Engineering Economic Analysis
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Lecture 21
Depreciation: Definition, Reasons, Types of Property, Value Time Function and Book Value

Welcome to the lecture on depreciation. So basically the equipments which we use, their value decreases with time. In other words, they are said that they are depreciating.

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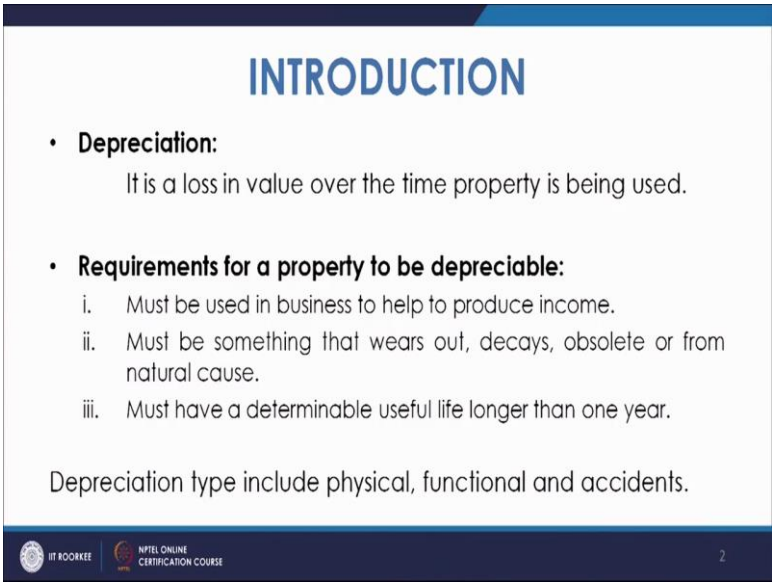

So depreciation is nothing but it is a loss in value over the time the property is used. In economic analysis, this is very important because it is also concerned with tax calculations. The investors can take the benefit of this property even for the tax payments. Basically the investors invest a lot of machines, these machines are used to generate income but these machines basically lose its value over time.

So even for tax purposes, the depreciation is used because the depreciated amount can be subtracted from their total income. So basically there are different methods by which this depreciation is calculated. Let us first discuss something about what depreciation is. So we have anyway discussed that it is a loss in value of the property over time is used. Not there is a requirement for a property to be depreciable.

The requirements is that it should be used in business so that you can produce income, it can give you income. So only those items which can be used to give you income, they are treated under this category. Must be something that wears out, decays, obsolete becomes obsolete or maybe from natural causes they are gone. So it must be something which is basically wearing out. Also it should have a determinable useful life more than one year.

So these are the three conditions which say that this material or this asset is depreciable. Now depreciation will be of different types, physical depreciation and functional depreciation and also it depreciation one of the reason of depreciation is because of the accidents. So we will discuss about physical and functional depreciation.

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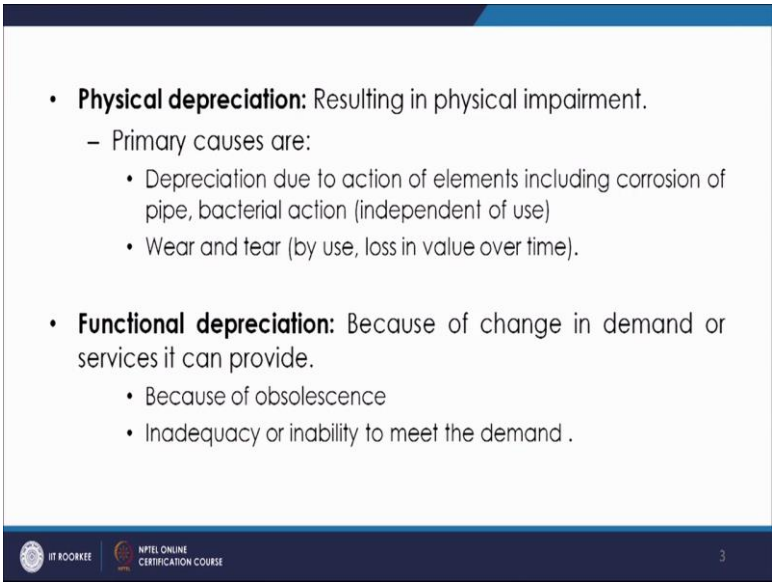

What is physical depreciation? Physical depreciation is because of the physical impairment of the material. The material, if it is a running element, if it is a machine which is permanently used all which has the mating parts, then certainly there will be natural wear and tear. So slowly its value decreases, the ability to produce the same degree of finish or same accuracy is decreasing.

So this depreciation is known as physical type of depreciation because it is because of the physical impairment of the asset. So in that the reason is because of the action of elements including corrosion of pipe, bacterial action, sometimes we do not use it, some of the materials we are keeping in the atmosphere and there will be rusting on it or there will be corrosion.

Even if we do not use it, physically there is impairment of the property of the material, so that comes under the physical causes and that comes under physical depreciation. Also wear and tear, so basically here you use. The difference between the two is, in one case you even do not use, the value is decreasing. In another case, you are using it and that is why by using there will be wear and tear of the elements and its value will increase over time.

Functional depreciation on the other hand, it is because of change in demand or services it can provide. So basically in this case, it is not that the material is physically inefficient. Material or asset can work satisfactorily but there are external reasons which affect its demand or its value. Those reasons are maybe because of change in demand, the demand has changed and that is why the asset has lost its value.

Because of obsolescence, sometimes because of the technological changes, certain assets lose its value because an equally same priced asset is available at lower cost but with more accuracy, it can provide you more accuracy. So in that case, you say that the machine which you have, it has become obsolete because of the technological enhancement or technological upgradation.

In that case you say that it has lost its value although physically it is capable of working up to a satisfactory level. Then you have inadequacy or inability to meet the demand. This is a reason because in course of time, the company may require a machine which need larger capacity and this machine, the existing machine has somewhat irated capacity and the machine needs either to be supplemented with another machine.

Or sometimes you go for another machine which in one quantity itself can satisfy your demand. So in this way the value of the existing machine changes because anyway either you have to supplement it all you have to replace it, so its value decreases for the person who owns and it can be taken by others. So this way you have two types of depreciation because of which the machine needs to be replaced.

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Now let us see, we have types of property, so basically there are two types of property, tangible and intangible. The tangible properties are those which we can touch and feel. So they depreciate due do the reasons listed before, they depreciate because of the meeting of elements, because of wear and tear, because of corrosion, all these factors are responsible because of these factors they lose the value.

Then you have intangible properties, so in the intangible type of property you have the properties which cannot be seen but they can be felt. So they cannot be touched like you have software, trademark, patent, copyright. So these are the documents or the properties, although they cannot be seen but they have value and the values also, these values also change with time.

So now you have also a property in the category of real property. So basically you have personal properties, it can be tangible or intangible. You may have a building which has the tangible part as well as intangible part. So basically you have bought kinds of properties with you and they depreciate because of different reasons. You have also the personal properties which some of them integral part of the buildings and some of them can be removed out of it.

They are under the category of personal properties. Land is considered to be a non-depreciable property and building is said to be depreciable property because building loses its value. Building is said to have a life, so its value changes as the time progresses but land does not come under depreciable property.

So when we do the depreciation analysis, at that time we have to keep in mind that the cost of land cannot be taken as the cost whose value will change time.

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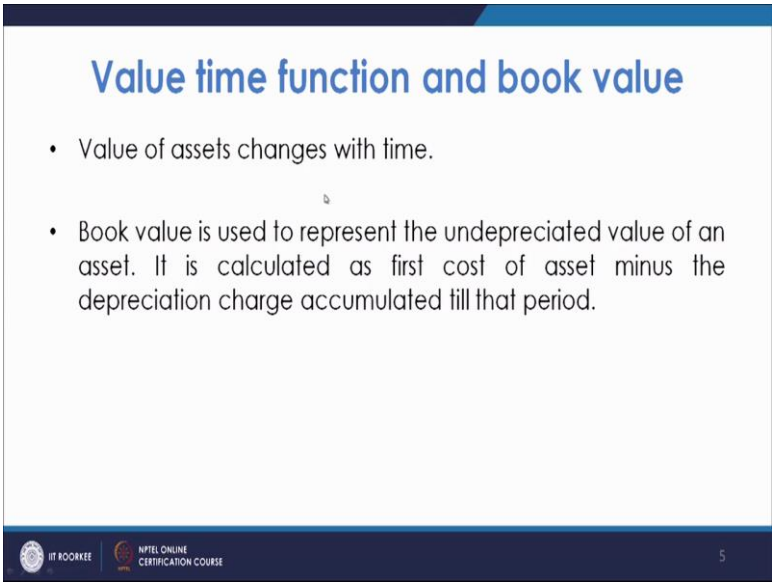

Now in depreciation across certain terms like book value. So if you have an asset whose value is something now, then its value will change with time. So the functional relationship which shows how the value of the asset changes with time, that is known as value time function. So you have different kinds of functions which may represent how the book value is changing with time.

Anyway book value also should be defined, book value is to represent the undepreciated value of an asset. So book value is nothing but the value which you have now and the depreciations will be there every year. So book value is the value of the asset at any particular time. So if you take at any time t, Bt represents the book value at the end of year t. So it is also calculated as first **os** cost of asset - the depreciation charge accumulated till that period.

So when we do the depreciation analysis, we will seldom, we will most of the time come across this term known as book value. Let us see how we calculate the book well you.

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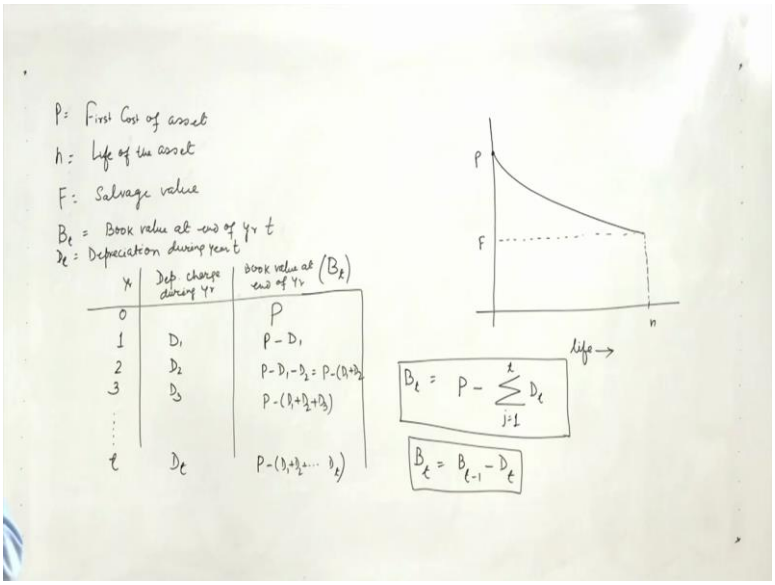

So what happens that if you have an asset whose first cost is P, So if P is the first cost of the asset, then if the asset has n years of life, so if life is this, so the value may change. So after n years it will have certain value and this is known as the salvage value. So basically if n is the life of the asset, in that case the value of the asset at the end of its life is known as salvage value.

So as we discussed that this function, it can be of any type and this is known as value time function. Now if we take Bt as book value at end of year t, so what happens we can see you have end of year. You can take year basically then you can take depreciation charge during year and book value at end of year. So if you take 0 year, at the end of 0 year means presently the value is nothing but P. So this is the first cost of the asset.

Let us see the first year, we can assume that depreciation during n year is Dt. So we can also write Dt is nothing but depreciation during year t. So in the first year you have depreciation as D1. So once you have depreciation as D1 during the first year, the value becomes P - D1. So now this P - D1 is the book value at the end of year one.

In the second year, your depreciation charge is D2, so it will be P - D1 is the value at the end of first year and depreciation during second year is D2 so it would be P - D1 - D2, that is you can write as P - D1 + D2. So in the third year if it is D3, you can write as P - D1 + D2 + D3. So this way you see that the depreciation charge is being accumulated and it is basically subtracted from the first cost of the asset.

So if you take 40 years, during the tth year, depreciation charges Dt, so it will be P - D1 + D2 + upto Dt. This value is also at that as Bt, we have defined the book value as the value after the end of year t. So what we see is Bt as P - summation of J equal to t Dt, you can say one to t. So this is how the book value is calculated. We can also have the expression Bt will be nothing but Bt - 1 - Dt.

So if you have to find the depreciation during n year and you have the book values of the two years, you can find the values. Or if you have to find the book value at the end of any year, the book value in the previous year - depreciation charge calculated during that year will give you the book value after that year. So this is how you calculate the book values.

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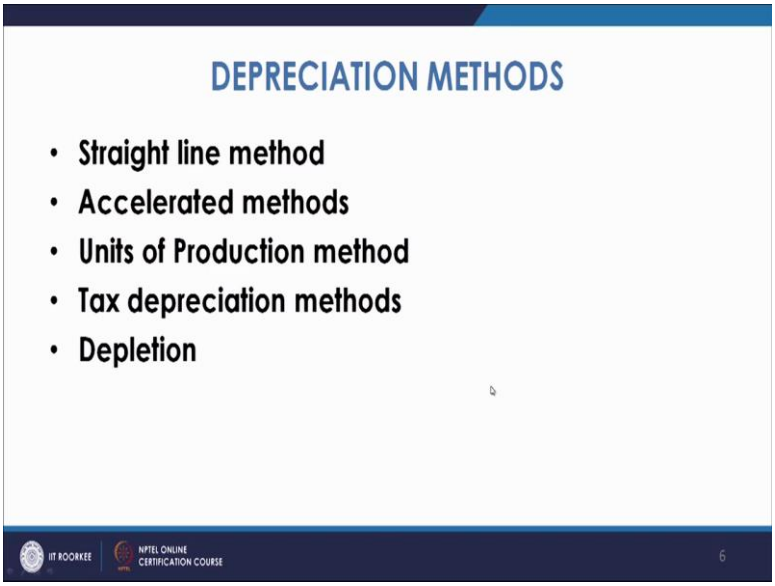

Now depreciation methods, basically there are different types of depreciation methods. As we have discussed that the value time function may be different and value time function is used to find the book value of the asset after any year t. Now based on that, there are certain depreciation methods. Now among these depreciation methods which we will discuss briefly in the upcoming lectures.

The methods which are of importance is straight-line method, accelerated method, units of production method, tax depreciation methods and depletion. Now what happens in these methods?

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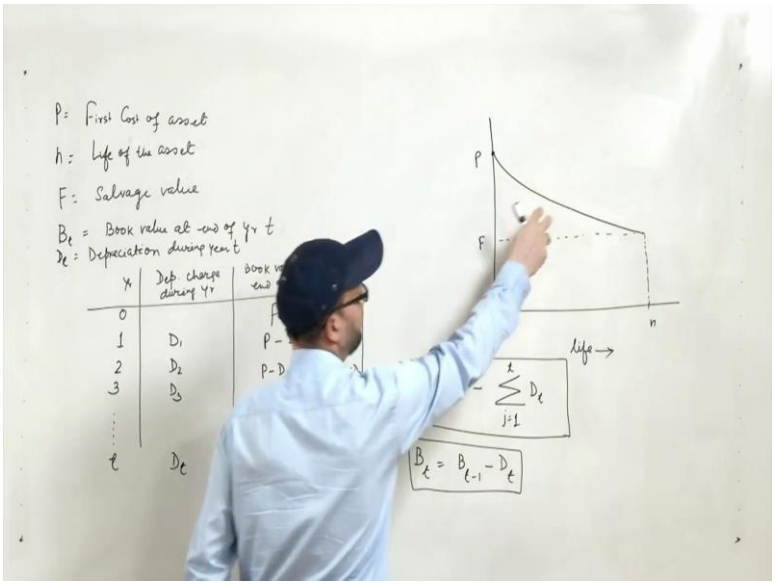

So as you know that this straight-line method tells that this function, the value time function, this is a straight-line, so basically straight-line means the amount of depreciation during any with be constant. It will be basically governed by the slope of this curve. So this straight-line method assumes that the depreciation amount during any year is constant.

So ultimately after n years you reach to a finite value of book value that is given at the end of n years as salvage value. Then in many cases it is assumed that the amount of depreciation should not be a constant amount. In many cases, the assets when we use for our personal satisfaction or our business to produce income, the value is decreasing at a larger rate initially. So in those cases we use these accelerated methods.

So normally you have accelerated methods used for machines in which the depreciation during the previous year is more and as we move ahead, as we go ahead in time, the depreciation amounts decreases. So there are many methods and this where basically there is a percentage of the first cost which is used for calculating the depreciation charge of the asset and that is how we proceed.

We will discuss about the different methods of depreciation using the accelerated methods, in that there is another method known as some of years digit methods that is also one of the accelerated method. One of the method is units of production method. So basically many times what happens that the machine which has come to the investor, it has certain capacity to produce. Suppose it has the capacity to produce 3,00,000 units over its life of 5 years.

Now the depreciation will depend upon how much you are using that machine. So anyway after 5 years the machine will depreciate to its final salvage value but if during the first year machine is utilised for large number of production or it is utilised quite heavily, in that case the depreciation or loss in its value will be more because larger the machine will run, the more will be wear and tear between the parts of the elements, the more will be loss in its value.

So this production method tell you that as much you use, as much you produce the depreciation will be proportional to that. Then you have tax depreciation methods. So basically as we had discussed earlier, depreciation is also used for tax calculation. The industries are promoted to go for investing more and more. Now industries use the machines or assets to generate income, in turn they provide the employment.

Now they produce the income out of which they have to give tax. So basically the government gives certain freedom to them. The depreciation which is there on these machines, basically government gives a rebate on tax on those amounts. So basically there are certain methods by which the amount of depreciation which will be there on an equipment over time that is to be calculated.

So basically in this scheme you need to know what type of equipment is to be used and what is its life. So basically that you the property which certain life that is to be taken into account and percentage of its present cost will be used as the depreciation so that after certain years of life, the material or the asset completely depreciates and its tax benefit is taken by the investor. So there are methods which will be taught under the tax depreciation methods.

Then we have to discuss about depletion, the depletion is the depreciation of the natural assets because we deal with sometimes the assets all which are used for mining industries where you do not know the quantity of the mineral deposit. In those cases basically when you use the depreciation methods, they are known as depletion method in which there are two methods, cost method and percentage method.

The cost method tells that how much you have generated the income and based on that the depreciation will be calculated and there is percentage method where depending upon the mineral which is extracted, you generate the depreciation of those natural resources cost and that the way the depreciation charge is calculated. So these are known as depletion. So these are the different type of methods which are used for depreciation.

We will discuss it in next lecture, one by one about these methods. Thank you.