UNIT II –VALUE ENGINEERING

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MAKE OR BUY DECISION

- It is the determination whether to produce a component internally or to buy it from the outside supplier

- The decision is based on the cost

- The cost for both the alternatives should be calculated and the alternative with less cost is to be chosen

CRITERIA FOR MAKE

- The product can be made cheaper by the firm.
- The finished product is being manufactured only by limited firms
- The part needs extremely close quality control
- The part can be manufactured from the existing facilities with experienced operators

CRITERIA FOR BUY

- High investments required for making
- Does not have facilities for making.
- Skilled workers not available
- Demand is either temporary or seasonal
- Patents or legal formalities prevent from making the product.

APPROACHES FOR MAKE OR BUY DECISION

The following are the approaches

- Simple cost analysis
- Economic analysis
- Break Even Analysis

SIMPLE COST ANALYSIS

- It is concerned with finding the actual expenditure incurred on a given product.

- Finding the total value of economic resources used to produce a product

EXAMPLE

A company has been buying a part of machinery for Rs.1000/- each. It has an extra capacity that can be used to produce the same. The annual fixed cost of the unused capacity is Rs.10,00,000/-. If the company decided to make the product it will incur material cost of Rs.350/- per unit, labour cost of Rs 300 per unit and variable overhead cost of Rs 100/- per unit. The future demand is estimated as 5000 units. Which decision is profitable for the company.

SOLUTION

Given data :

Fixed cost : Rs. 10,00,000
Labour cost : Rs. 300/unit
Material cost : Rs. 350/unit
Overhead cost : Rs 100/unit
Demand : 5000 units
Buying price : Rs. 1000 each

Cost of making

Total Cost = FC + VC
FC = Rs.10,00,000

SOLUTION:
VC/unit = material cost + Labour cost + Overhead cost
=300 + 350 + 100
= Rs. 750/unit
Demand = 5000 units
Total Variable cost = 5000 × 750 = Rs. 37,50,000/-
Total cost = FC + VC = 10,00,000 + 37,50,000 = **Rs.47,50,000/-**

Cost of buying :
TC = FC + Buying cost = 10,00,000 + (5000 × 1000) = **Rs. 60,00,000/-**

Decision : Since the cost of making is < cost of buying it is decided to make the product

ECONOMIC ANALYSIS

The following models are used

1. Purchase model

2. Manufacturing model

$Q1$ = economic order size

$Q2$ = economic production size

TC = total cost per year

Purchase model	Manufacturing model
$Q1 = \sqrt{\frac{2C_oD}{C_c}}$	$Q2 = \sqrt{\frac{2C_oD}{C_c(1 - r/k)}}$
$TC = D \times P + \frac{DC_o}{Q1} + \frac{Q1 \times C_c}{2}$	$TC = D \times P + \frac{DC_o}{Q2} + C_c(k - r)\frac{Q2}{2 * k}$

where

D = demand/year

P = purchase price/unit

C_c = carrying cost/unit/year

C_o = ordering cost/order or set-up cost/set-up

k = production rate (No. of units/year)

r = demand/year

Where

Q1- Economic Order size

Q2 – Economic Production size

TC = Total cost per year

PROBLEM

A part of the machine has a yearly demand of 3000 units. The different costs in respect of make or buy are as given below

Details	Buy	Make
Item cost/unit	Rs.10	Rs.8.0
Procurement cost/order	Rs.150	-
Setup cost/setup		Rs.80/-
Annual carrying cost/year	Rs.2.0	Rs.1.50/-
Production rate/year	-	10,000 units

SOLUTION

Purchase Model

D = 3000 Units/Year

C_0 = Rs.150/order

Cc = Rs.2.0/item/year

P = Rs. 10/unit

Q1 = $\sqrt{2CoD}$/ Cc = 670.82 units

TC = 3000 x 10 + 3000 x 150/670.82 + 670.82 x2/2

= **Rs. 31,341.64**

BREAK EVEN ANALYSIS

Break even analysis implies at a particular point the

total revenue = total cost.

A manufacturer of TV buys TV cabinet at Rs 500 each. In case the company makes it within the factory the fixed and variable costs would be Rs.4,00,000 and Rs 300 per cabinet respectively. Should the manufacturer make or buy the cabinet if the demand is 1500 TV cabinet

SOLUTION:

Selling price / unit = Rs. 500/-

Variable cost / unit = Rs. 300/-

Fixed cost = Rs. 4,00,000

BEP = 4,00,000/(500-300) = 2,000 units

Decision : Since the demand is < the BEP the company should buy

Manufacturing Model

$$Q2 = \sqrt{2Co\ r / Cc\ (1 - (r/k))}$$

TC = 3000 x 8 + 3000 x 80/676.12 + 1.5(10,000-3000)676.12/2 x 10000

= **Rs. 24,709.93**

Decision : Since the cost of making the item is < the cost of Producing it is decided to make the product

VALUE ENGINEERING, INTEREST FORMULAE AND ITS APPLICATIONS

INTRODUCTION

Value analysis is a special type of cost reduction technique developed in USA in the year 1947.

It critically investigates the different aspects of materials, design cost and production of each component

DEFINITION OF VALUE ANALYSIS

According to Society of American Value Engineers

“Value analysis is the systematic application of recognized techniques which identify the function of a product or service, establish a monetary value for the function and provide the necessary function reliability at the lowest overall cost”.

VALUE

Value may be defined as the cost proportionate to the function. Value is also defined as the ratio of utility to the cost
It is expressed mathematically as

$$\text{Value} = \frac{FUNCTION\ OR\ UTILITY}{COST}$$

TYPES OF VALUES

Economic value can be subdivided into four types

They are

- Cost Value
- Exchange Value
- Use Value
- Esteem Value

TYPES OF VALUES

Esteem Value :

- It creates the qualities and appearance of a product which attracts persons and create in them a desire to possess the product.

- It is the price paid by the buyer or the cost incurred by the manufacturer beyond the use value.

FUNCTION

Function may be defined as the purpose for which the product is made.

Types of functions

- Primary Function
- Secondary Function
- Tertiary Function

Primary Function : They are the basic functions for which the product is specially designed to achieve.
For Eg : A fluorescent tube gives light

Secondary Function : Secondary functions are those which if not in built would not prevent the device from performing its primary functions.
For Eg : The arms of a chair provides support for the hands.

Tertiray Function : These functions are related to the esteem appearance.

For Eg : Sun mica top of a table gives esteem appearance for the table.

WHEN TO DO VALUE ANALYSIS

- Company's products show a decline in sales
- Company's prices are higher than those of the competitors.
- Raw materials cost has grown disproportionate to the volume of production.
- New designs are being introduced.
- The cost of manufacturing is disproportionate to the volume of production.
- Rate of return on investment has a falling trend.
- Inability of the firm to meet its delivery commitments.

DIFFERENCE BETWEEN VALUE ANALYSIS AND VALUE ENGINEERING

S. No.	VALUE ANALYSIS	VALUE ENGINEERING
1.	Value analysis is the applications of a set of techniques to an existing product with a view to improve its value	**Value engineering is the application of exactly the same set of techniques to a new product at a design stage,**
2	**Value Analysis is thus a remedial process.**	**Value engineering is thus a preventive process**

AIMS AND OBJECTIVES OF VALUE ANALYSIS

- Simply the product
- Reduce the cost of the product
- Use cheaper and better materials
- Modify and improve the product design so as to make it acceptable to the customer.
- Use efficient processes
- Increase the utility of the product by economical means.
- Ensure greater return on investment
- Improve organizational efficiency

ADVANTAGES OF VALUE ANALYSIS/VALUE ENGINEERING

- Value analysis identifies and reduces the product cost.
- It modifies and improves the product design
- It increases the performance/utility of the product by economical means.
- It helps to generate new ideas.
- It creates quality consciousness and cost consciousness among the employer.
- It helps to save money and increase the profits.
- Value engineering improves the ability to manage project, solve problems, innovate and communicate.

VALUE ANALYSIS/VALUE ENGINEERING

PROCEDURE:

The basic steps of value engineering are as follows: (BCR)

1. Blast
   (i) Identify the product
   (ii) Collect relevant information
   (iii) Define different functions

2. Create
   (iv) Different alternatives
   (v) Critically evaluate the alternatives

3. Refine
   (vi) Develop the best alternative
   (vii) Implement the alternative

INTEREST FORMULAE AND ITS APPLICATIONS

- Interest rate is the renal value of money.
- It represents the growth of capital per unit period.

INTEREST FORMULAE

P = Principle Amount or Initial amount

N = no. of periods

i = Interest periods

F = Future worth of the amount at the end of the interest period

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

G = Uniform amount which will be added/subtracted period after period from the amount of deposit A1.

TIME VALUE OF MONEY

If an investor invests a sum of Rs 100 in a fixed deposit for 5 years with an interest rate of 15% compounded annually, the accumulated amount at the end of every year is as shown below

The formula to find the future worth is F = P (1+i)n

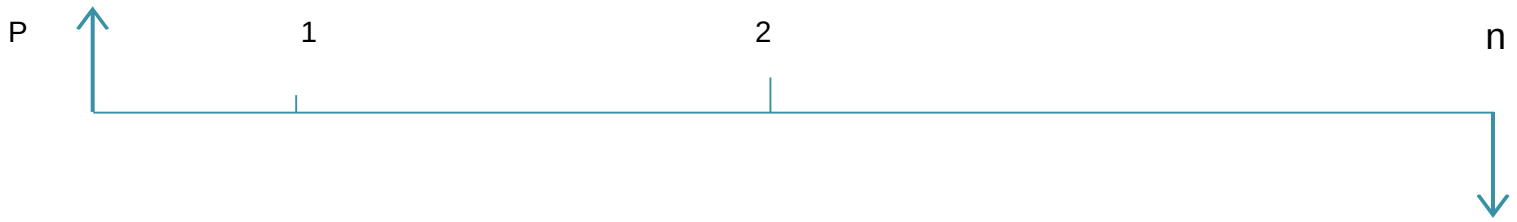
Year End	Interest (Rs)	Compound Amount
0	-	100.00
1	15.00	115.00
2	17.25	132.25
3	19.84	152.09
4	22.81	174.90
5	26.24	201.14

SINGLE PAYMENT COMPOUND AMOUNT

The objective is to find the future sum (F) of the initial payment (P) made at time 0 after n periods at an interest rate i compounded every period.

The formula to obtain single payment compound amount

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



PROBLEM

A person deposits a sum of Rs 20,000 at the interest rate of 18% compounded annually for 10 years. Find the maturity value after10 years

Solution:

P = Rs 20,000

i = 18%, n= 10 years

F = P(F/P,i,n) = 20,000 x 5.234

F = Rs 1,04,680/-

SINGLE PAYMENT PRESENT WORTH AMOUNT

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

The formula to obtain the present worth is

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

= F(P/F, i, n)

F(P/F, i, n) is the single payment present worth factor

PROBLEM

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

•Solution

F = Rs 1,00,000

i = 15% n= 10 years

P = F(P/F, i, n)

P = 1,00,000 x 0.2472

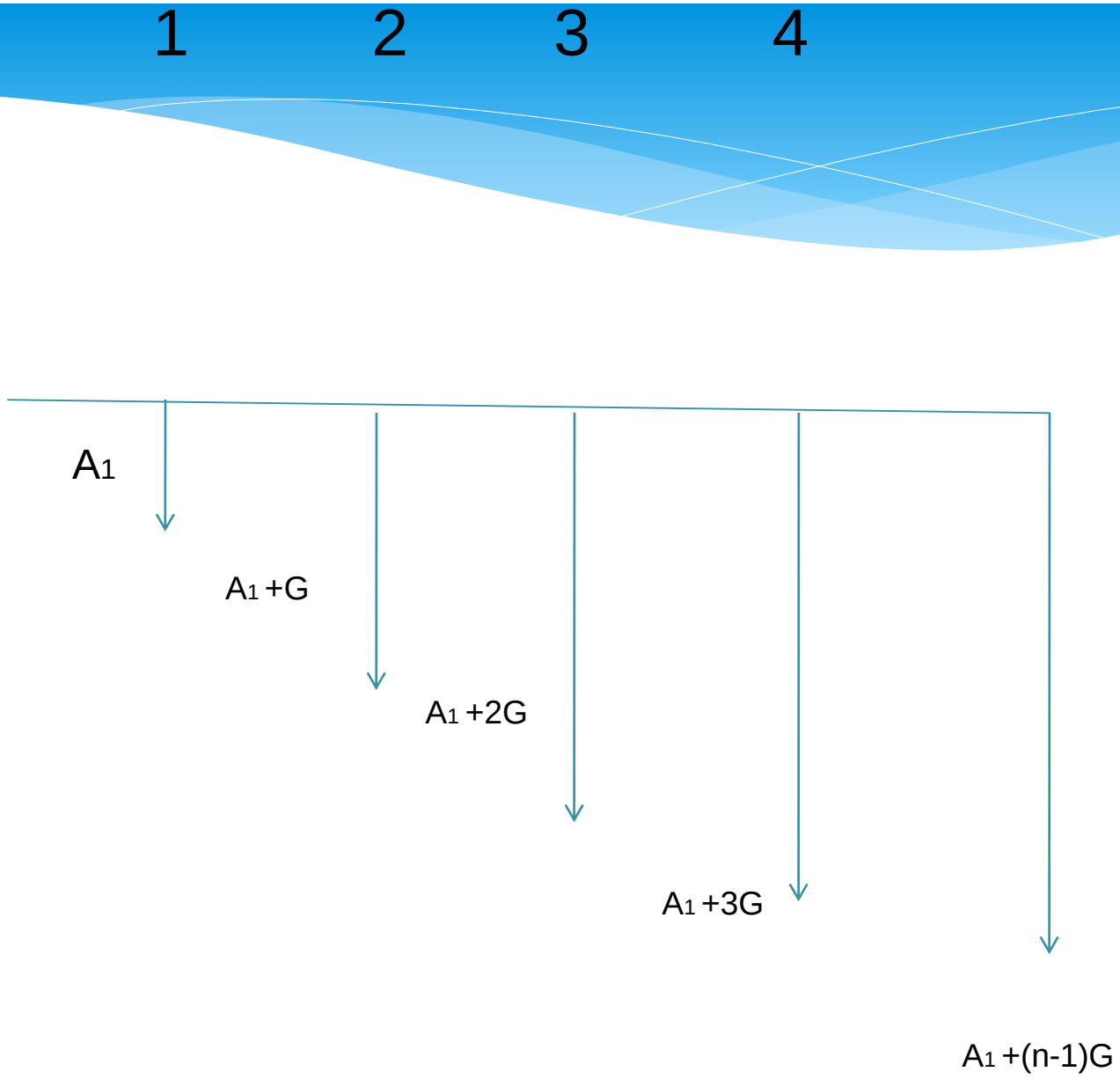
P = Rs 24,720/-

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 i= 15%

UNIFORM GRADIENT SERIES METHOD

Suppose a person wants to deposit a sum A1 at the end of the first year and increase this amount with an equal
amount (G) for each of the following (n-1) years with an interest rate i compounded annually.
What would be the annual amount he should deposit at the end of every interest period.

•The corresponding cash flow diagram is as follows



FORMULA TO COMPUTE THE ANNUAL EQUIVALENT AMOUNT

$$A = A1 + G \left[\frac{(1+i)^N - iN - 1}{i[(1+i)^N - 1]} \right]$$

Using Table the formula to be used is

A = A1 + G (A/G, i ,N)

EXAMPLE :

A person would like to invest Rs 5000/- at the end of the first year and thereafter he wishes to deposit the amount with an annual increase of Rs 300/- for the following 9 years with an interest rate of 10%. Find the total amount at the end of the 10th year of the above series.

SOLUTION :

The formula to compute the value of A is

= A1 + G (A/G, i ,N)

A = 5000 + 300 (3.7255)

A = Rs 6117.65/-

A = 5000 + 300 (3.7255)

A = Rs 6117.65/-

The future sum of the “A” at the end of the 10 years is calculated using the formula

F = A (F/A ,i, N)

F = 6117.65 x 15.937 F = Rs 97,496.99/-

EFFECTIVE INTEREST RATE

Generally nominal interest rate are compounded annually.
When the interest rate is compounded less than a year i.e. monthly, quarterly, half yearly.
Under such situations we need to calculate the effective interest rate.

EFFECTIVE INTEREST RATE

Effective interest rate may be defined as a percentage which is periodically applied to measure the cost of money when the interest rates compounded for less than a year i.e. monthly, quarterly and half yearly.

1. Effective interest rate (R) = $(1 + i/C)^C - 1$

where i = Nominal interest Rate

C = No of interest periods

Example :

Mr. Sai deposits a sum of Rs10,000 in a bank at a nominal interest rate of 12% for 10 years. The compounding is quarterly. Find the maturity value of the deposit after 10 years.

No of interest periods per year C = 4

Effective interest rate (R) = (1 + i/ C)c - 1
R = [1 + 12%/4]4 – 1 = 12.55% compounded annually

The formula to find the maturity value
(F) = P(1+R)N
F = 10,000 (1 + 0.1255)10
= Rs 32,617.82

EQUAL PAYMENT SERIES PRESENT WORTH METHOD

The objective is to find the present worth of an equal payment made at the end of every interest period at an interest rate of i compounded at the end of every interest period

P = Present worth

A = Annual equivalent payment

i = Interest rate, n= interest periods

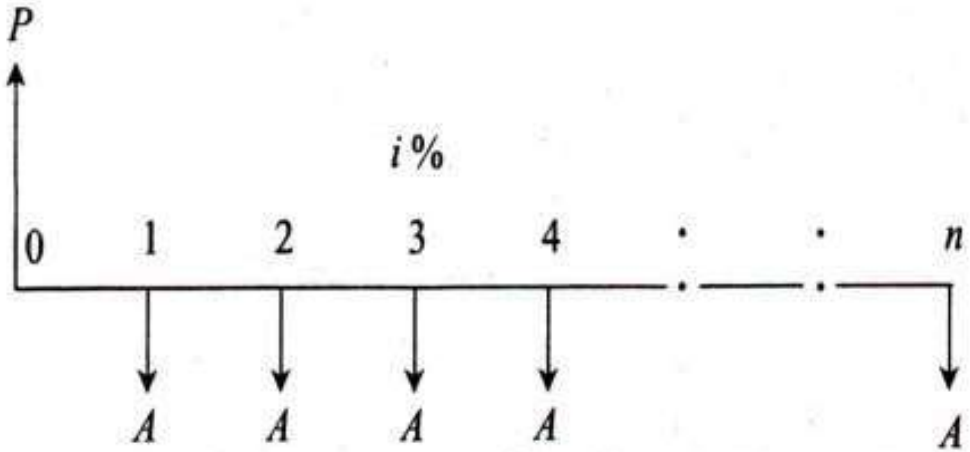
CASH FLOW DIAGRAM

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.*



Worked Example:

A company wants to set up a reserve which will help it is have an amountreserve amount. The next 20 years towards its employees welfares

Measures. The reserve is assumed to grow at the rate of 15% annually. Find the single payment that must be made as the reserve amount.

Solution :

A = Rs 15,00,000

n = 20 years i = 15%

P = ?

P = A (P/A, i,n)

= 1500000 x 6.2593

=Rs 93,88,950/-

EQUAL PAYMENT SERIES CAPITAL RECOVERY AMOUNT

The objective 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) sanctioned at an interest rate of i compounded at the end of every interest period.

CASH FLOW DIAGRAM

P = present worth (loan amount)

A = annual equivalent payment (recovery amount)

i = interest rate

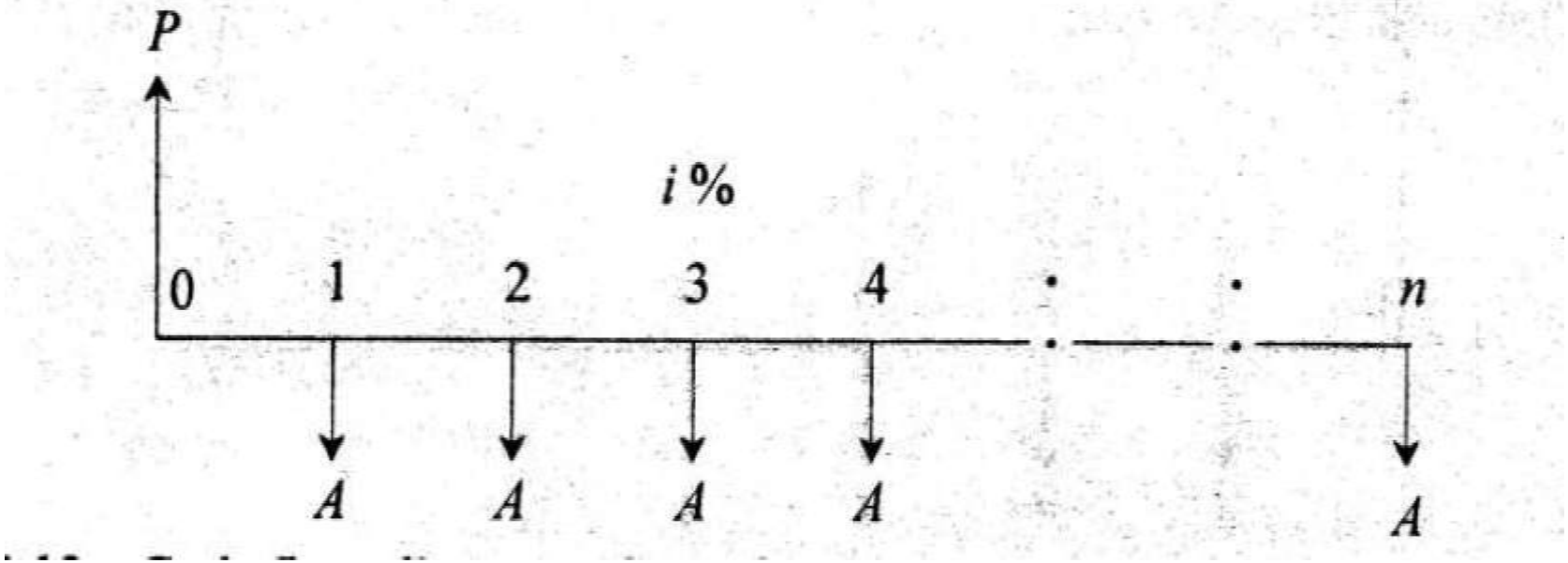
n = No. of interest periods

The formula to compute A is as follows:

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

where

CASH FLOW DIAGRAM



Worked example:

A company takes a loan of Rs 20,00,000 to modernize its boiler sections. The loan is to be repaid in 20 equal installments at 12 % interest rate compounded annually. Find the equal installment amount that should be paid for the next 20 years.

Solution

P = Rs 20,00,000

n = 20 years i = 12%

A = ?

A = P(A/P, i,n)

= 2000000 x 0.1339

= Rs 2,67,800/-

WORKED EXAMPLE 2 :

A bank gives loan to a company to purchase an equipment which is worth of Rs 5,00,000 at an interest rate 11% compounded annually. This amount is to be repaid in 25 equal installments. Find the installment amount that the company has to pay to the bank