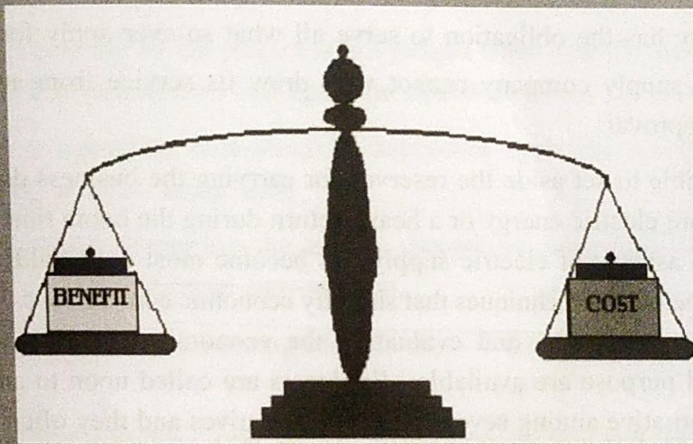
CHAPTER - 2

ENERGY ECONOMIC ANALYSIS



OBJECTIVES

You will be able to:

- Explain what is the time value of money concept and What are the different cash flow modules.
- Explain pay back analysis and Mention its advantages and disadvantages.
- Write short notes on couses of Depreciation.
- Explain the meaning of Depreciation and how it is is calculated using: i) Sum of digits method; ii) Stright line Method.
- Develop a cash flow model for Uniform series compound amount factor and single payment compound amount factor.
- Explain the meaning of life cycle cost analysis
- List the advantages of Energy Audit
- Enumerate the Costs of in Electrical Energy Generated

INTRODUCTION:

A country is said to be strong and progressive if she has a strong economic position.similarly commercial enterprises incuding electric supply companies must have a strong footings to stay in business and attract capital to meet new and additional demands, how ever,there are basic differences between electric utility company and the usual business enterprise, these are:

1. Electric supply companies usually donot have directly competition, even though being public utility services, there is a limitation to the earnings. In most of the cases, this business is in the hands of states.
2. The company has the obligation to serve all what so ever apply for its service.
3. The electric supply company cannot with draw its service from any consumer without regulatory approval.

As it is not possible to set aside the reserves for carrying the business during low earnings or slack period or to store electric energy or a heavy return during the boom times, so, thorough study of various economic aspects of electric supply has become most essential.Engineering Economy is a collection of mathematical techniques that simplify economic comparisons. Engineering economy involves formulating, estimating, and evaluating the economic outcomes when alternatives to accomplish a defined purpose are available. Engineers are called upon to analyze and select the most economical alternative among several design alternatives and they often play a major role in investment decisions based on the analysis and design of new products or processes.

Energy exists in various forms across the globe, for human comforts. it has to be transformed into a convenient (Electrical) form and made available at the door steps of the consumer.for this huge sum of money (in crores) has to be spent /invested by government /public sectors on the energy projects/programmes. If the investment is not judicious, then the entrepreneurs (company) suffer huge losses. Hence to justify the energy investment cost, knowledge of energy economic analysis is required.

Cost of Generating Station

When ever any project is sponsored by an individual or by group of people or by the state a certain amount of capital is required. The total capital required can be sub divided into the following two heads:

1. Fixed Capital, (2) Running Capital (Variable Cost).

Fixed Capital. The total capital comprises that part of the project which is to be spent for the purchase of assets such as land, plant and equipments etc, on which the further operation of the project depends. For an electrical installation the fixed cost may be grouped under the following heads:

i. Capital cost of Generating Equipment.
ii. Capital cost for Transmission system.
iii. Capital cost for Distribution system both H.T and L.T.

The cost incurred as freight, Cartage, Octroi, labour etc, to bring the equipment from the manufactures premises to the site of erection are to be taken in account into the capital cost of the plant.

The cost of implement to be purchased for erection purposes and the cost of supervision. Book keeping, managerial work etc for the purchase of equipment up to the instant it can be commissioned must also be added the capital cost of the equipment.

Running Capital. The capital required for the purchase of raw materials, payment of salary, wages etc, for the for the continuous operation of the project, make up the running cost.

Annual cost. The economy of the project is not judged from total investment made for it. But from the annual cost. The annual cost can again be subdivided into the following two heads:

i. Running cost or operating cost-which is dependent upon the manner and to extent to which the equipment is being used

ii. Fixed charges-which comprises the annual charges on the assets on the assets covered under fixed capital to be taken into account.

Running Charges. The annual running charges of an electric station comprise the following

i. Fuel cost.

ii. Maintenance and repairing cost of the equipment in the generating, transmission and distribution sections.

iii. Wages of the operational staff.

iv. The wages of the supervising staff.

v. Cost of water, lubricating oil etc.

Fixed charges. These depend upon the equipment acquired of the use. It is being put in and the capital cost incurred on the other assets such as buildings etc.

The annual fixed charges comprise the following:

i. **Taxes**. Generally the following taxes are to be paid:

a. The property taxes levied on the generating station building and substation building etc.

b. Tax to be paid to the municipal corporation for the use of streets roads etc.

c. Tax to be paid to the government as public utility tax for inspection purposes etc.

d. Income tax.

e. These may vary from 1 to 2 percent of the capital cost assets over which the taxes are being paid.

frieght → goods trasported in bulk by truck, ship or aircraft
cartage → delivery of goods by road from a warehouse
octroi → tax that you pay on goods when you bring them into a particular area

ii. **Insurance charges.** The following premiums are to be paid to the insurance company:

a. To cover the risk of fire to the buildings
b. To cover accidental breakdown.
c. Workers compensation

iii. **Depreciation or sinking fund.** After a certain time the equipment is to be replaced due to the following reasons:

1. **Physical**. This is due to reasons that the plant has worn out and has become unfit for further use.
2. **Functional.** It can be further subdivided into the following two parts
   a. The capacity of the plant has become inadequate due to the growth of Load.
   b. The plant has become obsolete due to new technical improvements.

2.1. The time value of money concept:

"The change in the amount of money over a given time period is called the time value of money" Money can "make" money if invested. Money made depends on the interest rate, Money has a time value. capital can be employed productively to generate positive returns, in which case an investment of one Rupee today would grow to (1+i) in a year where 'i' is the rate of ineterst earned on the investment. But in an inflationary period, a Rupee today represents a greater purchasing power than a Rupee a year, hence almost every one is directly exposed to interest transactions and is indirectly affected regularly. It is essential to know the various factors and qualities. Which have to be considered in the various types of costs like money to be spent, money to be borrowed, money to be kept as depreciation etc, the knowledge involved in the calculation of interest, annuities etc ,helps to formulate the budget. It also helps to take a decision regarding the selection of proper equipment from various available alternatives.

The cash flow occurs at different points of time have to be brought to the same point of time for purposes of comparision.hence,it is important to understand the role of compounding and discounting in dealing with the time value of money.

2.2. Interest:

Interest is the earning power of money. It represents the growth of capital per unit period. The period may be a month, a qurter, semi annual or a year. In other words, interest is the income produced by money that is lent or loaned. It is the premium paid to compensate a lender for the administrative expenses for making a loan for risk of non payment and loss of use of the loaned money.

Annuities → a fixed sum of money paid to someone each year, typically for the rest of the life"
& a form of ~~[illegible]~~ insurance or investment entitling the

2.3. Types of interest:

2.3.1. Simple interest:

In simple interest, the interest to pay on repayment of loan is proportional to the length of the time and the principle sum borrowed.

Let P=principal amount

i=Rate of interest

n=no of periods

Then, Total interest, i=Pni

If F is the total sum realized after n years, then

F=P+i=P+Pni

$\boxed{F=P\ (1+ni)}$

2.3.2. Compound interest:

In compound interest, the interest for the current period is computed based the amount i.e., principal plus interest up to the end of the previous period that is at the beginning of the current period. It means that each interest payment is reinvested to earn further interest in future periods.

Let P=Principal amount at the beginning of the year

F=Future amount

i=Rate of interest per annum

At the end of 1st year, the amount payable, $F_1=P\ (1+i)$

At the end of 2nd year, the amount payable, $F_2=P\ (1+i) + (1+i)$

$F_2=P\ (1+i)^2$

$F_3= P\ (1+i)^3$

Generally at the end of 'n' years, Total amount accumulated will be

$\mathbf{F_n=P\ (1+i)^n}$

2.3.3. Nominal interest rate:

Ihe interest period is normally one year. The interest based annually is known as nominal Interest rate.

2.3.4. Effective interest:

Sometimes, the interest period may be less than one year. In half yearly compounding, interest is compounded twice a year, in quarterly four times a year and in monthly 12 times a year and so on, based on the number of compounding periods, this frequent compounding results in higher interest rates. This interest rate is known as effective interest rate.

If i=nominal interest rate, C= no of compounding in a year, i_e= Effective interest rate

Then, $i_e = \left(1 + \frac{i}{C}\right)^c - 1$

Interest to a series of annual fees -

Note:

When compounding is more than once a year, then Future amount can be found either by (1) Finding out the effective interest rate (i_e) and then substituting the effective rate in $F = P(1+i)^n$, or

By using the formula $\boxed{F = P\left(1+\frac{i}{C}\right)^{cn}}$

Where i= Nominal rate of interest, C=No of interest periods/year, n=total no of years

2.3.5. True or continoues compounding:

the ultimate limit for the no of compounding periods in one year is called continuous compounding. The effective interest for continuous compounding for a nominal interest rate (i) is developed as

$i_e = e^i - 1$ and $F = Pe^{n\ ie}$

2.3.6. Present worth:

Refers to the value of money as on dated for which payment has to be made at a future day with due interest.

2.3.7. Future worth:

Refers to the realized amount along with interest

Annuity:

It is a sum of money received or paid in annual in one or more instalments, for a given period of time. Is a stream of constant flow, either payment receipt occurring at a regular interval of time.

2.4 Developing cash flow models:

2.4.1. Cash flow diagram:

It is a tool in graphical form which helps the decision maker to understand and solve problem during several equivalent situations. During the construction of a cash flow diagram, the structure of a problem often becomes distinct. it is usual advantageous to first define the time frame over which cash flow occurs. This establishes the horizontal scale; it is divided into time period, often in years. Cash flow are then located on the time scale in adherence to problem specifications.

2.4.2. The cash flow model:

The cash flow model assumes that cash flow occurs at discrete points in terms of lump sum and that interest is computed and payable at discrete points in time. To develop cash flow model which illustrates the effect of compounding of interest payments, the cash flow model is developed as follows:

End of year 1: $p+i\ (p) = (1+i)\ P$

End of year 2: $(1+i)\ P+ (1+i)\ Pi= (1+i)\ P\ (1+i) = (1+i)^2 p$

End of year 3= $(1+i)^3 p$

Year n: $(1+i)^n P$ **or** $S= (1+i)^n P$

Where p= present sum

i= Interest rate earned at the end of each interest period

n= number of interest periods

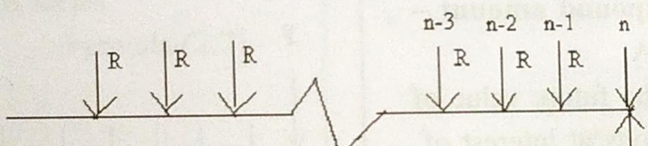
s= future value

$(1+i)^n$ P is refereed as the single payment compound amount factor and is tabulated for various values of i

The cash flow model can also be used to find the present value of a future sum S

$$\boxed{P = \left(\frac{1}{(1+i)^n}\right) S}$$

Cash flow models can be developed for a variety of other types of each as illustrated in figure below



Where R is a Uniform series of year end payments and s is the future sum of R payments for n interest periods.

The R dollars deposited at the end of the n^{th} period earns no interest and there fore contribute R dollars to the fund .The R dollars deposited at the end of the (n-1) period earn interest for 1 tear and will there fore, contribute R (1+i) dollars to the fund. The R Dollars deposited at the end of (n-1) period earn interest for 1 year and there fore contribute R (n+1) Dollars to the fund.

R Dollars deposited at the end of (n-2) period earn interest for 2 years and will ,therefore, contribute R $(1+i)^2$ these years of earned interest in the contribution will continue to increase in this manner. And the R deposited at the end of the first period will have earned interest for (n-1) periods. The total in the sum S is, thus equal to

$$R+R(1+i)+R(1+i)^2+ R(1+i)^3+ R(1+i)^4+ \ldots\ldots + R(1+i)^{n-2}+ R(1+i)^{n-1}.$$

Factorizing out R.

$$S=R[1+(1+i)+ (1+i)^2+\ldots\ldots+(1+i)^{n-2}+(1+i)^{n-1}] \text{ ------------------(1)}$$

Multiplying both sides of this equation by (1+i)

$$(1+i)S= R[(1+i)+ (1+i)^2+\ldots\ldots+(1+i)^{n-1}+(1+i)^{n}] \text{ ------------------(2)}$$

Subtracting equation 1 from equation 2

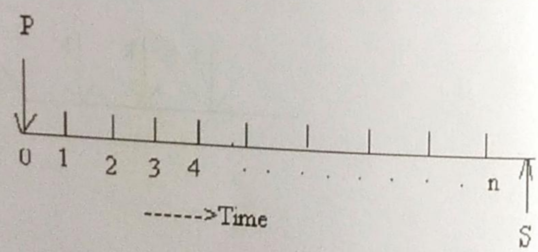
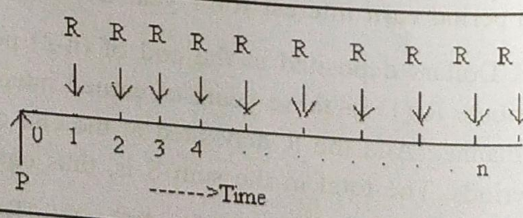
$$(1+i)S-S= R[(1+i)+ (1+i)^2+\ldots\ldots.+(1+i)^{n-1}+(1+i)^{n}]- R[1+(1+i)+ (1+i)^2+\ldots.+(1+i)^{n-2}(1+i)^{n-1}]$$

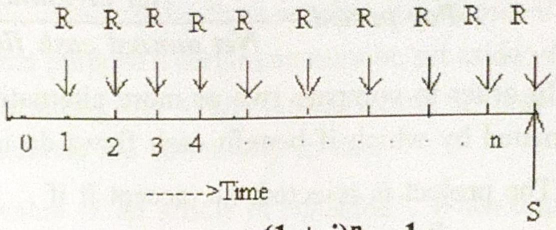
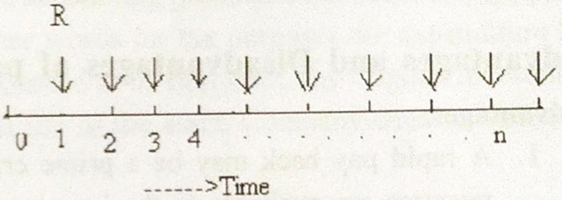
$$Si=R\ [(1+i)^{n}-1]$$

$$\boxed{S = R\left[\frac{(1 + i)^n - 1}{i}\right]} \quad \text{------------------(3)}$$

The equation 3 is the cash flow model for the present value of a future sum S

Interest factors are seldom calculated. They can determine from programs, each factor is defined when number of periods (n) and interest rate (i) is specified. In the case of Gradient present worth factor the escalation rate must also be stated. The three most commonly used methods in life cycle costing are the annual cost, present worth and rate of return analysis.

Single payment compound amount – SPCA The SPCA factor is the future value of one dollar in "n"periods at interest of "i"present. S=PX (SPCA)n_i Formula—(2.1)	
<u>Single payment present worth –SPPW</u> Then SPPW factor is the present of one dollar. "n"perids from now at interest of "I"Present. P=SX(SPPW)i_n Formula—(2.2)	$SPCA=(1+i)^n$ $SPPW = \frac{1}{([1 + i)]^n}$
<u>Uniform series compound amount-USCA</u> The USCA factor is the future value of a uniform series of 1 dollar deposits. S=Rx(USCA)i_n Formula—(2.3)	
<u>Sinking fund payment –SFP</u> SFP factor is the uniform series of deposits whose future value is one dollar. *R=Sx(SFP)i_n Formula—(2.4)*	$USCA = \frac{([1 + i)]^n - 1}{i}$ $SFP = \frac{i}{[(1 + i)]^n - 1}$

Uniform series present worth-USPW The USPW factor is the present value of uniform series of one dollar deposits. $P=Rx(USPW)i_n$ Formula—(2.5)	 $USPW = \frac{(1+i)^n - 1}{i(1+i)^n}$
Capital recovery-CR The CR factor is the uniform series of deposits whose present value is one dollar. $R=Px(CR)i_n$ Formula-(2.6)	$CR = \frac{i(1+i)^n}{(1+i)^n - 1}$
Gradient present worth-GPW The GPW factor is the present value of a gradient series $P=Rx(GPW)i_n$ Formula-(2.7)	 $GPW = \frac{\frac{1+e}{1+i}\left[1-\left(\frac{1+e}{1+i}\right)^n\right]}{1-\frac{1+e}{1+i}}$

Where,

P = is the present worth (occurs at the beginning of the interest period).
S = is the future worth (occurs at the end).
n = is the number of periods that the interest is compounded.
i = is the interest rate or desired rate of rate of return.
R = is the uniform series of deposits (occurs at the end of the interest period).
e = is the escalation rate.

2.5 Pay back analysis:

The simple payback analysis is sometimes used instead of the methods previously out lined the simple pay back is defined as an investment divided by annual savings after taxes. The simple pay back does not take into account the effect of interest or escalation rate. Since the pay back period is relatively simple to calculate and due to the fact managers wish to recover their investment as rapidly as possible the payback method is frequently used. It should be used in conjunction with other decision tools. when used by itself as the principal criterion it may result in choosing less profitable investments which yield high initial returns for short period as compared with more profitable investments which provide profits over long period of time The pay back period is based upon determining the numbers of years required for the invested capital to be recovered from net cash flows.

$$\textit{Pay period} = \frac{\textit{Net investment or capital cost}}{\textit{Net annual cash flow or net annual savings}}$$

In order to compare two or more alternatives .some maximum acceptable time horizon N is estimated by which if benefit cash flows do not cover all cost flows in the period.

The project is rejected, i.e. accept it if

$$\sum_{i=0}^{n} CFi - Cost > 0$$

Where , CF_i = cash flows, cos = cost, t = time

Computationally the method is simple, how ever, conceptually. it has the following

Advantages and Disadvantages of pay back analysis:

Advantages:

1. A rapid pay back may be a prime criterion for judging on investment when financial resource are available to the investor for only a short period of time.
2. The speculative investor who has a very limited time horizon will usually desire rapid recovery of the initial investment.
3. Where the expected life of the assets is highly uncertain, the determination of the breakeven life, i.e, pay back period, is helpful in assessing the likelihood of achieving a successful investment.

Disadvantages:

1. The time value of money is not directly considered, indeed payback implies a zero discount rate toN and an infinite rate there after. With no pinning down of the particular time of money. One can only compare alternative conservation actions that require exactly the same life or term and cannot compare optional programmes that would have different estimated life time periods
2. The effect of cash flows occurring after the payback period is not considered. Clearly, the method makes no allowance for projects with long gestation periods, the selection of N being arbitrary.

2.6. Depreciation:

After a certain time the equipment is to be replaced due to the following reasons:

- This is due to the reasons that the the plant has worn out and has become unfit for further use.
- The capacity of the plant has become inadequate due to the growth of Load.
- Plant has become obsolute due to new technical improvements.

The life of the plant is decided it keeping in view the above facts.so after the elapse of life of the plant is to be replaced by a new one and for that purpose a certain amount be set aside yearly to cover the cost.there are many methods of calculating the yearly subscription towards this fund.out of there straight line and sinking fund methods are commonly in use.

Depreciation can be defined as "a falling off value of an article or machine". When applied to money it means a loss of exchange value or purchasing power applied to other things it means a lowering of other things. It is also defined as "fall in the capital outlay of wasting assets" Depreciation is the accounting of the deterioration of the physical and functional utility of a fixed asset due to usage and time. . Internal Revenue Service allows several methods for determining the annual depreciation rate. Depreciation affects the accounting procedure for determining profits and losses and the income tax of a company. In other words for tax purposes the expenditure for on asset such as a pump or motor cannot be fully expensed in its first year. The original investment must be charged of for tax purposes over the useful life of the asset. Company usually wishes to expense an item as quickly as possible.

2.7 Methods of Depreciation:

1. Straight line Depreciation.
2. Sum of years digits Depreciation.
3. Declining balance Depreciation.
4. Sinking fund Depreciation.

2.7.1 Straight line Depreciation:

the useful life of any plant may be fixed by the time taken for it to wear out and become unfit for further use, or it may be fixed by becoming obsolete due to new technical improvements .in either case, money must be set aside, so that at the end of the useful life of the plant there will be a sufficient sum available to purchase a new plant, to carry on the business, or to repay the loan which was initially raised to purchase the plant. The PP calculated above, illustrating just how long it will take for an investment to be paid off through operating savings, does not differentiate between money saved now and money saved in the future,i.e there is no recognition of the time value of money. With no pinning down of the particular time values of money, one must only compare alternative conservation actions that require exactly the same life or term. and one cannot compare optional programmed that have different estimated life time periods .The simplest method is referred to as straight line depreciation and is

$$D = \frac{(P - L)}{n}$$

Where; **D** is the annual Depreciation rate; **L** is the value of equipment at the end of its useful life, commonly referred to as Salvage value; **n** is the Number of years of useful life of equipment which is determined by internal revenue Service Guidelines; **P** is the initial cost. The figure 2.7.1 illustrates the straight line depreciation Method

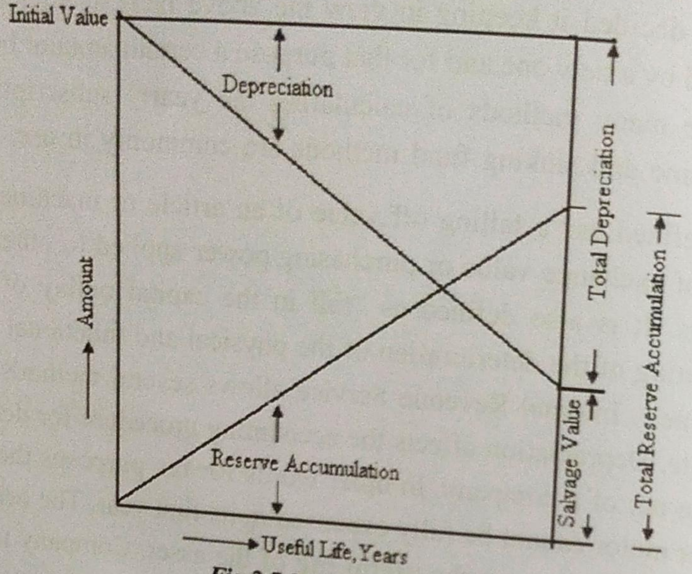


Fig.2.7.1.Stright line Depreciation

2.7.2 Sum of years digits Depreciation

Another method is referred to as the sum of year digits .in this method the depreciation rate is determined by finding the sum of digits using the following formula:

$$N = \frac{n(n+1)}{N(P-L)}$$

$N = \frac{n(n+1)}{2}$

Where n is the life of equipment.each year's depreciation rate is determined as follows:

First year

$$D = \frac{n}{N(P-L)}$$

$D_0 = \frac{n}{N}(P-L)$

Second year

$$D = \frac{n-1}{N(P-L)}$$

n^th year

$$D = \frac{1}{N(P-L)}$$

$D_1 = \frac{n-1}{N}(P-L)$

$D_2 = \frac{n-2}{N}(P-L)$ $D_n = \frac{1}{N}(P$

2.7.3. Declining balance Depreciation

The declining balance method allows for larger depreciation charges in the early years which are some times referred to as fast write-off. (Fixed percentage method) The rate is calculated by taking a constant percentage of the declining undepreciated balance. The most common method used to calculate the declining balance is to pre determines the depreciation rate. Under certain circumstances a rate equal to 200% of the straight line depreciation rate may be used. Under other circumstances the rate is limited to 1 ½ or ¼ times as great as straight line depreciation. In this method the salvage value or undepreciated book value is established once the depreciated rate is reestablished.

To calculate the undepreciated book value below formula is used

$$D = 1 - \left(\frac{L}{P}\right)^{1/N}$$

Where,

D is the annual depreciation rate

L is the salvage value

P is the first cost.

2.7.4 Sinking Fund Depreciation Method:

It may be necessary to take a loan from a bank to purchase new equipment .this loan must be repaid over the life time of the equipment. The usual method of ensuring loan repayment is to pay annual installments into a deposit called "sinking fund".This method is based on the fact that the annual depreciation reserve, when invested at compound interest, will accumulate to the difference between the initial cost and the salvage value at the end of the usefull life of the equipment.

Annual sinking fund Depreciation reserve = ***[Initial cost - Salvage value]X[i/(([1+i)] in) - 1)]***

Where i is the interest rate and n is the number of years.The sinking fund Dpreciation method is illustrated in Fig 2.7.4

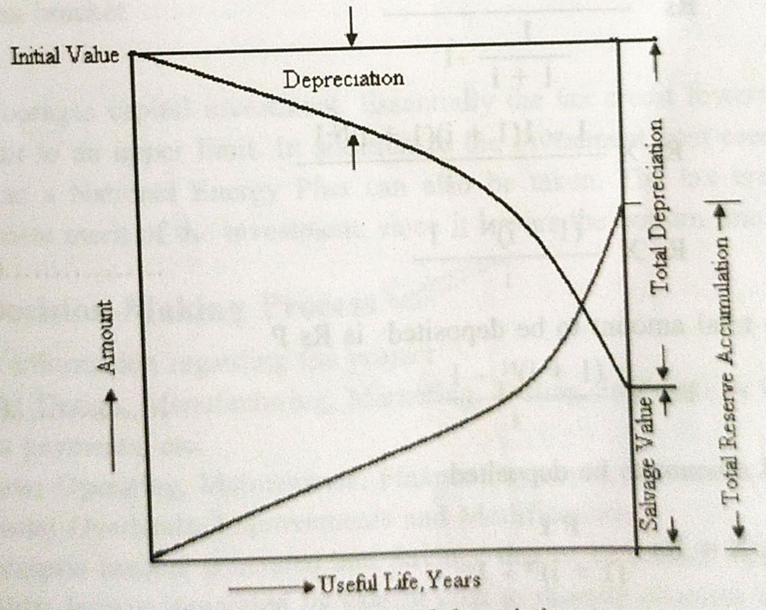


Fig 2.7.4.Sinking fund depreciation

Let Rs P are to be provided after N years.If the amount in the sinking fund is kept in a safe then naturally the amount to be provided per year will be Rs P/N but generally the sinking fund is invested in divided giving concernes so that the amount may earn interest.Let the amount so deposited after first year be Rs X and i be the annual rate of interest.

After elapse of one year, in N-1 years thus the amount will be

$$= Rs\ X\ (1+i)^{N-1} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

After elapse of 2nd year, in N-2 years the amount will be

$$= Rs\ X\ (1+i)^{N-2} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

Similarly after elapse of 3rd year, in N-3 years the amount will be

$$= Rs\ X\ (1+i)^{N-3} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

After elapse of N-1 years the X deposited will be of worth

$$= Rs\ X\ (1+i) \quad \ldots\ldots\ldots\ldots\ldots (4)$$

After N years, Total Sinking fund will be will be

$$= Rs\ X\ \{(1+i)^{N-1} + (1+i)^{N-2} + (1+i)^{N-3} + \ldots (1+i)\} \quad \ldots\ldots\ldots\ldots\ldots (5)$$

The above terms are in geometric progression having a common ration

$$R = \frac{1}{1+i} \quad \ldots\ldots\ldots\ldots\ldots (6)$$

$$\text{Total sum} = Rs\ \frac{RX - X(1+i)^{N-1}}{R-1}$$

$$Rs\ \frac{\frac{1}{1+i}x - x(1+i)^{N-1}}{\frac{1}{1+i} - 1}$$

$$Rs\ X\ \frac{1 - 1(1+i)(1+i)^{N-1}}{-i}$$

$$Rs\ X\ \frac{(1+i)^N - 1}{i} \quad \ldots\ldots\ldots\ldots\ldots (7)$$

Since the total amount to be deposited is Rs P

$$P = Rs\ X\ \frac{(1+i)^N - 1}{i} \quad \ldots\ldots\ldots\ldots\ldots (8)$$

Or annual amount to be deposited

$$Rs\ X = Rs\ \frac{P\,i}{(1+i)^N - 1}$$

Advantages and Disadvantages of Sinking Fund Depreciation Method:

Advantages

1. Interest on deposits made also adds upto the depreciation reserve. Thus same savings results, making the method economically sound.
2. This is the only method, which provides cash for the replacement of asset at the end of its useful life.

3. The method provides means to get amortized from the loans and leases.
4. It enables drawing up of balance sheets.

Disadvantages

1. Calculation is not simple.
2. Accounting is rather difficult.
3. Fixed amount of deposit, standing for depreciation, is most of the cases not according to the very rate of depreciation.

2.8 Taxes and tax credit

2.8.1 Tax Consideration

Tax deductible expenses such as maintenance, energy, operating costs, insurance and property taxes reduce the income subject to taxes. For the after tax life cycle cost analysis and payback analysis the actual incurred annual savings is given as follows:

$$AS = (1-i)\,E + iD$$

AS = yearly annual after tax savings (excluding effect of tax credit)

E = yearly annual Energy savings (difference between original expenses and expenses After modification)

D = annual Depreciation rate

i = income tax bracket

2.8.2 Tax Credit

A tax credit encourages capital investment. Essentially the tax credit lowers the income tax paid by the tax credit to an upper limit. In addition to the investment cost credit, the Business Energy Tax Credit as a National Energy Plan can also be taken. The tax credit substantially increases the investment merit of the investment, since it lowers the bottom line on the tax form.

2.9 Economic Decision-Making Process

Collect relevant information regarding the project

1. **Initial Costs:** Design, Manufacturing, Marketing, Testing, Installation, Construction, Taxes, down payments, etc.
2. **Annual Costs:** Operating, Maintenance, Finance Payments, Insurance, Income Taxes,
3. **Periodic Costs:** Overhauls, Improvements and Modifications.
4. **Annual Receipts:** Income generated and Savings due to increased Productivity.
5. **Salvage Value:** Income generated by sale or cost to remove obsolete equipment.

2.10 Recognize and Define Feasible Alternatives:

Consider all possible options including the "Do nothing" alternative. The generated alternatives may not be economically viable. Examine each alternative and remove any overlapping options. If the productivity is the about the same for each alternative, focus only on the costs

2.11 Life Cycle Cost Analysis:

The life cycle cost analysis evaluates the total owning and operating cost. It takes into account the time value of money and can incorporate fuel cost escalation into the economic model. This approach also used to evaluate competitive projects. In other words the life cycle cost analysis considers the cost over the life of system rather than the just the initial investment cost. Such an analysis of money spent on energy projects is the energy economic analysis.

Typical costs for a system may include:

- Design and development costs.
- Operating costs
- Cost of repair
- Cost of failure
- Down time cost
- Cost of spares
- Loss of production 1) Disposal cost 2) Other costs
- Accounting financial elements ,such as discount rates, interest rates, depreciation
- Present value of money

2.12 Different Ways to Minimize Costs

1. Project Engineering wants to minimize capital costs as they criteria,
2. Maintenance Engineering wants to minimize repair hours as the only criteria,
3. Production wants to maximize uptime hours as the only criteria,
4. Reliability Engineering wants to avoid failures as the only criteria,
5. Accounting wants to maximize project net present value as the only criteria, and
6. Shareholders want to increase stockholder wealth as the only criteria.
7. Management is responsible for harmonizing these potential conflicts under the banner of operating for the lowest long term cost of ownership.
8. LCC can be used as a management decision tool for harmonizing the never ending conflicts by focusing on facts, money, and time.

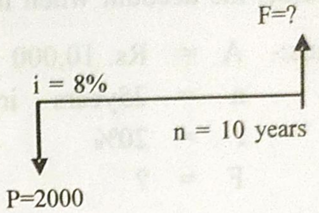
Computer analysis software package

M/s The Alliance to save energy, Washington DC, has developed an investment analysis software package ,ENVEST, which is available in 5.25 inch disc &3.5.inch disc sizes and includes a 170 page user manual and 30 days of telephonic support. The programme can be run on an IBM PC, PCXT, PCAT with 256K RAM .The programme enables the user to, and Generate spread sheets and graphs showing the yearly cash flows from any energy related investment. Compute payback, internal rate of return and other important investment measures. Experiment with differing Energy Price Projections.

Perform sensitivity analysis on key assumptions. Compare alternative financing options including Loans, Leases and shared savings. Store data of over 100 Energy efficiency investments.

2.13 Worked Ecamples

2.13.1 Mr. x deposit's Rs. 2000 in a SB account which pays an interest rate of 8% per year compounded annually. If all the money is accumulated, how much will Mr. x will have after



Ans: - P = Rs. 2000

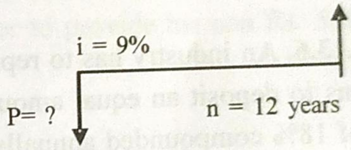
I = 8% compounded annually

n = 10 years

F = $P(1+i)^n = 2000\,(1+0.08)^{10}$

F = Rs. 4317.85

2.13.2 How much money must be deposited in a SB account so that Rs. 2, 00,000 can be withdrawn after 12 years from now, if the interest rte is 9% compounded annually?



Ans:- F = Rs. 2,00,000

n = 12 years

i = 9% compounded annually

P = $P(1+i)^n = 2000\,(1+0.08)^{10}$

$$P = \frac{F}{(1+i)^n} = \frac{200000}{(1+0.09)^{12}} = \frac{200000}{2.81266}$$

P = Rs. 71106.945

2.13.3 A person invests a sum of Rs. 5000 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?

Ans:- P = Rs. 5000

n = 10 years

i = 12% (nominal)

F = ?

C = No. of compounding

= 4 in a year

$$F = P\left(1+\frac{i}{c}\right)^{cn}$$

$$= 5000\left(1+\frac{0.12}{4}\right)^{4x10} = 5000\,(1.03)^{40}$$

F = Rs. 16310.19

2.13.4 A company wants to set up a reserve which wills the company to have an annual equivalent amount of Rs. 10, 00,000 for the next years towards its employee's welfare measures. The reserve is assumed to grow at the rate of 15% annually. Find the single – payment that will be made now as the reserve amount.

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

Ans:- A = Rs. 10,00,000

I = 15%

n = 20 years

P = ?

$$= 1000000\left[\frac{(1+0.15)^{20} - 1}{0.15\,(1+0.15)^{20}}\right]$$

$$P = 1000000\left[\frac{15.3665}{2.4549}\right]$$

P = Rs. 62, 59,300.

2.13.5 A person who is now 35 years old is planning for hi, retired life. He plans to invest 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, his account when he is 60 years old.

Ans:- A = Rs. 10,000

n = 25years ir. (60-35)

i = 20%

F = ?

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

$$= 10000\left[\frac{(1+0.2)^{25} - 1}{0.2}\right]$$

$$= 10000\left[\frac{94.3962}{0.2}\right]$$

F = Rs. 47, 19,810

2.13.6. An industry has to replace a present facility after 15 years at an outlay of Rs. 500000. 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.

Ans:- F = Rs. 500000

n = 15years

i = 18% compounded annually

A = ?

$$A = F\left[\frac{i}{(1+i)^n - 1}\right] = 500000\left[\frac{0.18}{(1+0.18)^{15} - 1}\right] = \left[\frac{0.18}{10.9737}\right] \times 500000$$

$$= 500000 \times 0.0164$$

A = Rs. 8,200

2.13.7 Mr. X deposits Rs. 1000 at the end of each year which pays an interest rate of 6% compounded annually. How long does it take to accumulate Rs. 20000?

Ans:- A = Rs. 1000

i = 6%

F = Rs. 20,000

n = ?

$$A = F\left[\frac{i}{(1+i)^n - 1}\right] = 20000\left[\frac{0.06}{(1.06)^n - 1}\right]$$

$$1000 = 20000\left[\frac{0.06}{(1.06)^n - 1}\right]$$

$$(1.06)^n - 1 = \frac{20000}{1000} \times 0.06 = 1.20$$

$$(1.06)^n = 1.2 + 1 = 2.2$$

Taking log on both sides

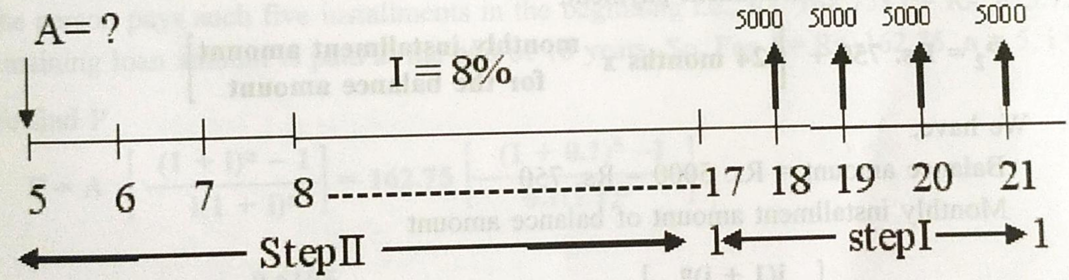
$$n \log 1.06 = \log 2$$

$$n = \frac{\log 2}{\log 1.06} = \frac{0.3424}{0.0253} = 13.53 \text{ Years}$$

n = 13 years 6 months 11 days.

2.13.8 A father wants to set aside his money for his 5 year old son for future education. Money can be deposited in a bank account that pays 8% per year compounded annually. What deposits should be made by the father till his son's 17th birthday in order to provide his son Rs. 5000 on his 18th, 19th, 20th & 21th birthday?

Ans:-

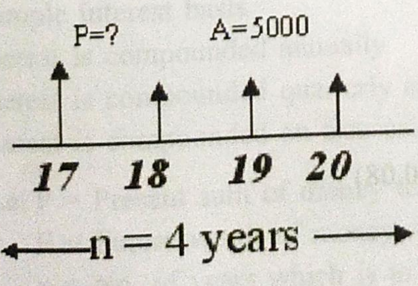


StepI: A = 5000
i = 8%
n = 4 years
P = ?

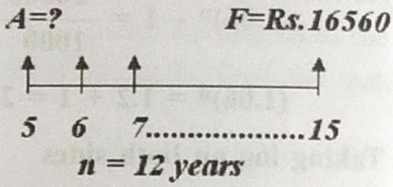
$$P = A\left[\frac{(1+i)^n - 1}{i\,(i+i)^n}\right] = 5000\left[\frac{(1+0.08)^4 - 1}{0.08\,(1+0.08)}\right]$$

$$= 5000 \times \frac{0.3604}{0.1088}$$

P = Rs. 16560/-



Step II:



F = Rs. 16560 ie. (P obtained before)
$i = 8\%$
n = 12years (from 5^{th} to 17^{th} year)
A =?

$$A = F\left[\frac{i}{(1+i)^n - 1}\right] = 16560\left[0.\frac{0.08}{(1 + 0.08)^{12} - 1}\right] = 16560 \times \frac{0.08}{1.51}$$

A = Rs. 872.63

2.13.9 A TV set can be purchased for a down cash of Rs. 5060. Alternatively it can be purchased for an initial payment of Rs. 750 only, with another 24 end monthly installment. By how much will the total exceed the cash price, if the interest if reckoned at 1% p.m?

Ans:- **case I :** For down cash payment, P_1 = Rs. 5000

Case II : For installment payment,

$$P_2 = \text{Rs. } 750 + \left[24 \text{ months} \times \frac{\text{monthly installment amount}}{\text{for the balance amount}}\right]$$

We have,

Balance amount = Rs. 5000 – Rs. 750

Monthly installment amount of balance amount

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

$$4250\left[\frac{0.01(1 + 0.01)^{24}}{(1 + 0.01)^{24} - 1}\right]$$

$$= 4250\left[\frac{0.01(1.2697)}{1.2697 - 1}\right]$$

$$= 4250 \times \frac{0.012697}{0.2697}$$

= **Rs. 200.08**

∴ Net amount paid P_2 = 750 + (24x200.08)

P_2 = Rs. 5551.92

∴ The total exceeds the cash price by

(Rs. 5551.92 – Rs. 5000) =

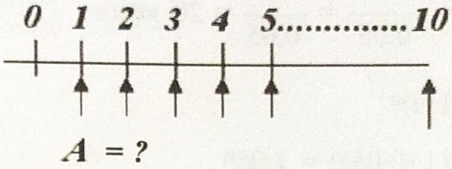
Rs. 551.92.

2.13.10 A person arranges to pay Rs. 1000 loan in 10 annual installments. The rate of interest is 10%. After paying 5th installment, he wishes to pay the balance in a lump sum at the end. How much has he to pay assuming there is no penalty amount?

Ans: - For n = 10 year

i = 10%

P = 1000



We find A,

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

$$A = 1000\left[\frac{0.1(1.1)^{10}}{(1.1)^{10}-1}\right] = 1000\left[\frac{0.2594}{1.5937}\right] = 1000\ (0.16275)$$

A = Rs. 162.75

The person pays such five installments in the beginning i.e., Rs. 162.75x5 = Rs. 813.75. And the remaining loan amount is paid at the end of 10 years. So, For A= Rs. 162.75, n = 5, i = 10%

We find P

$$\mathbf{P = A\left[\frac{(1 + i)^n - 1}{i(1 + i)^n}\right] = 162.75\left[\frac{(1 + 0.1)^5 - 1}{0.1(1.1)^5}\right]}$$

$$\mathbf{= 162.75 \times \frac{0.6105}{0.16105} = Rs.\ 616.95}$$

For this , P = Rs. 616.75, n = 5years, i = 10%,

We find Fi.e., $F = P(1 + i)^n$

F = 616.75 $(1+0.1)^5$= **Rs. 993.604** is the balance amount paid in lump sum.

2.13.11 How long will it take for a sum of money to double? When a accumulating at 5% interest?

a) On simple interest basis
b) If interest is compounded annually
c) If interest is compounded quarterly and
d) If interest is compounded on true compound interest basis

Ans: Let P = Present sum of money to be deposited

F = Future worth of money = 2xP = 2P

n = No. of years which is to be found

i = 0.05 (rate of interest)

c = No. of compounding in a year

(a) $F = P + S.I + P + Pni$

i.e., $2P = P(1+i_n) = P(1+0.05_n)$

$1+0.05_n = 2$

$$n = \frac{2-1}{0.05} = \frac{1}{0.05} = 20 \text{ years}$$

(b) $F = P(1+i)^n$

$2P = P(1+0.05)^n = 1.05^n$

$\text{Log}2 = n \log 1.05$

$$n = \frac{\log 2}{\log 1.05} = \frac{0.301}{0.02119} = 19.207 \text{ years} = 14 \text{ years } 2.5 \text{ months}$$

(c) $F = P\left(1+\frac{i}{c}\right)^{cn}$; we have c=4

$$2P = P\left(1+\frac{0.05}{4}\right)^{4n}$$

$2 = (1.0125)^{4n}$

$\text{Log}2 = 4n \log 1.0125$

$$n = \frac{\log 2}{4\log 1.0125} = 13.9494 \text{ years} = 13 \text{ years } 11.4 \text{ months}$$

(d) $F = Pe^{ni}$

$2P = Pe^{0.05n}$

$e^{0.05n} = 2$

$0.05n = \ln 2$

$$n = \frac{\ln 2}{0.05} = 13.86 \text{ years}$$

2.13.12. A person is planning for his retired life. He has ten more years of service. He would like to deposit 20% of his salary, which is Rs. 4000, at the end of the first year and there after 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.

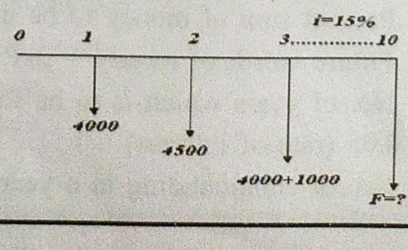
Ans: A_1 = Rs. 4000

G = Rs. 500

i = 15%

n = 10 years

A =? F =?



We have,

$$A = A_1 + G\left[\frac{1}{i} - \frac{n}{(1+i)^n - 1}\right]$$

$$= 4000+500\left[\frac{1}{0.15} - \frac{10}{(1+0.15)^{10} - 1}\right]$$

$$= 4000+500\left[\frac{1}{0.15} - \frac{10}{3.0456}\right]$$

$$= 4000+500\left[\frac{1.5456}{0.4568}\right] = 4000 + 1691.62$$

$$A \quad = \text{Rs. } 5691.62$$

We have $F = A\left[\frac{(1+i)^n - 1}{i}\right] = 5691.62 \times \left[\frac{(1+0.15)^{10} - 1}{0.15}\right]$

$$= 5691.62 \times \frac{3.0456}{0.15}$$

The total amount at the end of 10^{th} year **F = Rs. 115561.05**

2.13.13 Calculate the depreciation rate using the (i) Stright Line,

(ii) Sum of year's digit and Declining balance methods, for the data given below:

Salvage Value L is Rs 0

Life of the equipment, n=5 Years

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

For a declining balance method use a 200%rate. **VTU/Dec 2010/08marks**

Ans: **Stright-Line Method:**

$$\mathbf{D} = \frac{\mathbf{P - L}}{\mathbf{n}}\;;\; \mathbf{D} = \frac{\mathbf{150000}}{\mathbf{5}} = \textbf{Rs 30,000/year}$$

Sum of years digit method:

$$N = \frac{n(n+1)}{2}\;;\; N = \frac{5(5+1)}{2}\;;\quad N = 15$$

$$D_1 = \frac{n}{N}(P) \quad = \frac{5}{15}(150{,}000) = \text{Rs } 50{,}000;\ \text{for } n=5,\ P = \text{Rs } 50,\ 000$$

$$D_2 = \frac{n}{N}(P) \quad = \frac{4}{15}(150{,}000) = \text{Rs } 40{,}000;\ \text{for } n=4,\ P=\text{Rs } 40{,}000$$

$$D_1 = \frac{n}{N}(P) \quad = \frac{3}{15}(150{,}000) = \text{Rs } 30{,}000;\ \text{for } n=3,\ P=\text{Rs } 30{,}000$$

$$D_1 = \frac{n}{N}\ (P) = \frac{2}{15}\ (150{,}000) = \text{Rs } 20{,}000;\ \text{for } n=2,\ P=\text{Rs } 20{,}000$$

$$D_1 = \frac{n}{N}\ (P) = \frac{1}{15}\ (150{,}000) = \text{Rs } 10{,}000;\ \text{for } n=1,\ P=\text{Rs } 10{,}000$$

Declining- Balance method:

D = 2x20%=40%

(Stright Line Depreciation rate=20%),Total depreciation charge=**Rs 138,336**

Undepreciated book value=P-D=Rs (150,000-138,336) =**Rs 11,664**

Declining balance method

Year	undepreciated Balance of begining of the year	Depreciation charge
1	150,000 (40%)	60,000-00
2	90,000 (40%)	36,000-00
3	54,000 (40%)	21,600-00
4	32,400 (40%)	12,960-00
5	19,440 (40%)	7,776-00
	Total	**138,336-00**

Undepreciated book value

Rs. (150,000 - 138,336) = Rs. 11,664

2.13.14. You have accumulated Rs 5000 in credit card debit.The credit card company charges 18% nominal annual interest compounded monthly.you can only offered to pay only Rs 100 per month.How many months will it take you to pay-off debit and how much money will you have to pay as interest?

VTU/Dec.09/Jan.10/08marks

Ans:

$$\frac{P}{A} = \frac{\left[\left(1+\frac{i}{c}\right)^{cn} - 1\right]}{\frac{i}{c}\left(1+\frac{i}{c}\right)^{cn}}$$

$$\frac{5000}{100} = \frac{\left[\left(1+\frac{0.08}{12}\right)^{12n} - 1\right]}{\left[\frac{0.18}{12}\left(1+\frac{0.18}{12}\right)^{12n}\right]}$$

$= 0.75(1.015)^{12n} - (1.015)^{12n} + 1 = 0$

$$n = \frac{93.64}{12} = 8 \text{ years}$$

$n = 8 \times 12 = 96$ months

amount of interest paid 96 x 100 - 5000 = **Rs. 4,600/-**

2.13.15. The Original Cost of an asset is Rs 8000. It has a salvage value of Rs. 500 at the end of 8 Years evaluate its book value at the end of 5th year by Reducing -balance method.

Ans: Rate of Depreciation $\quad r = 1 - \left(\frac{V}{C}\right)^{1/L}$

$$= 1 - \left(\frac{500}{8000}\right)^{1/8}$$

$= 29.3\%$

$r = 29.3\%$

$BV_5 = C\ (1\text{-}r)^5$

$= 8000\ (1\text{-}0.293)^5$

$\mathbf{BV_5 = Rs.\ 1,414.21}$

Where;

C	-	Capital Cost
V	-	Salvage Value
L	-	Life of the equipment 8 years
r	-	rate of depreciation
BV_5	-	Book value at the end of 5 years

Assumptions:

1. Cost & repair increase with time
2. Depreciation in higher during starting.
3. Depreciation reducing with passage ofime
4. Realistic method

2.13.16. An industrial plant with value of Rs. 400,000 has a salvage value of Rs. 50,000 at the end of 25 years but sold for Rs. 260,000 at the end of 10th year. What is the profit or loss to the owner if sinking fund method of depreciation is adopted the interest at 8%

Ans: C = 400000; Salvage Value (V) = 50000; r = 0.08 (8%)

Accrued depreciation, A = C-V

= Rs (400,000 – 50,000)

= Rs 350,000

The annual sinking fund deposit is given by

$$D = \frac{(C\text{-}V)i}{(1+I)^{L}-1} \;;\; L = 25\text{Years}$$

$$D = \frac{[(400{,}000\text{-}50{,}000)\ 0.08]}{(1.08)^{25}\text{-}1)} = \text{Rs } 4787.60$$

Accrued Depreciation at the end of 10 year is

$$A_{10} = \frac{D}{i}[(1+i)^{L}-1] \quad ; \quad \text{for L=10 Years}$$

$$A_{10} = \frac{4787.60}{0.08}[(1+0.08)^{10}-1]$$

Rs. 69,356

Expected value at the end of 10^{th} year

$BV_{10} = (C - A)$

400,000-69,356

V_{10} = **Rs. 330,644**

But the plant is sold at 260,000

So owner suffers a loss of

Rs. (330,644-260,000) = **Rs.70,644**

2.13.16. A Manufacturing concern purchases a Lathe for Rs. 9000 the freight and haulage cost is Rs. 200 and the Charges for installation it is Rs. 250 its life is 20 years and the scrap value is Rs 300. Calculate the annual Depreciation charges by straight line method.

Ans: First Cost or Capical Cost

Invoice Cost + Transportation Cost +Installation Charges

Rs. (9000+250+200) = Rs. 9450/-

Salvage Value: 300 Rs. Its life 20 Years

$$\text{Annual Depreciation} = \frac{C-V}{L} = \frac{9450-300}{20} = \textbf{Rs 457.5}$$

2.13.17. The following particulars are available for the purchase of an electrical machine Initial Cost Rs. 40,000, Transportation Charges Rs 500, Installation Cost Rs 1000, Accessories Rs 2500 Estimated salvage value Rs 5000, estimated life 20 Years, Calculate by straight line method

(a) Amount to be recoverd

(b) Annual depreciation cost

(c) The depreciation book value at the end of 10 years.

Sol: C = First cost of the machine

C = Invoice + Transportation + Installation + Accessories

C = 40,000+500+1000+2500, C = 44,000

V = Salvate value Rs 5000

L = Life of equipment 20 years

a) Amount to be recovered

A = (C - V)

= Rs (44000-5000)

A = Rs 39,000

b) Annual depreciation cost

$$D = \frac{A}{L} = \frac{39,000}{20} = \text{Rs. } 19500$$

A_{10} = 1950 x 10 = Rs19500

c) Book value after 10 years =C-A_{10}=(44000-19500) = **Rs24,500**

2.13.18. The equipment in a power station costs Rs 15,000/- and has a salvage value of Rs 60,000/- at the end of 25 years. Determine the depreciation value of the equipment at the end of 20 years by the following methods: 1) Straight line method ii) Diminishing value method iii) Sinking fund method at 5% compounded annually.

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Ans: P=15, 60,000, Salvage S = 60,000, N = 25 years

i) Stright line Method:

$$\text{Annual Depreciation} = \frac{P - S}{N} = \frac{15,60,000 - 60,000}{25} = \text{Rs } 60,000$$

book value at the end of 20 years = 20 x 60,000 = Rs. 3,60,000

ii) Diminishing value Method:

$$\text{Annual Depreciation, } r = 1 - \left(\frac{S}{P}\right)^{1/n} = 1 - \left(\frac{60,000}{15,60,000}\right)^{1/25} = 0.122$$

Book value after 20 years, =P $(1-r)^{20}$=15, 60,000$(1-0.122)^{20}$=Rs 1, 15,615

(iii) Sinking fund Method:

Rate of interest, r=5%

$$\text{Annual depreciation, } A = (P-S)\,\frac{i}{(1+i)^n - 1}$$

$$A = (15{,}60{,}000\text{-}60{,}000)\ \frac{0.05}{(1 + 0.05)^{25} - 1} = \text{Rs } 31{,}433.$$

A = **Rs. 31,433/-**

$\therefore$ Sinking fund after 20 years, $A_{20} = \dfrac{A(1 + i)^{20} - 1}{i} = \text{Rs } 10{,}39{,}362$

A_{20} = **10,39,362/-**

There fore book value after 20 years= Rs $(P\text{-}A_{20})$

=Rs (15, 60,000-10, 39,362)

= **Rs 5,20,638**

2.13.19. A Plant costs Rs $7.56\text{x}10^5$ and it is estimated that after 25 years it will have to be replaced by a new one, at that instant its salvage value will be Rs $1.56\text{x}10^5$. Calculate (i) The annual deposite to be made in order to replace the plant after 25 years, (ii) The value of the plant after 10 years on the following basis:

(a)Stright Line Depreciation Method.

(b)Reducing Balance Depreciation Method.

(c)Sinking fund Depreciation Method at 8% annual compound interest

Solution.

(a) Stright Line Depreciation Method.

The total amount to be allowed for in 25 years

= (Capital cost – Salvage value)

= Rs $(7.56 \text{ x } 10^5 - 1.56 \text{ x } 10^5)$ = **Rs $6.0\text{x}10^5$**

Annual Deposite to be made

$$=\text{Rs } \frac{6.0\text{x}100000}{25} = \textbf{Rs 24,000 / year}$$

Value of the plant after 10 years

Rs $(7.56 \text{ x } 10^5 - 24{,}000 \text{ x} 10)$

= $(P\text{-}BV_{10})$ = **Rs $(5.16\text{x}10^5)$**

(b) Reducing Balance Depreciation Method.

Let Rs P be the capital cost of the plant,Rs X be the annual percentage depreciation.

The value of the plan after 25 years = $P(1-X)^{25}$

Or $P(1-X)^{25} = 1.56 \times 10^5$

$$(1-X)^{25} = \frac{1.56 \times 10^5}{7.56 \times 10^5}$$

$$(1-X)^{25} = 0.206$$

$$(1-X) = \left(\frac{1}{4.85}\right)^{1/25}$$

$$X = 0.612$$

Annual deposit to be made

=0.0612x7.56×10^5=Rs 46,300

The value of the plant after 10 years

$$BV_{10} = P(1-X)^{10}$$

$$7.56 \times 10^5 (1-0.0612)^{10}$$

$$7.56 \times 10^5 (0.9388)^{10}$$

BV_{10} = **Rs. 402024**

(c) Sinking fund Depreciation Method at 8% annual compound interest:

The annual amount to be allowedbfor =Rs X

$$Rs \frac{P\,i}{(1+i)^N - 1}$$

Where **r** is the rate of compound interest,P is the total amount to be allowed for 25 years.

$$X = Rs \frac{6.0 \times 10^5 \times 0.08}{(1+0.08)^{25} - 1}$$

$$X = Rs \frac{6.0 \times 10^5 \times 0.08}{6.84 - 1}$$

X= **Rs 8220/-**

After 10 years sinking fund will be

$$Rs\ X \frac{(1+i)^{10} - 1}{i}$$

$$\text{Rs } 8220 \left[\frac{(1+0.08)^{10}-1}{0.08}\right]$$

Rs $11.9\text{X}10^4$

Hence value of plant after 10 Years

Rs ($7.56\text{x}10^5$-$11.9\text{X}10^4$)

BV_{10} = Rs $6.37\text{X}10^5$

2.13.20. In a Milk industry the existing low cost conventional 5 HP Motor is to be replaced with energy efficient Motor after 10 years, assume that Rs10, 000 is to be provided after 10 years, find the total fund during the cource of 10 years by straight line depreciation method and sinking fund depreciation method.plot the graph of total fund verses time in years for both the methods.assume rate of interest 5% for sinking fund depreciation method.

Solution:

a) <u>Straight line method:</u>

$$\text{Yearly instalment} = \text{Rs } \frac{P}{N} = \text{Rs } \frac{10{,}000}{10} = \text{Rs } 1000.00$$

Fund after 1 year=1000.00 : Fund after 2 year= 2000.00

Fund after 3 year=3000.00 : Fund after 4 year= 4000.00

Fund after 5 year=5000.00 : Fund after 6 year= 6000.00

Fund after 7 year=7000.00 : Fund after 8 year= 8000.00

Fund after 9 year=9000.00 : Fund after 10 year=10,000.00

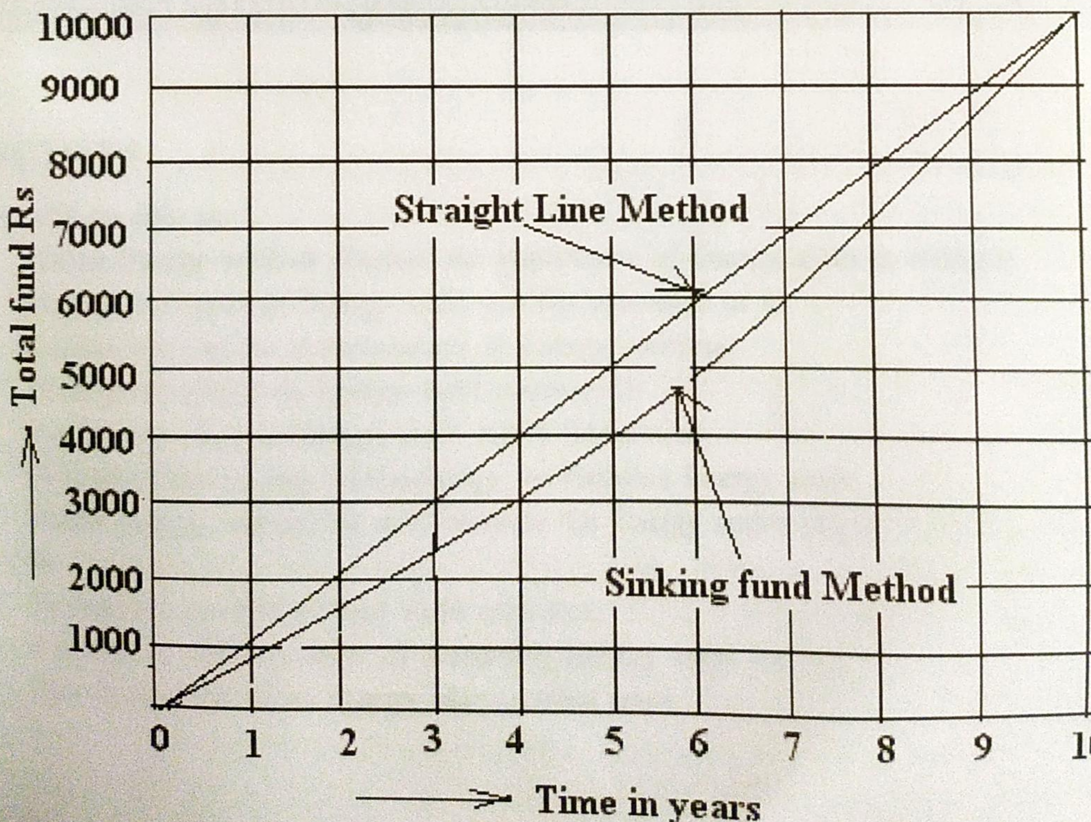
b) <u>Sinking fund Dpreciation Method:</u>

$$\text{Yearly instalment=Rs X= Rs } \frac{P\,i}{(1+i)^N-1} = \text{Rs } \frac{10{,}000\text{x}0.05}{((1+0.05)^{10})-1} = \text{Rs } 795.00$$

The total fund at any time will be the total subscription so far made plus the interest, i.e, the total fund after 2 years will be:

$$795 \text{ X } 2 + \frac{795\text{x}5}{103} = \text{Rs } 1629.75$$

		Straight Line Method		Sinking fund Method		
SN	Year	Yearly subscription Rs	Total fund in Rs	Yearly subscription Rs	Interest	Total fund Rs
1	1	1000	1000	795.00	—	795.00
2	2	1000	2000	795.00	39.75	1629.75
3	3	1000	3000	795.00	81.50	2506.25
4	4	1000	4000	795.00	125.31	3426.56
5	5	1000	5000	795.00	171.34	4392.90
6	6	1000	6000	795.00	219.55	5407.45
7	7	1000	7000	795.00	270.37	6473.82
8	8	1000	8000	795.00	323.58	7592.40
9	9	1000	9000	795.00	379.50	8766.90
10	10	1000	10000	795.00	438.10	10000.00



REVIEW QUESTIONS

1. What is the time value of money concept? What are the different cash flow modules?
2. Explain pay back analysis.Mention its advantages and disadvantages.
3. Write short notes on couses of Depreciation.
4. What do you understand by depreciation? Explain how depreciation reserve is Calculated using using: i) Sum of digits method; ii) Stright line Method.
5. Develop a cash flow model for Uniform series compound amount factor.
6. What is meant by life cycle cost analysis? Develop single payment compound amount Cashflow model.