rn/(1+i)^n + S/(1+i)^n$$

Now, the above function is to be evaluated for different values of i until the present worth function reduces to zero, as shown in Fig. 7.2.

In the figure, the present worth goes on decreasing when the interest rate is increased. The value of i at which the present worth curve cuts the X-axis is the rate of return of the given proposal/project. It will be very difficult to find the exact value of i at which the present worth function reduces to zero.

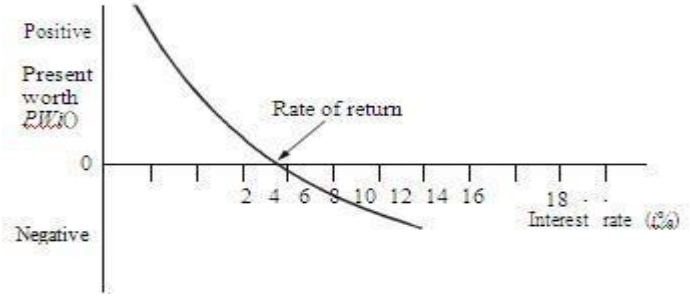

Fig. 7.2 Present worth function graph.

So, one has to start with an intuitive value of i and check whether the present worth function is positive. If so, increase the value of i until PW(i) becomes negative. Then, the rate of return is determined by interpolation method in the range of values of i for which the sign of the present worth function changes from positive to negative.

7.2 EXAMPLES

In this section, the concept of rate of return calculation is demonstrated with suitable examples.

EXAMPLE 7.1 A person is planning a new business. The initial outlay and cash flow pattern forthe new business are as listed below. The expected life of the business is five years. Find the rate of return for the new business.

Period	0	1	2	3	4	5
Cash flow (Rs.)	–1,00,000	30,000	30,000	30,000	30,000	30,000

Solution

Initial investment = Rs. 1,00,000 Annual equal revenue = Rs. 30,000 Life = 5 years

The cash flow diagram for this situation is illustrated in Fig. 7.3.

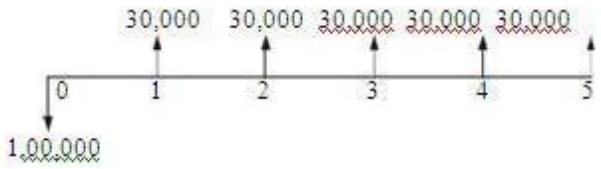

Fig. 7.3 Cash flow diagram

The present worth function for the business is

PW(i) = –1,00,000 + 30,000(P/A, i, 5)

When i = 10%,

PW(10%) = –1,00,000 + 30,000(P/A, 10%, 5)
= –1,00,000 + 30,000(3.7908)
= Rs. 13,724.

When i = 15%,

PW(15%) = –1,00,000 + 30,000(P/A, 15%, 5)
= –1,00,000 + 30,000(3.3522)
= Rs. 566.

When i = 18%,

PW(18%) = –1,00,000 + 30,000(P/A, 18%, 5)
= –1,00,000 + 30,000(3.1272)
= Rs. – 6,184

$$i = 15\% + \frac{566 - 0}{566 - (-6184)} (3\%)$$
$$= 15\% + 0.252\%$$
$$= 15.252\%$$

Therefore, the rate of return for the new business is 15.252%.

EXAMPLE 7.2 A Company is trying to diversify its business in a new product line. The life ofthe project is 10 years with no salvage value at the end of its life. The initial outlay of the project is Rs. 20,00,000. The annual net profit is Rs. 3,50,000. Find the rate of return for the new business.

Solution

Life of the product line (n) = 10 years
Initial outlay = Rs. 20,00,000
Annual net profit = Rs. 3,50,000
Scrap value after 10 years = 0
The cash flow diagram for this situation is shown in Fig. 7.4.

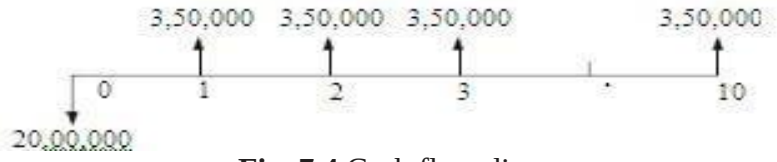

Fig. 7.4 Cash flow diagram

The formula for the net present worth function of the situation is

PW(i) = –20,00,000 + 3,50,000(P/A, i, 10)

When i = 10%,

PW(10%) = –20,00,000 + 3,50,000(P/A, 10%, 10)
= –20,00,000 + 3,50,000(6.1446)
= Rs. 1,50,610.

When i = 12%,

PW(12%) = –20,00,000 + 3,50,000(P/A, 12%, 10) = –20,00,000 + 3,50,000(5.6502)

$$i = 10\% + \frac{1,50,610}{1,50,610 - (-22,430)} (2\%)$$

= 11.74 %

Therefore, the rate of return of the new product line is 11.74%

EXAMPLE 7.3 A firm has identified three mutually exclusive investment proposals whosedetails are given below. The life of all the three alternatives is estimated to be five years with negligible salvage value. The minimum attractive rate of return for the firm is 12%.

	Alternative		
	A1	*A2*	*A3*
Investment	Rs. 1,50,000	Rs. 2,10,000	Rs. 2,55,000
Annual net income	Rs. 45,570	Rs. 58,260	Rs. 69,000

Solution Calculation of rate of return for alternative A1

Initial outlay = Rs. 1,50,000
Annual profit = Rs. 45,570
Life = 5 years
The cash flow diagram for alternative A1 is shown in Fig. 7.5.

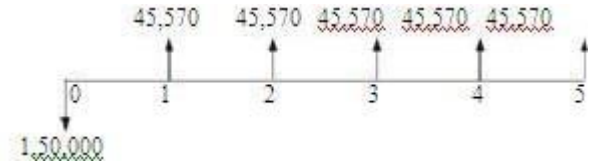

Fig. 7.5 Cash flow diagram for alternative A1.

The formula for the net present worth of alternative A1 is given as

PW(i) = –1,50,000 + 45,570(P/A, i, 5)

When i = 10%,

PW(10%) = –1,50,000 + 45,570(P/A, 10%, 5)
= –1,50,000 + 45,570(3.7908)

= Rs. 22,746.76

When i = 12%,

PW(12%) = –1,50,000 + 45,570(P/A, 12%, 5)

= –1,50,000 + 45,570(3.6048)

= Rs. 14,270.74

When i = 15%,

PW(15%) = –1,50,000 + 45,570(P/A, 15%, 5)

= –1,50,000 + 45,570(3.3522)

= Rs. 2,759.75

When i = 18%,

PW(18%) = –1,50,000 + 45,570(P/A, 18%, 5)

= –1,50,000 + 45,570(3.1272)

= Rs. –7,493.50

Therefore, the rate of return of the alternative A1 is

$$i = 15\% + \frac{2{,}759.75 - 0}{2{,}759.75 - (-7{,}493.5 \times (3\%) - 0)}$$

$$= 15\% + 0.81\%$$

$$= 15.81\%$$

Calculation of rate of return for alternative A2

Initial outlay = Rs. 2,10,000

Annual profit = Rs. 58,260

Life of alternative A2 = 5 years

The cash flow diagram for alternative A2 is shown in Fig. 7.6.

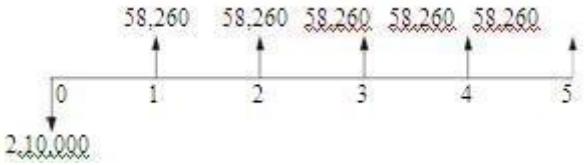

Fig. 7.6 Cash flow diagram for alternative A2

The formula for the net present worth of this alternative is

PW(i) = –2,10,000 + 58,260(P/A, i, 5) When i = 12%,

PW(12%) = –2,10,000 + 58,260(P/A, 12%, 5)

= –2,10,000 + 58,260(3.6048)

= Rs. 15.65

When i = 13%,

PW(13%) = –2,10,000 + 58,260(P/A, 13%, 5)

= –2,10,000 + 58,260(3.5172)

= Rs. –5,087.93

Therefore, the rate of return of alternative A2 is

$$i = 12\% + \frac{15.65 - 0}{15.65 - (-5,087.93)} \times (1\%)$$

$$= 12\% + 0\%$$

$$= 12\%$$

Calculation of rate of return for alternative A3

Initial outlay = Rs. 2,55,000

Annual profit = Rs. 69,000

Life of alternative A3 = 5 years

The cash flow diagram for alternative A3 is depicted in Fig. 7.7.

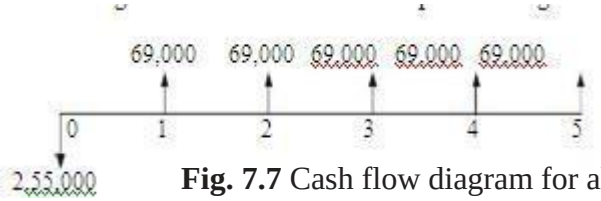

Fig. 7.7 Cash flow diagram for alternative A3

The formula for the net present worth of this alternative A3 is

PW(i) = –2,55,000 + 69,000(P/A, i, 5) When i = 11%,

PW(11%) = – 2,55,000 + 69,000(P/A, 11%, 5)

= – 2,55,000 + 69,000(3.6959)

= Rs. 17.1

When i = 12%,

PW(12%) = – 2,55,000 + 69,000(P/A, 12%, 5)

= – 2,55,000 + 69,000(3.6048)

= Rs. – 6,268.80

Therefore, the rate of return for alternative A3 is

$$i = 11\% + \frac{171. - 0}{17.1 - (-6,26880.)} \times 1\%$$

$$= 11\%$$

The rates of return for the three alternatives are now tabulated.

Alternative	*A1*	*A2*	*A3*
Rate of return	15.81%	12%	11%

From the above data, it is clear that the rate of return for alternative A3 is less than the minimum attractive rate of return of 12%. So, it should not be considered for comparison. The remaining two alternatives are qualified for consideration. Among the alternatives A1 and A2, the rate of return of alternative A1 is greater than that of alternative A2. Hence, alternative A1 should be selected.

EXAMPLE 7.4 For the cash flow diagram shown in Fig. 7.8, compute the rate of return. Theamounts are in rupees.

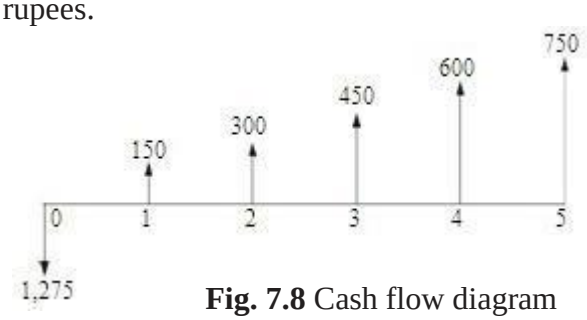

Fig. 7.8 Cash flow diagram

Solution For the positive cash flows of the problem,

A1 = Rs. 150, G = Rs. 150

The annual equivalent of the positive cash flows of the uniform gradient series is given

by A = A1 + G(A/G, i, n)

= 150 + 150(A/G, i, 5)

The formula for the present worth of the whole diagram = –1,275 + [150 + 150(A/G, i, 5)] ´ (P/A, i, 5)

PW(10%) = –1,275 + [150 + 150(A/G, 10%, 5)] ´ (P/A, 10%, 5)

= –1,275 + [150 + 150(1.8101)] ´ (3.7908)

= Rs. 322.88

PW(12%) = –1,275 + [150 + 150(A/G, 12%, 5)] ´ (P/A, 12%, 5)

= –1,275 + [150 + 150(1.7746)] ´ (3.6048)

= Rs. 225.28

PW(15%) = –1,275 + [150 + 150(A/G, 15%, 5)] ´ (P/A, 15%, 5)

= –1,275 + [150 + 150(1.7228)] ´ (3.3522)

= Rs. 94.11

PW(18%) = –1,275 + [150 + 150(A/G, 18%, 5)] ´ (P/A, 18%, 5)

= –1,275 + [150 + 150(1.6728)] ´ (3.1272)

= Rs. –21.24

Therefore, the rate of return for the cash flow diagram is $i = 15\% + \frac{94.11 - 0}{94.11 - (-21.24)} \times 3\% = 15\% + 2.45\% = 17.45\%$

UNIT 5
ESTIMATING AND COSTING

INTRODUCTION:

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

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

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

The essentials of an estimate are:

(a). The drawings – plans, elevations and sections of the work;

(b). Specifications indicating the nature and class of work and materials to be employed;

(c). The local rates at which different types of work can be executed. The designs of an engineer will be of little use of he is not able to give an idea of cost.

NEED FOR ESTIMATING AND COSTING:

Following points illustrate the need for estimation and costing:

1. For determining the cost of production: Estimating and costing provides reliable data regarding expenditure on materials, wages and other things which helps in determining the cost of production precisely.
2. For controlling the costs: It provides the cost for each product, process, job, department etc., which helps in identifying profitable and non-profitable areas in the organization. This guides the management to take corrective measures of their non-profitable activities. It helps in reducing the total manufacturing cost. It helps to reduce material wastages and control labour wages.
3. For fixing selling price: Costing provides information for fixing the selling price of the product. The cost and volume of production, profit and break-even analysis serves as a basis for determining the selling price of the product.
4. For preparing the quotations and submitting tenders: A quotation is the information regarding the selling price of a product or service offered to a prospective buyer. A

tender is the information regarding the selling price given to a prospective buyer, but given in a sealed envelope. The principles of costing help immensely in preparing quotations and submitting tenders.

5. For specific managerial decisions: Costing provides invaluable information for taking the managerial decisions like – make or buy, whether to own fixed assets or buy them, whether to replace the existing machinery before its useful life, etc. Costing also provides information on wage incentive plans, cost control measures for materials and supplies, budget and budgetary control, etc.
6. It helps in formulating the policies of the concern for changing prices of the products.
7. It helps in making the product more economical by incorporating suitable changes in the design.

ESTIMATING PROCEDURE:

(i). Production planning department:

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

(b). Make out the drawings:

Lays down the method of manufacturing and required operations Machines to beused Labour rates

Accuracy and finish required

Prepare a list of components of the product Make or buy decision

(ii). Determine the material cost

(iii). Determine the time required for various operations (iv). Determine labour cost

(v). Determine prime cost = Direct expenses + direct material cost + direct labour cost

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

(vii). Determine the administrative overheads (viii). Determine the packing and delivery charge (ix). Determine the total cost

(x). Determine the selling price = total cost + profit (xi). Decide the discount allowed to the distributors (xii). Decide delivery time

COMPONENTS OR ELEMENTS OF COST:

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

1. Material cost
   (a). Direct material cost (b). Indirect material cost
2. Labour cost
   (a). Direct labour cost (b). Indirect labour cost
3. Expenses
   (a). Direct expenses (b). Indirect expenses or overheads or on cost

Figure 1 shows the elements of product cost.

Direct material cost:

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

cupboards, etc.

Indirect material cost:

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

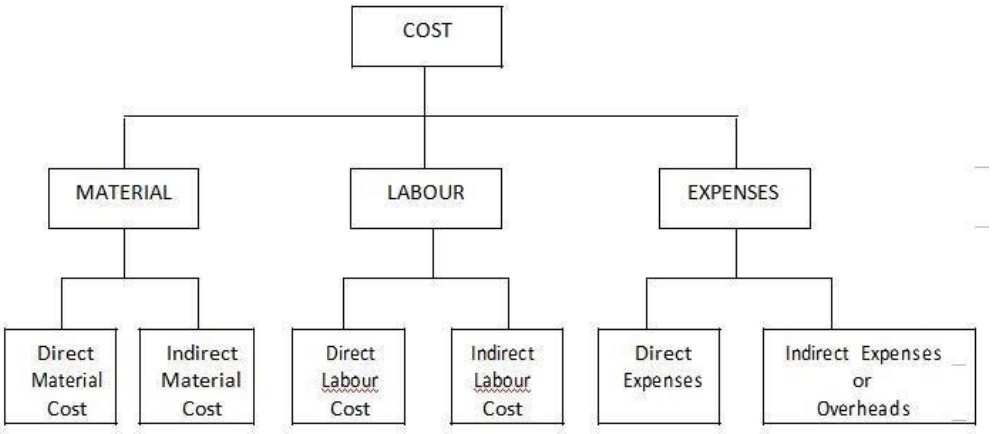

Figure 1: Elements of Product cost

Calculation of material cost:

The method is as follows:

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

Direct labour cost:

Direct or productive labours are the workers who actually involve either manually or with the aid

of machines in manufacturing components using different materials. The nature of their duties is such that their wages may be directly related to the job they are manufacturing. Direct labour include the workers operating various production machines in machine shop, welding shop, fitting shop, assembly shop, etc.

Direct labour cost consists of wages paid to the workers directly engaged in the manufacturing of a product. It also includes the wages paid to the workers engaged in handling the product within the department. Example: wages paid to the machinist, turner, fitter, welder, moulder, etc.

Indirect labour cost:

It consists of wages paid to the workers who are indirectly helpful for the production. In other words, it is the wages paid to the labourwho help the direct labour in performing their duties. Indirect labour cost cannot be associated directly to a particular job, but are charged on the whole log of products produced in the plant during a particular period. Example: wages paid to supervisor, inspector, sweeper, helper, loader, watchman, store keeper, crane driver, etc.

Calculation of Direct labour cost:

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

a) Set up time: It is the time required to set and fix the tools and jobs on the machine. It includes time to study drawings, blue prints, to set machines, to study job, etc. It is independent of the number of jobs produced.
b) Operation time or cutting time or floor to floor time: It is the time required to carry out specific operations on machines. It includes both work handling and machining times.
c) Tear-down time: It is the time considered from the moment, the last operation has been completed.
d) Miscellaneous allowances:
    i. Personal allowances: It is the time allowance given to a worker to attend his personal needs. It is about 5% of the total working time.
    Fatigue allowances: Excessive and continuous work, improper illumination, excessive machine noise, etc. lead to fatigue. To maintain the efficiency of the worker, about 5% of the total working time is allotted as fatigue allowance.
    iii. Tool changing and grinding allowances: It is the time allowance given to remove the tool from holder, to fix another tool, etc. It is nearly 5-10% of the total working time.
e) Measurement and checking allowances: It includes time taken for measuring and checking different dimensions of the product. It is generally taken as 2-3% of the total working time.
f) Other allowances: They include time taken for periodic cleaning, oiling and lubrication, procuring inventory, disposing scraps and surplus stocks, etc. This allowance may sometimes as high as 15-20% of the operation time.

Expenses:

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

Direct expenses:

These are the expenses which are directly charged to a particular job and are incurred for that specific job only. Direct expenses are identified and allocated to persons and materials involved in that job. Example: cost of preparing designs and drawings, cost of manufacturing jigs and fixtures for a particular product, cost of patterns, moulding boxes, dies, cost of consultancy charges for the design and manufacture of a specific product, etc.

Indirect expenses:

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

Indirect expenses can be classified as given below:

Production or Factory overheads:

They include all the expenditure made on the actual operation of the product in the plant like indirect material and indirect labour. They are also known as works on cost.

Some of the expenses charged under factory overheads are as follows:

i. Cost of indirect materials or consumables such as grease, coolants, cotton waste, etc.
ii. Indirect labour wages paid to foreman, inspectors, sweepers, helpers, watchman, etc.
iii. Factory rent and lighting, water, fuel, power, internal transport, maintenance charges.
iv. Insurance of plant and factory.
v. Depreciation on machinery, factory, plant.
vi. Stationery consumed in the factory.
vii. Works canteen and labour welfare activities expenses.

Administrative expenses:

These expenses include the following:

i. Salaries to MD, GM, personal manager, medical officer, finance manager, secretary and staff.
ii. Expenses incurred on legal, banking and audit charges.
iii. Telephone, telegraph, postal charges.
iv. Printing and stationary for office.
v. Office rent, repair and depreciation charges.
vi. Office lighting and power charges.
vii. Insurance of office building and equipment.

Selling and distribution overheads:

These expenses include the following:

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

R & D overheads:

These expenses include the following:

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

SELLING PRICE OF THE PRODUCT:

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

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

Prime cost or Direct cost = Direct material cost + Direct labour cost + Direct Expenses b).**Factory cost or Works cost:** It consists of prime cost and factory expenses.

Factory cost or Works cost = Prime cost + factory expenses (production overheads) c). **Office cost or Manufacturing cost or Production cost or Grosscost:**

It consists of factory and administrative overheads.

Office cost or Gross cost = Factory cost + Office and Administrative overheads d). **Total cost or Selling cost:**

It consists of office cost and selling and distribution expenses.

Total cost or selling cost = Office cost or Gross cost + selling and distribution overheads e). **Selling Price:**

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

Selling price = Total cost + Profit

Figure 2 shows the various elements of cost and determination of selling price of a product.

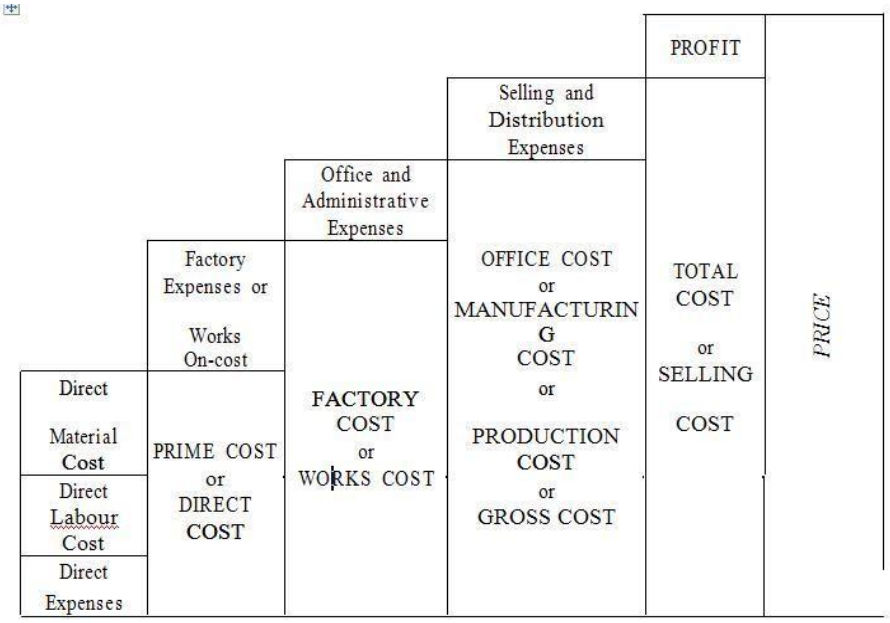

Figure 2: Determination of selling price of the product

FIXED and VARIABLE COSTS:

Fixed costs remain constant irrespective of the volume of production. They remain the same whether the production is smaller, larger or nil. Examples for fixed costs are: costs on land, building, salaries to top management, rent of building and insurance, depreciation, taxes on property, interest on the invested capital, etc.

Variable costs vary with the volume of production. Variable costs are the function of the output. Higher the production, higher will be the production costs. Variable costs become zero when the production is stopped. Prime costs are generally variable costs. Examples for variable costs are: power or fuel consumed costs of raw materials, labour, packing costs, transportation of finished goods, etc.

ALLOCATION OF OVERHEADS:

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

follows:

i. **Percentage on Prime cost:**

The total overhead or on-cost is expressed as a percentage of prime cost. This percentage is charged on each job being manufactured.

This method is more suitable when both direct material and direct labour costs are almost same and where only one type of product is being manufactured.

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

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

ii. **Percentage on direct material cost:**

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

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

iii. **Percentage on direct labour cost:**

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

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

iv. **Man hour or Labour hour rate:**

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

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

v. **Machine hour rate:**

On-cost is expressed based on the total productive machine hours. The total overheads are distributed over a group of similar machines as explained below:

Building rents, taxes, insurance, lighting charges, indirect material and labour costs aredistributed based on the floor area occupied by the machines. Power consumed and depreciation charges are measured separately.

The expenses of wages paid for the machine idle periods is separately charged from the profit and loss account and not considered in the overheads.

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

vi. **Combination of man hour and machine hour rate:**

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

vii. **Unit rate method or production unit basis method:**

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

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

METHOD OF COSTING:

The methods of costing that are commonly used to assist the determination of selling price of a product are listed below. The method differs according to the nature of business and types of

products manufactured.

i. Job costing and Order costing iv. Departmental costing

ii. Process costing v. Unit cost

iii. Operating cost method

Job costing or Order costing:

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

Process costing:

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

Operating cost:

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

Departmental costing:

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

Unit cost:

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

MARGINAL COST:

Marginal cost of a product is the cost of producing an additional unit of that product. It is an extra cost incurred for every unit increase in production. It is assumed that fixed costs remain unchanged by increasing output by one more unit; marginal cost of a product will consists of the variable costs only. Let the cost of producing 20 units of a product be Rs. 10000 and the cost of producing 21 units of the same product be Rs. 10045, then the marginal cost of producing the 21^{st} unit is Rs. 45.

MARGINAL REVENUE:

Marginal revenue of a product is the incremental revenue of selling an additional unit of that product. Let the revenue of selling 20 units of a product be Rs. 15000 and the revenue of selling 21 units of the same product be Rs. 15085, then the marginal revenue of selling the 21^{st} unit is Rs. 85.

SUNK COST:

This is known as the past cost of an equipment or asset. Assume that an equipment has been purchased for Rs. 100000 about three years back. If it is considered for replacement, then its

present value will not be equal to Rs. 100000. Instead, its present market value should be taken as the present value of the equipment for further analysis. So, the purchase value of the equipment in the past is known as its sunk cost.

OPPORTUNITY COST or ALTERNATIVE COST:

In practice, if an alternative X is selected from a set of competing alternatives (X,Y), then the Corresponding investment in the selected alternative is not available for any other purpose. If the same money is invested in some other alternative Y, it may fetch some return. Since the money invested in the selected alternative X, one has to forego the return from the other alternative Y. the amount that is foregone by not investing in the other alternative Y is known as opportunity cost of the selected alternative X. So the opportunity cost of an alternative is the return that will be foregone by not investing the same money in other alternative.

OPERATING and MAINTENANCE & ALTERATION COSTS:

Operating costs are incurred in operating the facility throughout its operational life and involve such commitments such as facility supervision, labour for common services, indirect materials, tools and fixture, management overhead, associated space provision costs and support services, facility cleaning and functional use cost, etc. facility operating expenditures can be treated as a direct or indirect variable cost.

Maintenance and alteration costs are incurred to maintain facility at its designed (or updated) utilization and performance level with an acceptable degree of reliability. It include costs related to scheduled and unscheduled repairs and replacements, downtime costs of lost production during preventive maintenance, cost of drop in performance levels of aging components, spares inventory, depreciation, taxes, etc. Maintenance and alterations costs can be treated as either fixed or variable costs.

STANDARD COSTING:

It is a predetermined or budgeted cost which is calculated from management standards of efficient operation and economical expenditures. Standard costs are built upon theoretical desired standards that an industry is capable of attaining under practical and professional operating conditions. The standards are decided by using past experiences and with the help of time and motion study, process charts, therbligs, etc.

Standard cost represents the best estimate that can be made of; what cost should be for material, labour and overheads after eliminating inefficiencies and waste. Standard costing is an important activity to determine the efficiency of cost controlling in an industry. The actual cost is compared with the standard cost to find the differences which is commonly known as variance. If the actual cost is more than the standard cost, corrective measures are taken to reduce the cost of production.

Standard costs are calculated separately for each cost element like material, labour, overheads, etc. The actual costs incurred are then calculated. Standard costs are compared with the actual costs to find out the difference called variance. The variances are analyzed to find out the reasons. The analysis results are then conveyed to the management for further actions.

Standard cost detects wastage of time, material and labour, helps in formulating policies,

fixing selling price, controlling costs and budgeting. It also helps in establishing efficiency of each department as well as that of entire organization.

Standard costing depends more on theory than on practicalities. It cannot accurately take into account the miscellaneous expenditure. It is not suited to industries that produce non-standardized products. Moreover, it is difficult to choose appropriate standards for each cost centre.

FIRST COST: It is same as Prime cost.

BREAK EVEN ANALYSIS:

It is an algebraic or graphical model which relates costs and revenues for different volumes of production. The main aim of break even analysis is to find the cut-off production volume from where a firm will make profit. It clearly demarcates the line between profit and loss. Some of the important assumptions to be made in the break even analysis are as follows:

(i). All costs (fixed or variable) and volumes are known.
(ii). There exists a linear relationship between cost and volume.
(iii). Production matches sales quantity i.e. all output can be sold.

TERMINOLOGY IN BREAK-EVEN ANALYSIS:

Fixed cost (FC):

It doesn't change with production volume or output. For example: cost of land and buildings, salaries of top management, insurance, depreciation, taxes on property, equipment, etc.

Variable cost (VC):

It changes depending on the output volume. For example: cost of raw materials, labour, transportation charges, packaging cost, etc.

If s is the selling price per unit, v is the variable cost per unit, FC is the fixed cost per period, Q is the volume of production, then,

Total Sales Revenue (sales) of the firm, S = s.Q in Rupees.

Total cost (TC):

It is the sum of Fixed cost (FC) and variable cost (VC).

TC = Total variable cost + Fixed cost = v.Q + FC

Profit = Total Sales Revenue–Total Cost = Total Sales Revenue–(Fixed cost +Variable cost) i.e. Profit = s.Q – (FC + v.Q)

Break-even Quantity, $Q_{B.E.P}$= Fixed cost/ (selling price per unit–Variable costper unit)

$Q_{B.E.P}$ (in units) = FC/s-v

Break-even sales revenue =[Fixed cost/(selling price/unit–Variable cost/unit)]. (Sellingprice/unit) $S_{B.E.P}$ (in Rs) = [FC/s-v].s

Contribution:

It is the difference between total sales revenue and the total variable costs. For maximum profit, contribution should be always higher than fixed cost.

Contribution = total sales revenue – total variable cost = S – v. Q Contribution/unit = selling price/unit – variable cost/unit = s – v

Margin of safety:

It is the sales revenue over and above break-even sales revenue. It can also be defined as the difference between actual output of a plant to the break-even output. Higher margin of safety means more profit and lower margin of safety means less profit.

Margin of safety (in Rs) = actual sales revenue – break-even sales revenue

= [Profit/contribution]. Sales revenue

% Margin of safety = [(actual output – break even output)/actual output].100 Margin of safety as a percent of sales revenue = (Margin of safety/sales revenue).100

Angle of incidence, θ:

It is the angle between the sales revenue line and the total cost line. It is represented by θ. Higher the angle of incidence, higher profit to the company. This usually happens when the Break-even point is at a lower level.

Profit/Volume ratio (P/V Ratio):

It is the ratio of contribution to the total sales revenue or turnover of the company. It is used tomeasure profitability of different products. Naturally, higher the P/V ratio, higher is the profit. P/V ratio = [Contribution/ total sales revenue] .100

= [(total sales revenue – total variable costs)/total sales revenue].100 Also, Break-even point (BEP) = Fixed cost/(P/V ratio)

Margin of safety = Profit/(P/V ratio)

LIFE CYCLE COSTING:

A study that gives special attention to both direct and indirect cash flows over the complete life of a project or product is called life cycle costing (LCC). It mean entire period from specifications to final disposal of the product. The intent of LCC is to direct attention to factors that might be overlooked – especially inputs that occur during the inception stage, to get a project underway, and activities associated with the termination phase.

LCC is expected to reduce the total cost by selecting the correct designs and components to minimize the total cost of service, not only the first cost. For instance, additional expenditures for the preliminary design might lower operating costs and thereby reduce total costs.

Expenditures during the life of most projects roughly follow the pattern shown in figure 4. The first stage –design- accounts for research, engineering design, administration and financing costs. The development stage takes the basic plan and converts it to hardware or services through charges for fabrication, installation, delivery, training, trial runs and material purchases. After the process is established, operating costs required to keep it going include personnel, consumable supplies, overhead, maintenance and services.

Design to cost is a variation of LCC that sets a limit on the total life time cost and forces designers to work backward from the disposal phase to the operating expenses through production costs and finally to initial design charges.

Projects, products and systems of a similar nature tend to share common life cycle patterns. Studies of military hardware systems show that approximately two-thirds of life cycle costs are firmly established during the design stage.

UNIT 6
INTRODUCTION, SCOPE OF FINANCE, FINANCE FUNCTIONS

Financial statements: meaning and objectives

When a student has studied for a year, he/she wants to know how much he/she has learnt during that period. Similarly, every business enterprise wants to know the result of its activities of a particular period which is generally one year and what is its financial position on a particular date which is at the end of this period. For this, it prepares various statements which are called the financial statements. Financial statements are the statements that are prepared at the end of the accounting period, which is generally one year. These include income statement i.e. Trading and Profit & Loss Account and Position statement i.e. Balance Sheet.

Objectives of financial statements

Financial statements are prepared to ascertain the profits earned or losses incurred by a business concern during a specified period and also to ascertain its financial position at the end of that specified period.

Financial statements are generally of two types (a) Income statement which comprises of Trading Account and Profit & Loss Account, and (b) Position Statement i.e., the Balance Sheet.

Following are the objectives of preparing financial statements: -

1. Ascertaining the results of business operations

Every businessman wants to know the results of the business operations of his enterprise during a particular period in terms of profits earned or losses incurred. Income statement serves this purpose.

2. Ascertaining the financial position

Financial statements show the financial position of the business concern on a particular date which is generally the last date of the accounting period. Position statement i.e. Balance Sheet is prepared for this purpose.

3. Source of information

Financial statements constitute an important source of information regarding finance of a business unit which helps the finance manager to plan the financial activities of the business and making proper utilization of the funds.

4. Helps in managerial decision making

The Manager can make comparative study of the profitability of the concern by comparing the results of the current year with the results of the previous years and make his/her managerial decisions accordingly.

5. An index of solvency of the concern

Financial statements also show the short term as well as long term solvency of the concern. This helps the business enterprise in borrowing money from bank and other financial institutions and/or buying goods on credit.

Capital Expenditure and Revenue Expenditure, Capital Receipts and Revenue Receipts

The preparation of Trading Account and Profit and Loss Account requires the knowledge of revenue expenditure, revenue receipts and capital expenditure and capital receipts. The knowledge shall facilitate the classification of revenue items and put them in the Trading

account and Profit and Loss Account on one hand and prepare Balance Sheet based on capital items (expenditure as well as receipts) on the other hand.

Capital Expenditure refers to the expenditure incurred for acquiring fixed assets or assets which increase the earning capacity of the business. The benefits of capital expenditure to the firm extend to number of years. Examples of capital expenditure are expenditure incurred for acquiring a fixed asset such as building, plant and machinery etc.

Revenue expenditure, on the other hand, is an expenditure incurred in the course of normal business transactions of a concern and its benefits are availed of during the same accounting year. Salaries, carriage etc. are examples of revenue expenditure.

There is another category of expenditure called deferred revenue expenditure. These are the expenses incurred during one accounting year but are applicable wholly or in part in future periods. These expenditures are otherwise of a revenue nature. Example of deferred revenue expenditure is heavy expenditure on advertisement say for introducing a new product in the market, expenditure incurred on research and development, etc.

Table 1: Difference between capital expenditure and revenue expenditure

Basis of Difference	Capital Expenditure	Revenue Expenditure
1. Purpose	It is incurred for acquiring of fixed assets.	It is incurred for the maintenance of fixed assets.
2. Earning capacity	It increases the earning capacity of the business.	It helps in maintaining the earning capacity of the business intact.
3. Periodicity of benefit	Its benefits are spread over a number of years.	Its benefits accrue only in one accounting year.
4. Placement in financial statements	It is an item of Balance Sheet and is shown as an item of asset.	It is an item of Trading and Profit and Loss Account and is shown on the debit side of either of the two.
5. Occurrence of expenditure	It is non-recurring in nature.	It is usually a recurring expenditure.

Capital and Revenue Receipts

Capital receipts are receipts which do not arise out of normal course of business. Examples of such receipts are sale of fixed assets, and raising of loans etc. Such receipts are not treated as income of the enterprise.

Revenue receipts are receipts which arise during the normal course of business, Sale of goods, rent from tenants, dividend received, etc. are some of the examples of revenue receipts. They are the items of incomes of the business entity.

Table 2: Distinction between Capital Receipts and Revenue Receipts

Basis of difference	Capital Receipt	Revenue Receipt
Source	Receipts that do not arise during the normal course of business.	Receipts that arise during the normal course of business.
Nature	These are of capital nature and hence are not treated as items of income of the business.	These are of revenue nature and hence are treated as items of income of the business.
Occurrence	These are of non-recurring in nature.	These are recurring in nature.

Trading account

Income statement consists of Trading and Profit and Loss Account. Let us first study the Trading Account. A business firm either purchases goods from others and sells them or manufactures and sells them to earn profit. This is known as trading activities. A statement is prepared to know the results in terms of profit or loss of these activities. This statement is called Trading Account.

Trading Account is prepared to ascertain the results of the trading activities of the business enterprise. It shows whether the selling of goods purchased or manufactured has earned profit or incurred loss for the business unit. Cost of goods sold is subtracted from the net sales of the business of that accounting year. In case the total sales value exceeds the cost of goods sold, the difference is called Gross Profit. On the other hand, if the cost of goods sold exceeds the total net sales, the difference is Gross Loss. All accounts related to cost of goods sold such as opening stock, net purchases i.e. purchase less returns outward, direct expenses such as wages, carriage inward etc. and closing stock with net sales (i.e. Sales minus Sales returns) are taken to the Trading Account. Then this account is balanced. Credit balance shows the gross Profit and debit balance shows the gross loss.

It is necessary to understand the meaning of cost of goods sold before preparing Trading Account

Cost of goods sold and gross profit

A business enterprise either purchases goods or manufactures goods to sell in the market. Cost of goods sold is computed to know the profit earned (Gross Profit) or loss incurred (Gross Loss) from the trading activities of a business unit for a particular period.

Cost of goods sold = the amount of goods purchased + expenses incurred in bringing the goods to the place of sale or expenses incurred on manufacturing the goods (called direct expenses).

In case there is a stock of goods to be sold in the beginning of the year or at the end of the year, the cost of goods is calculated as follows:

Cost of goods sold = Opening stock + Net purchases + All direct expenses – Closing stock

Gross Profit = Net sales – Cost of goods sold

UNIT 7
FINANCIAL RATIO ANALYSIS

INTRODUCTION

As a manager, you may want to reward employees based on their performance. How do you know how well they have done? How can you determine what departments or divisions have performed well? As a lender, how do decide the borrower will be able to pay back as promised? As a manager of a corporation how do you know when existing capacity will be exceeded and enlarged capacity will be needed? As an investor, how do you predict how well the securities of one company will perform relative to that of another? How can you tell whether one security is riskier than another? We can address all of these questions through financial analysis.

Financial analysis is the selection, evaluation, and interpretation of financial data, along with other pertinent information, to assist in investment and financial decision-making. Financial analysis may be used internally to evaluate issues such as employee performance, the efficiency of operations, and credit policies, and externally to evaluate potential investments and the credit-worthiness of borrowers, among other things.

The analyst draws the financial data needed in financial analysis from many sources. The primary source is the data provided by the company itself in its annual report and required disclosures. The annual report comprises the income statement, the balance sheet, and the statement of cash flows, as well as footnotes to these statements. Certain businesses are required by securities laws to disclose additional information.

Besides information that companies are required to disclose through financial statements, other information is readily available for financial analysis. For example, information such as the market prices of securities of publicly-traded corporations can be found in the financial press and the electronic media daily. Similarly, information on stock price indices for industries and for the market as a whole is available in the financial press.

Another source of information is economic data, such as the Gross Domestic Product and Consumer Price Index, which may be useful in assessing the recent performance or future prospects of a company or industry. Suppose you are evaluating a company that owns a chain of retail outlets. What information do you need to judge the company's performance and financial condition? You need financial data, but it doesn't tell the whole story. You also need information on consumer spending, producer prices, consumer prices, and the competition. This is economic data that is readily available from government and private sources.

Besides financial statement data, market data, and economic data, in financial analysis you also need to examine events that may help explain the company's present condition and may have a bearing on its future prospects. For example, did the company recently incur some extraordinary losses? Is the company developing a new product? Or acquiring another company? Is the company regulated? Current events can provide information that may be incorporated in financial analysis.

The financial analyst must select the pertinent information, analyze it, and interpret the analysis, enabling judgments on the current and future financial condition and operating performance of the company. In this reading, we introduce you to financial ratios -- the tool of financial analysis. In financial ratio analysis we select the relevant information -- primarily the financial statement data -- and evaluate it. We show how to incorporate market data and

economic data in the analysis and interpretation of financial ratios. And we show how to interpret financial ratio analysis, warning you of the pitfalls that occur when it's not used properly.

We use Microsoft Corporation's 2004 financial statements for illustration purposes throughout this reading. You can obtain the 2004 and any other year's statements directly from Microsoft. Be sure to save these statements for future reference.

Classification of ratios

A ratio is a mathematical relation between one quantity and another. Suppose you have 200 apples and 100 oranges. The ratio of apples to oranges is 200 / 100, which we can more conveniently express as 2:1 or 2. A financial ratio is a comparison between one bit of financial information and another. Consider the ratio of current assets to current liabilities, which we refer to as the current ratio. This ratio is a comparison between assets that can be readily turned into cash -- current assets -- and the obligations that are due in the near future-- current liabilities. A current ratio of 2:1 or 2 means that we have twice as much in current assets as we need to satisfy obligations due in the near future.

Ratios can be classified according to the way they are constructed and their general characteristics. By construction, ratios can be classified as a coverage ratio, a return ratio, a turnover ratio, or a component percentage:

1. A **coverage ratio** is a measure of a company's ability to satisfy (meet) particular obligations.
2. A **return ratio** is a measure of the net benefit, relative to the resources expended.
3. A **turnover ratio** is a measure of the gross benefit, relative to the resources expended.
4. A **component percentage** is the ratio of a component of an item to the item.

When we assess a company's operating performance, we want to know if it is applying its assets in an efficient and profitable manner. When we assess a company's financial condition, we want to know if it is able to meet its financial obligations. There are six aspects of operating performance and financial condition we can evaluate from financial ratios:

1. A liquidity ratio provides information on a company's ability to meet its shortterm, immediate obligations.
2. A profitability ratio provides information on the amount of income from each dollar of sales.
3. An activity ratio relates information on a company's ability to manage its resources (that is, its assets) efficiently.
4. A financial leverage ratio provides information on the degree of a company's fixed financing obligations and its ability to satisfy these financing obligations.
5. A shareholder ratio describes the company's financial condition in terms of amounts per share of stock.
6. A return on investment ratio provides information on the amount of profit, relative to the assets employed to produce that profit

We cover each type of ratio, providing examples of ratios that fall into each of these classifications.

Liquidity Ratios

Liquidity reflects the ability of a company to meet its short-term obligations using assets that are most readily converted into cash. Assets that may be converted into cash in a short period of time are referred to as liquid assets; they are listed in financial statements as current assets. Current assets are often referred to as working capital because these assets represent the resources needed for the day to-day operations of the company's long-term, capital investments. Current assets are used to satisfy short-term obligations, or current liabilities. The amount by which current assets exceed current liabilities is referred to as the net working capital.

The role of the operating cycle

How much liquidity a company needs depends on its operating cycle. The operating cycle is the duration between the time cash is invested in goods and services to the time that investment produces cash. For example, a company that produces and sells goods has an operating cycle comprising four phases:

(1) Purchase raw material and produce goods, investing in inventory;
(2) Sell goods, generating sales, which may or may not be for cash;
(3) Extend credit, creating accounts receivables, and
(4) Collect accounts receivables, generating cash.

The operating cycleis the length of time it takes to convert an investment of cash in inventory back into cash (through collections of sales). The net operating cycle is the length of time it takes to convert an investment of cash in inventory and back into cash considering that some purchases are made on credit.

The number of days a company ties up funds in inventory is determine by:

(1) The total amount of money represented in inventory, and
(2) The average day's cost of goods sold.

The current investment in inventory -- that is, the money "tied up" in inventory -- is the ending balance of inventory on the balance sheet. The average day's cost of goods sold is the cost of goods sold on an average day in the year, which can be estimated by dividing the cost of goods sold found on the income statement by the number of days in the year. We compute the number of days of inventory by calculating the ratio of the amount of inventory on hand (in dollars) to the average day's Cost of Goods Sold (in dollars per day):

$$\text{Number of days inventory} = \frac{\text{Inventory}}{\text{Average day's cost of goods sold}} = \frac{\text{Inventory}}{\text{Cost of goods sold / 365}}$$

If the ending inventory is representative of the inventory throughout the year, the number of day’s inventory tells us the time it takes to convert the investment in inventory into sold goods. Why worry about whether the year-end inventory is representative of inventory at any day throughout the year? Well, if inventory at the end of the fiscal year-end is lower than on any other day of the year, we have understated the number of days of inventory. Indeed, in practice most companies try to choose fiscal year-ends that coincide with the slow period of their business. That means the ending balance of inventory would be lower than the typical daily inventory of the year. We could, for example, look at quarterly financial statements and take averages of quarterly inventory balances to get a better idea of the typical inventory. However, here for simplicity in this and other ratios, we will make a note of this problem and

deal with it later in the discussion of financial ratios. We can extend the same logic for calculating the number of days between a sale -- when an account receivable is created -- to the time it is collected in cash. If the ending balance of receivables at the end of the year is representative of the receivables on any day throughout the year, then ittakes, on average, approximately the "number of days credit" to collect the accounts receivable, or the number of days receivables:

$$\text{Number of days receivables} = \frac{\text{Accounts receivable}}{\text{Average day's sales on credit}} = \frac{\text{Accounts receivable}}{\text{Sales on credit / 365}}$$

What does the operating cycle have to do with liquidity? The longer the operating cycle, the more current assets needed (relative to current liabilities) because it takes longer to convert inventories and receivables into cash. In other words, the longer the operating cycle, the more net working capital required.

We also need to look at the liabilities on the balance sheet to see how long it takes a company to pay its short-term obligations. We can apply the same logic to accounts payable as we did to accounts receivable and inventories. How long does it take a company, on average, to go from creating a payable (buying on credit) to paying for it in cash?

$$\text{Number of days payables} = \frac{\text{Accounts payable}}{\text{Average day's purchases}} = \frac{\text{Accounts payable}}{\text{Purchases / 365}}$$

First, we need to determine the amount of an average day's purchases on credit. If we assume all purchases are made on credit, then the total purchases for the year would be the Cost of Goods Sold, less any amounts included in this Cost of Goods Sold that are not purchases.The operating cycle tells us how long it takes to convert an investment in cash back into cash (by way of inventory and accounts receivable):

$$\text{Operating cycle} = \text{Number of days of inventory} + \text{Number of days of receivables}$$

The number of days of purchases tells us how long it takes use to pay on purchases made to create the inventory. If we put these two pieces of information together, we can see how long, on net, we tie up cash. The difference between the operating cycle and the number of days of payables is the net operating cycle:

$$\text{Net operating cycle} = \text{Operating Cycle} - \text{Number of days of purchases}$$

or, substituting for the operating cycle,

$$\text{Net operating cycle} = \text{Number of days of inventory} + \text{Number of days of receivables} - \text{Number of days of purchases}$$

The net operating cycle therefore tells us how long it takes for the company to get cash back from its investment in inventory and accounts receivable, considering that purchases may be made on credit. By not paying for purchases immediately (that is, using trade credit), the company reduces its liquidity needs. Therefore, the longer the net operating cycle, the greater the company’s need for liquidity.

Measures of liquidity

Liquidity ratios provide a measure of a company's ability to generate cash to meet its immediate needs. There are three commonly used liquidity ratios:

1.The current ratiois the ratio of current assets to current liabilities; indicates a company's ability to satisfy its current liabilities with its current assets:

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

2.The quick ratiois the ratio of quick assets (generally current assets less inventory) to current liabilities; indicates a company's ability to satisfy current liabilities with its most liquid assets

$$\text{Quick ratio} = \frac{\text{Current assets - Inventory}}{\text{Current liabilities}}$$

3.The net working capital to sales ratiois the ratio of net working capital (current assets minus current liabilities) to sales; indicates a company's liquid assets (after meeting short−term obligations) relative to its need for liquidity (represented by sales)

$$\text{Net working capital to sales ratio} = \frac{\text{Current assets - Current liabilities}}{\text{Sales}}$$

Generally, the larger these liquidity ratios, the better the ability of the company to satisfy its immediate obligations. Is there a magic number that defines good or bad? Not really. Consider the current ratio. A large amount of current assets relative to current liabilities provides assurance that the company will be able to satisfy its immediate obligations. However, if there are more current assets than the company needs to provide this assurance, the company may be investing too heavily in these non- or low-earning assets and therefore not putting the assets to the most productive use. Another consideration is the operating cycle. A company with a long operating cycle may have more need to liquid assets than a company with a short operating cycle. That's because a long operating cycle indicate that money is tied up in inventory (and then receivables) for a longer length of time

Profitability ratios

Profitability ratios (also referred to as profit margin ratios) compare components of income with sales. They give us an idea of what makes up a company's income and are usually expressed as a portion of each dollar of sales. The profit margin ratios we discuss here differ only by the numerator. It's in the numerator that we reflect and thus evaluate performance for different aspects of the business:

The gross profit margin is the ratio of gross income or profit to sales. This ratio indicates how much of every dollar of sales is left after costs of goods sold:

Gross profit margin= Gross income/ sales

The operating profit margin is the ratio of operating profit (a.k.a. EBIT, operating income, income before interest and taxes) to sales. This is a ratio that indicates how much of each dollar of sales is left over after operating expenses:

Operating profit margin= operating income/sales

The net profit margin is the ratio of net income (a.k.a. net profit) to sales, and indicates how much of each dollar of sales is left over after all expenses:

Net profit margin = Net income/ sales

Activity ratios

Activity ratios are measures of how well assets are used. Activity ratios -- which are, for the most part, turnover ratios -- can be used to evaluate the benefits produced by specific assets,

such as inventory or accounts receivable. Or they can be used to evaluate the benefits produced by all a company's assets collectively.

These measures help us gauge how effectively the company is at putting its investment to work. A company will invest in assets – e.g., inventory or plant and equipment – and then use these assets to generate revenues. The greater the turnover, the more effectively the company is at producing a benefit from its investment in assets.

The most common turnover ratios are the following:

1. Inventory turnover is the ratio of cost of goods sold to inventory. This ratio indicates how many times inventory is created and sold during the period:

Inventory turnover = Cost of goods sold/ Inventory

2. Accounts receivable turnover is the ratio of net credit sales to accounts receivable. This ratio indicates how many times in the period credit sales have been created and collected on:

Accounts receivable turnover = sales on credit/ Account receivable

3. Total asset turnover is the ratio of sales to total assets. This ratio indicates the extent that the investment in total assets results in sales.

Total asset turnover = Sales/ total assets

4. Fixed asset turnover is the ratio of fixed assets. This ratio indicates the ability of the company’s management to put the fixed assets to work to generate sales:

Fixed asset turnover = Sales/ Fixed assets

Financial leverage ratios

A company can finance its assets either with equity or debt. Financing through debt involves risk because debt legally obligates the company to pay interest and to repay the principal as promised.

Equity financing does not obligate the company to pay anything -- dividends are paid at the discretion of the board of directors. There is always some risk, which we refer to as business risk, inherent in any operating segment of a business. But how a company chooses to finance its operations -- the particular mix of debt and equity -- may add financial risk on top of business risk Financial risk is the extent that debt financing is used relative to equity.

Financial leverage ratios are used to assess how much financial risk the company has taken on. There are two types of financial leverage ratios: component percentages and coverage ratios. Component percentages compare a company's debt with either its total capital (debt plus equity) or its equity capital. Coverage ratios reflect a company's ability to satisfy fixed obligations, such as interest, principal repayment, or lease payments.

Component-percentage financial leverage ratios

The component-percentage financial leverage ratios convey how reliant a company is on debt financing. These ratios compare the amount of debt to either the total capital of the company or to the equity capital.

1. The total debt to assets ratio indicates the proportion of assets that are financed with debt (both short − term and long−term debt):

Total debt to assets ratio = Total debt / Total assets

Remember from your study of accounting that total assets are equal to the sum of total debt and equity. This is the familiar accounting identity: assets = liabilities + equity.

2. The long−term debt to assets ratio indicates the proportion of the company's assets that are financed with long−term debt.

Long term debt to assets ratio = Long term debt / Total assets

3.The debt to equity ratio(a.k.a. debt-equity ratio)indicates the relative uses of debt and equity as sources of capital to finance the company's assets, evaluated using book values of the capital sources:

Total debt to equity ratio = Total debt / Total shareholders equity

Coverage financial leverage ratios

In addition to the leverage ratios that use information about how debt is related to either assets or equity, there are a number of financial leverage ratios that capture the ability of the company to satisfy its debt obligations. There are many ratios that accomplish this, but the two most common ratios are the times interest coverage ratio and the fixed charge coverage ratio.

The times-interest-coverage ratio, also referred to as the interest coverage ratio, compares the earnings available to meet the interest obligation with the interest obligation:

Times- interest – coverage ratio = Earnings before interest and taxes/ Interest

The fixed charge coverage ratio expands on the obligations covered and can be specified to include any fixed charges, such as lease payments and preferred dividends. For example, to gauge a company's ability to cover its interest and lease payments, you could use the following ratio:

$$\text{Fixed - charge coverage ratio} = \frac{\text{Earnings before interest and taxes} + \text{Lease payment}}{\text{Interest} + \text{Lease payment}}$$

Shareholder ratios

The ratios we have explained to this point deal with the performance and financial condition of the company. These ratios provide information for managers (who are interested in evaluating the performance of the company) and for creditors (who are interested in the company's ability to pay its obligations). We will now take a look at ratios that focus on the interests of the owners -- shareholder ratios. These ratios translate the overall results of operations so that they can be compared in terms of a share of stock:

Earnings per share(EPS) are the amount of income earned during a period per share of common stock.

$$\text{Earnings per share} = \frac{\text{Net income available to shareholders}}{\text{Number of shares outstanding}}$$

As we learned earlier in the study of Financial Statement Information, two numbers of earnings per share are currently disclosed in financial reports: basic and diluted. These numbers differ with respect to the definition of available net income and the number of shares outstanding.

Basic earnings per share are computed using reported earnings and the average number of shares outstanding. Diluted earnings per share are computed assuming that all potentially dilutive securities are issued. That means we look at a "worst case" scenario in terms of the dilution of earnings from factors such as executive stock options, convertible bonds, convertible preferred stock, and warrants. Suppose a company has convertible securities outstanding, such as convertible bonds. In calculating diluted earnings per share, we consider what would happen to both earnings and the number of shares outstanding if these bonds were converted in to common shares. This is a "What if?" scenario: what if all the bonds are converted into stock this period. To carry out this "What if?" we calculate earnings considering that the company does not have to pay the interest on the bonds that period (which increases the numerator of earnings per share), but we also add to the denominator the number of shares that would be issued if these bonds were converted into shares

Illustration: 1

The following information relates to Mishra & Co. for the year 2003, calculate current ratio:

Current Assets Rs. 5,00,000

Current Liabilities Rs. 2,00,000

Solution:

Current Ratio =Current Assets/ Current Liabilities

=5,00,000/2,00,000

= 2.5 (or) 2.5 :1

The current ratio of 2.5 means that current assets are 2.5 times of current liabilities.

Illustration: 2

Calculate Current Ratio from the following Information

Liabilities	Rs.	Assets	Rs.
Sundry creditors	40000	Inventories	120000
Bills payable	30000	Sundry debtors	140000
Dividend payable	36000	Cash at Bank	40000
Accrued expenses	14000	Bills Receivable	60000
Short-term advances	50000	Prepaid expense	20000
Share Capital	150000	Machinery	200000
Debenture	200000	Patents	50000
		Land & Building	150000

Solution:

$$\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}}$$

Current Assets = Rs 120000+ 140000 + 40000 + 60000 + 20000

= Rs. 380000

Current Liabilities = Rs. 40000 + 30000 + 36000 + 14000+ 50000

= Rs 170000

Current ratio = 380000/170000

= 2.24 (or) 2.24:1

UNIT 8

FINANCIAL AND PROFIT PLANNING

Introduction

Financial Management means planning, organizing, directing and controlling the financial activities such as procurement and utilization of funds of the enterprise. It means applying general management principles to financial resources of the enterprise.

Investment decisions includes investment in fixed assets (called as capital budgeting). Investment in current assets is also a part of investment decisions called as working capital decisions.

Financial decisions - They relate to the raising of finance from various resources which will depend upon decision on type of source, period of financing, cost of financing and the returns thereby.

Dividend decision - The finance manager has to take decision with regards to the net profit distribution. Net profits are generally divided into two:

a. Dividend for shareholders- Dividend and the rate of it has to be decided.
b. Retained profits- Amount of retained profits has to be finalized which will depend upon expansion and diversification plans of the enterprise.

Financial Planning

Financial Planning is the process of estimating the capital required and determining it's competition. It is the process of framing financial policies in relation to procurement, investment and administration of funds of an enterprise.

Objectives of Financial Planning

Financial Planning has got many objectives to look forward to:

a. **Determining capital requirements-** This will depend upon factors like cost of current and fixed assets, promotional expenses and long- range planning. Capital requirements have to be looked with both aspects: short- term and long- term requirements.
b. **Determining capital structure-** The capital structure is the composition of capital, i.e., the relative kind and proportion of capital required in the business. This includes decisions of debt- equity ratio- both short-term and long- term.
c. **Framing financial policies** with regards to cash control, lending, borrowings, etc.
d. A finance manager **ensures that the scarce financial resources are maximally utilized in the best possible manner** at least cost in order to get maximum returns on investment.

Importance of Financial Planning

Financial Planning is process of framing objectives, policies, procedures, programmes and budgets regarding the financial activities of a concern. This ensures effective and adequate financial and investment policies. The importance can be outlined as-

1. Adequate funds have to be ensured.
2. Financial Planning helps in ensuring a reasonable balance between outflow and inflow of funds so that stability is maintained.
3. Financial Planning ensures that the suppliers of funds are easily investing in companies which exercise financial planning.
4. Financial Planning helps in making growth and expansion programmes which helps in long-run survival of the company.

5. Financial Planning reduces uncertainties with regards to changing market trends which can be faced easily through enough funds.
6. Financial Planning helps in reducing the uncertainties which can be a hindrance to growth of the company. This helps in ensuring stability and profitability in concern.

Profit planning

Profit planning is the process of developing a plan of operation that makes it possible to determine how to arrange the operational budget so that the maximum amount of profit can be generated. There are several common uses for this process, with many of them focusing on the wise use of available resources. Along with the many benefits of this type of planning process, there are also a few limitations.

The actual process of profit planning involves looking at several key factors relevant to operational expenses. Putting together effective profit plans or budgets requires looking closely at such expenses as labor, raw materials, facilitiesmaintenance and upkeep, and the cost of sales and marketing efforts. By looking closely at each of these areas, it is possible to determine what is required to perform the tasks efficiently, generate the most units for sale, and thus increase the chances of earning decent profits during the period under consideration. Understanding the costs related to production and sales generation also makes it possible to assess current market conditions and design a price model that allows the products to be competitive in the marketplace, but still earn an equitable amount of profit on each unit sold.

There are several advantages to engaging in profit planning. The most obvious is evaluating the overall operation for efficiency. If profits for the most recently completed period fall short of projections, this prompts an investigation into what led to the lower returns. Changes can then be made to the operation in order to increase the chances for higher profits in the next period.

Necessary changes that may be uncovered as part of the profit planning process include increasing or decreasing the employee force, changing vendors of raw materials, or upgrading equipment and machinery that are key to the production of goods and services. In like manner, the need to restructure marketing campaigns so that more resources are directed toward strategies that are providing the greatest return, while minimizing or even eliminating allocations to strategies that are not producing significant results, may also become apparent as a result of this type of planning. Even issues such as changing shippers or making slight changes to packaging that trim expenses may be identified as part of the profit planning process.

While this is a useful process in any business setting, there are some limitations on what can be accomplished. The effectiveness of the planning is only as good as the data that is assembled for use in the process. Should the data be incorrect or incomplete, the results of the planning are highly unlikely to produce the desired results. In addition, if the findings of the process do not result in the implementation of procedures and changes in the relevant areas of the business, the time spent on the profit planning is essentially wasted. For this reason, profit planning should be seen as a starting point for operations and not simply recommendations of what should be done in order to increase profit margins.

Profit Budgeting

A budget is a detailed plan for acquiring and using financial and other resources over a specified period of time. It represents a plan for the future expressed in formal quantitative terms. The act of preparing a budget is called **budgeting**. The use of budgeting to control a firm's activities is called **budgetary control**.

Master budget is a summary of a company's plan that sets specific targets for sales, production, distribution, and financing activities. It generally culminates in cash budget, a budgeted income statement, and a budgeted balance sheet. In short, it represents a comprehensive expression of management's plans for the future and how these plans are to be accomplished.

Difference Between Planning and Control:

The term **planning and control** are often confused, and occasionally these terms are used in such a way as to suggest that they mean the same thing. Actually, planning and control are two quite different concepts. **Planning** involves developing objects and preparing various budgets to achieve those budgets. Control involves the steps taken by management to increase the likelihood that the objectives set down at the planning stage are attained and that all parts of the organization are working together toward that goal. To be completely effective, a good budgeting system must provide for both planning a control. Good planning without control is time wasting.

Advantages and Disadvantages of Budgeting:

Companies realize many advantages / Benefits from a budgeting program. Among these benefits are the following:

- Budgets provide a means of communicating management's plans through the organization.
- Budgets force managers to think about and plan for the future. In the absence of the necessity to prepare a budget, many mangers would spend all of their time dealing with daily emergencies.
- The **budgeting process** provides a means of allocating resources to those parts of the organization where they can be used most effectively
- The budgeting process can uncover many potential bottlenecks before they occur .
- Budgets coordinate the activities of the entire organization by integrating the plans of the various parts of the organization. Budgeting helps to ensure that everyone in the organization is pulling in the same direction.
- Budgets provide goals and objectives that can serve as benchmark for evaluating subsequent performance.

Disadvantages / Limitations of Budgeting:

While budgets may be an essential part of any marketing activity they do have a number of disadvantages, particularly in perception terms.

Budgets can be seen as pressure devices imposed by management, thus resulting in:

Inaccurate record-keeping.

Departmental conflict arises due to:

a) Disputes over resource allocation; and

b) Departments blaming each other if targets are not attained.

It is difficult to reconcile personal/individual and corporate goals.

Waste may arise as managers adopt the view, "we had better spend it or we will lose it". This is often coupled with "empire building" in order to enhance the prestige of a department.

Responsibility versus controlling, i.e. some costs are under the influence of more than one person, e.g. power costs.

Managers may overestimate costs so that they will not be blamed in the future should they overspend.

Manufacturing operations benchmarks

Manufacturing operations benchmarks from MPI's Manufacturing Study include data for improvement methodologies, programs/practices in place, cost of goods sold (revenue, labor, overhead, and material), sales per employee, manufacturing cycle time, on-time delivery rate, perfect delivery rate, finished-product first-pass quality yield, scrap and rework, warranty costs, inventory management practices, inventory turn rates (raw material, work-in process, finished goods, and total inventory), and obsolete inventory.

Manufacturing operations benchmarks include:

- Improvement methodologies followed at the plant and level of adoption of chosen methodology(ies)
- Importance of process improvement to your plant's success over the next five years
- Percentage of a fully engaged workforce in chosen improvement methodology(ies)
- Programs and/or practices occurring at a plant (such as benchmarking, total productive maintenance, and quality certifications)
- Estimate of operation/production measures for a plant for the current year and three years prior, including manufacturing cycle time, on-time delivery rate, perfect delivery rate, finished-product first-pass quality yield, scrap and rework, and warranty costs
- Total production output (unit volume) change in the past 12 months
- Plant's costs as a percentage of costs of goods sold (COGS), including for plant revenue, labor, overhead, and material
- Approximate sales per employee
- Per-unit manufacturing costs
- Practices used to manage inventory
- Inventory turn rates for raw material, work-in-process material, finished goods, and total inventory
- Total obsolete inventory