Engineering Economic Analysis
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Lecture 22
Basic Depreciation Methods: S-L Method, Declining Balance Method

Welcome to the lecture on depreciation. So in this letter we will discuss about first straight-line method of depreciation and then we will discuss also about the declining balance method of depreciation.

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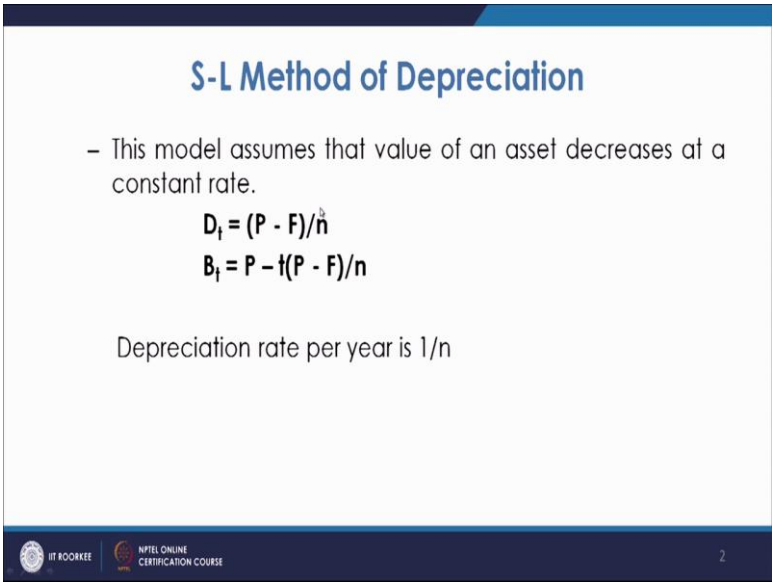

Now straight-line method of depreciation is you that the value of an asset decreases at a constant rate. So in the last lecture we discussed about the value function and book value at the end of year t or at the end of year n, that is the salvage value of the asset. Now in this case, this function is basically a straight line. So the depreciation during n year is a constant number and this number is P - F divided by n.

P is the first cost of the asset, F is the estimated salvage value of the asset after n years, so depreciation during n years will be P - F divided by n. Now book value at the end of n year t will be P - t times P - F by n. So how can we get it?

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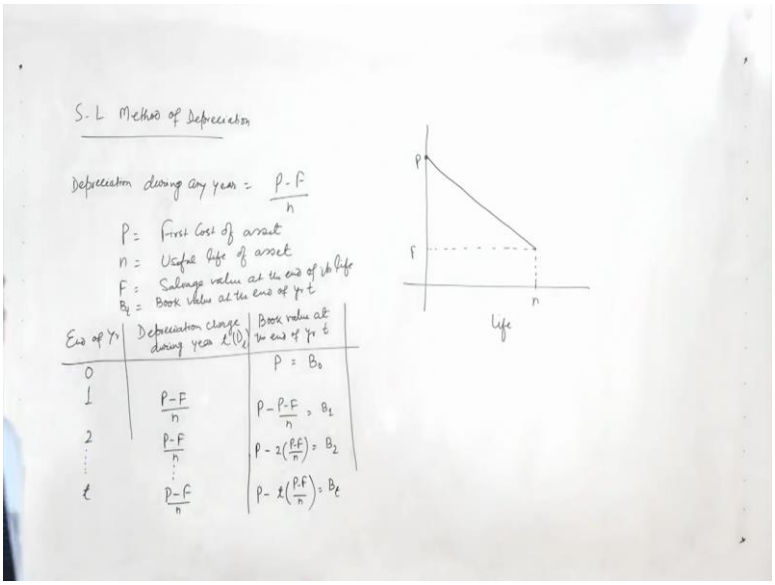

Now in this case when we talk about straight-line method of depreciation, so your value time function goes like this. Your first cost is P and the asset has life of n years and if suppose it has the salvage value of F, in that case, this is the function. P - F is this value and the depreciation is over n years. So depreciation during n year, it will be P - F by n. So P is the first cost of the asset, n is useful life of the asset and F is salvage value at the end of its life.

So if you take a table like this, this will be end of year, then we have depreciation charge during year t and book value at the end of year t. So if we make the table for straight-line method of depreciation, in the zero year, the value is P. So P is nothing but book value at zero year. So we can write Bt is nothing but book value at the end of year t. Now depreciation charge during year t will be denoted as d subscript t.

And book value at the end of year t we have already noted it as Bt. So at the end of zero year means presently, the value is P, that this P not. Now at the end of first year, the depreciation **co** is to be calculated, so during the first year as we have discussed, this amount is constant, so your appreciation charge is P - F by n. So the book value will be P - P - F by n and this will be nothing but B1.

Similarly in the second year again you have P - F upon n as the depreciation. So this time it will be P - P - F upon n again P - F upon n. So it will be P - 2 times P - F upon n and will B2. So this will be can have the expression, general expression at t year at the end of tth year, depreciation charge is constant as P - F upon n and this will be the book value at the end of year t will be P - t times P - F upon n.

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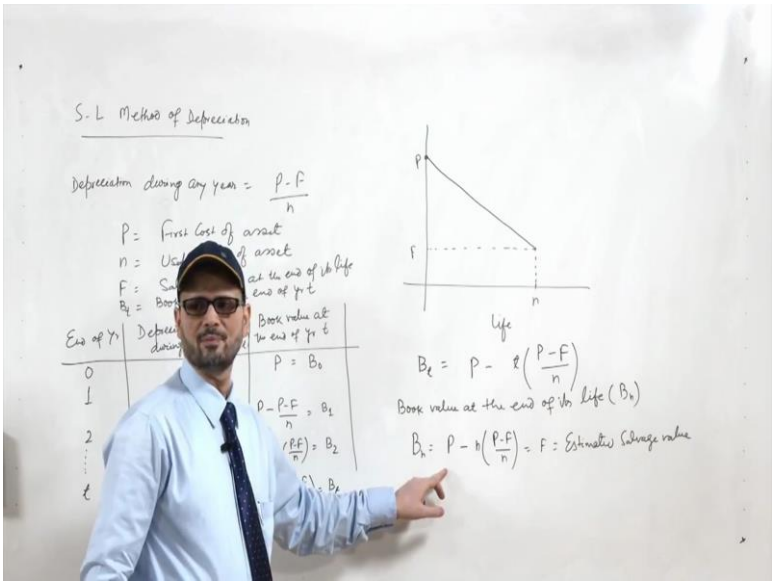

And this will be expressed as Bt. So using the straight-line method of depreciation, you see that book value at the end of year t will be nothing but P - t times P - F upon n. Now if we say, book value at the end its life, that is Bn, so in that t will be replaced with n. So Bn will be P - in place of t we will use n, n times the depreciation charge during that year. So that will be P - F upon n, so it will be nothing but F.

So that is nothing but the estimated salvage value. So basically what we see is, that after n years of time, the salvage value is attained. Once you accumulate all the depreciation charges for the previous n years and that is subtracted from the first cost of the asset.

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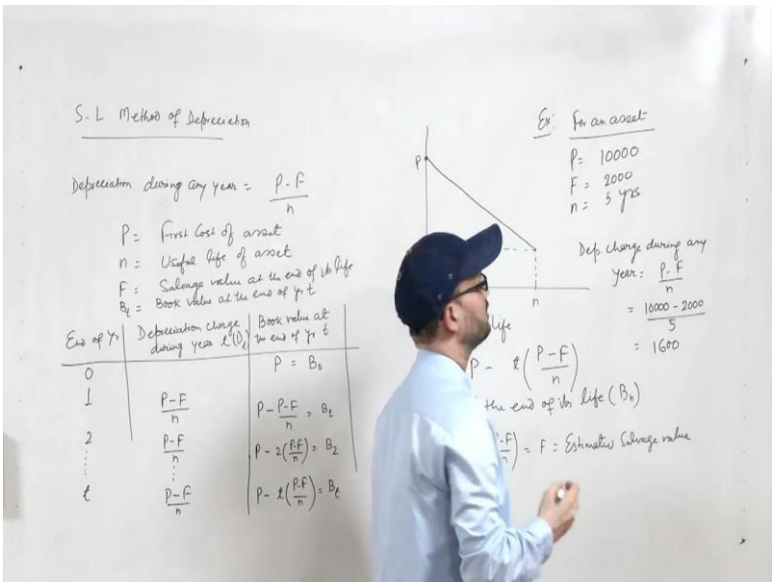

So we can have an example, suppose if there is an asset, for an asset with P equal to 10000, F as 2000, n as 5 years. So if we want to calculate the depreciation charges during n year, as we see the depreciation charge will be P - F by n. So depreciation charge during n year will be P - F upon n. So it will be 10,000 - 2000 divided by 5, it will be 1600. So this is how you calculate the depreciation charges in the straight-line methods.

After first year, the book value will be 10,000 - 1600 so that is 8400. Then after second year, again 8400 - 1600, so it will be 6800. So this way you can calculate the book value at the end of n year using this formula and also the depreciation charge using straight-line methods.

Using straight-line method, the depreciation rate is defined as 1 by n means basically the charge of depreciation will be calculated by multiplying 1 by n with the difference of first cost of asset and the salvage value of the asset. So that is why 1 by n is called as the depreciation rate for the straight-line methods.

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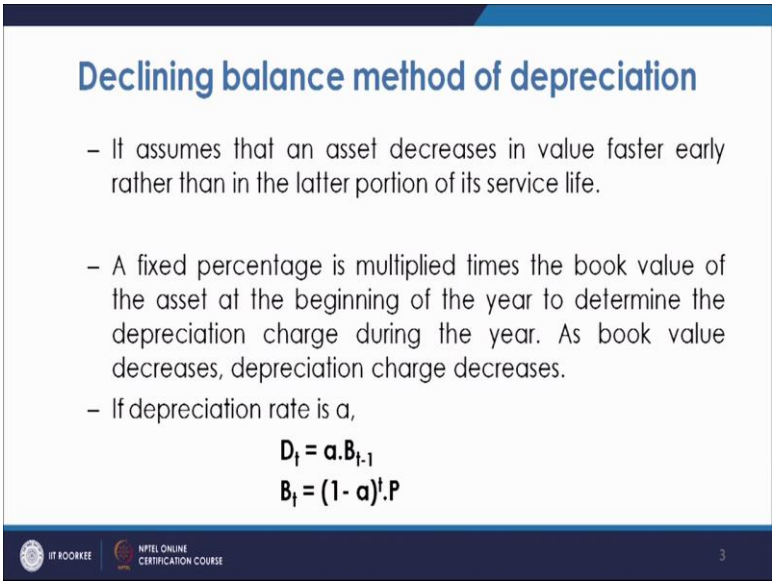

Now we will discuss about another method of depreciation that is declining balance method of depreciation. So we discussed about straight-line method of depreciation where the amount of depreciation is uniform. Now in many cases it is assumed that the depreciation during the early years should be larger, so they are known as accelerated methods of depreciation.

So in the accelerated methods of depreciation, basically we assume that depreciation during the early years will be larger. It is also realistic that things depreciate during their early years more, they lose its value more than the later part. So in the declining balance method of

depreciation, which is one of the type of accelerated methods of depreciation, it assumes that, asset decreases in value faster early rather than in the later portion of its service life.

So how we calculate the depreciation charges in this? In this basically, a fixed percentage is multiplied times the book value of the asset at the beginning of the year to determine the depreciation charge during the year. As book value decreases, depreciation charge decreases. So basically here, the amount of depreciation will depend upon the book value at the initiation of the year.

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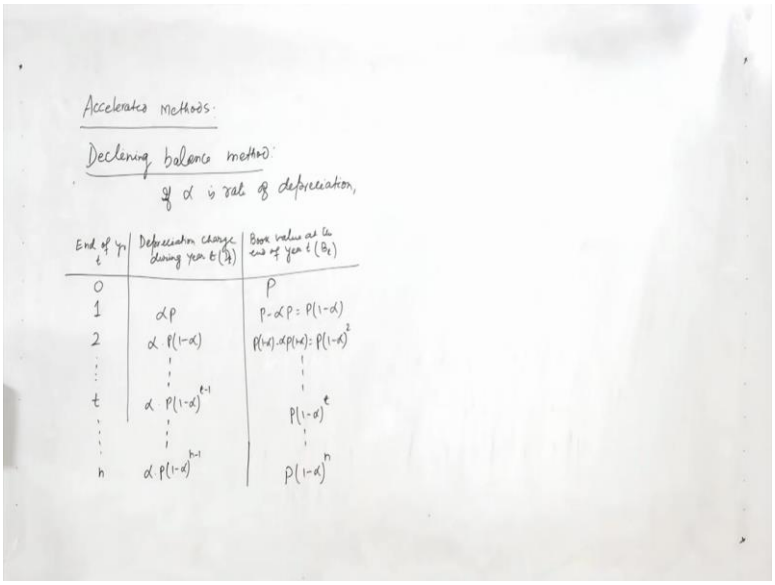

Now since book value decreases as the time progresses, amount of depreciation also decreases. Now, if alpha is the rate of the depreciation, so in that case let us see it is known that declining balance method. So as we discuss that since the value decreases, the depreciation charge also decreases as the time progresses. So if alpha is rate of depreciation, then in that case let us find the value of depreciation and the book value in this form of table.

End of year t, then depreciation charge during year t and book value at the end of year t, it is known as Bt, it is known as Dt and this is t. So in the zero year, the value is P, P is the first cost of the asset. In the first year, if alpha is the rate of depreciation, it will be alpha times P. So book value at the end of first year will be P - alpha P that is P into 1 - alpha.

In the second year, the depreciation charge will be calculated as alpha times the book value which was there at the end of first year. So it will be alpha times P into 1 - alpha. So it will be P into 1 - alpha - alpha times P into 1 - alpha that will be equal to P into 1 - alpha raised to the

power 2. So if you go this way, at the end of year t, it will be alpha times P 1 - alpha raised to the power t - 1.

And this value will be P into 1 - alpha raised to the power t. Similarly if you extend this further to n, the depreciation charge during nth year will be alpha times P times 1 - alpha raised to the power n - 1 and the book value at the end of year n will be basically P into 1 - alpha raised to the power n.

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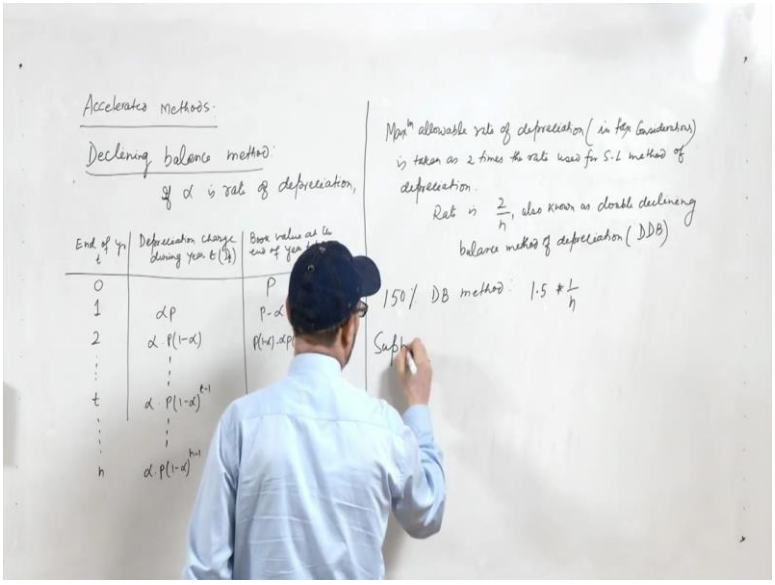

So this is how the depreciation charges calculated and also the book value at the end of year n or year t is calculated in the cases of declining balance methods of depreciation. Now in many cases, it is not sure that the book value which is reported will come once you go with this method of depreciation. Before that, let us discuss about certain facts.

Now while discussing the declining balance method of depreciation what is seen is, that rate of depreciation being 1 by n for tax considerations, the maximum rate of depreciation that is allowable is 2 times the straight-line rate of depreciation. So maximum allowable rate of depreciation in tax considerations is taken as 2 times the rate used for straight-line method of depreciation.

So we know that the rate of depreciation in case of straight-line method is 1 by n so that is why the rate is 2 by n and this is known as double declining balance method of depreciation. So basically when you have the rate as 2 times on 1 by n, that is double declining balance method of depreciation, also known as DDB. We may also come across the term known as 150% declining balance method. This is nothing but 1.5 times 1 by n.

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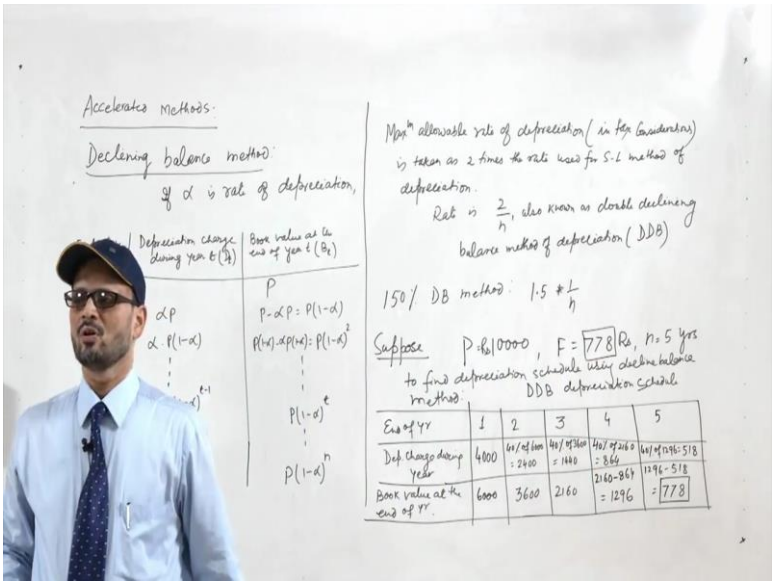

So when we take the depreciation rate as 1.5 times by 1 by n, this is basically known as 150% declining balance method of depreciation. Now what we are discussing that suppose we deal with the problem when you have P as Rs. 10,000, F as Rs. 778, n as 5 years. So if you are told to find depreciation schedule using declining balance method. So what we will see is, you have end of year, depreciation charge during year year and book value at the end of year.

Now if you look at the depreciation rate, basically n is 5, so depreciation rate will be 1 by 5 that is 20%. So at the end of year suppose 1, now depreciation charge during the year, so we will follow here the DDB depreciation schedule. So as we know that in the double declining balance the percentage of depreciation will be 2 times the rate of depreciation and rate of depreciation is 1 by 5 that is 20%.

So if you follow DDB depreciation schedule, in the first year the first cost is 10,000, so 40% of 10,000 and that will be 4000. This will be the depreciation charge during the first year. So book value at the end of first year will be 10,000 - 4000 that is 6000. Now if we go to second year, in the second year depreciation charge will be 40% of the book value at the end of first year, so 40% of 6000 that is 2400.

So your book value at the end of year 2 will be 3600. Then you have the third year, in the third year, your depreciation charge will be 40% of the book value at the end of second year, so 40% of 3600 that is 1440. So book value at the end of third year will be 3600 - 1440 that is 2160. The fourth year, again during the fourth year the depreciation charge will be 40% of 2160 that is 864, so the book value at the end of fourth year will be 2160 - 864, so it is 1296.

And in the end during the fifth year, the depreciation charge will be 40% of the book value at the end of fourth year that is 40% of 1296 that is 518. So you get the book value at the end of fifth year will be 1296 - 518 and that is equal to 778. This is what you achieve, the book value given as Rs. 778.

So using the declining balance method of depreciation we have seen that in this problem, we have got the amount of salvage value as the book value at the end of its life. Now this is not a certain situation in many cases and you will find that the book value at the end of its life, that is the salvage value maybe either more or less than its value.

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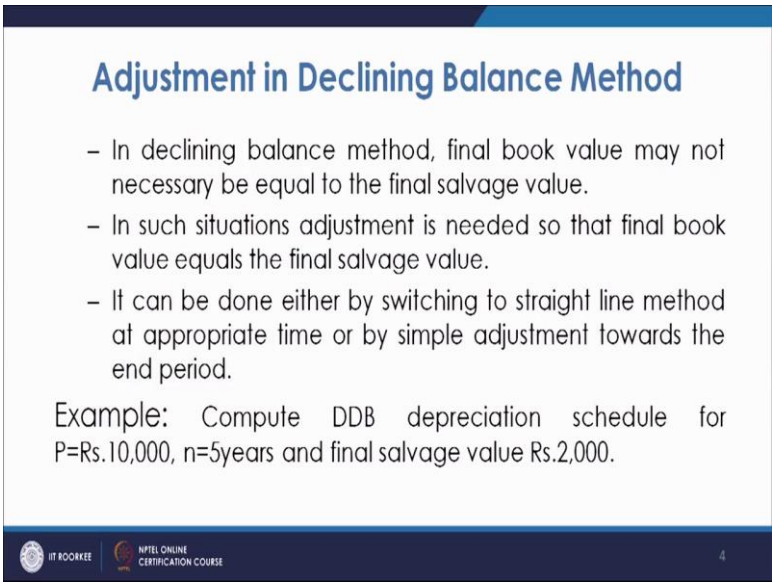

So let us see a problem where the salvage value as Rs. 2000. You have to find the depreciation schedule using DDB and the salvage value is given as Rs. 2000. It means the salvage value seems to be more than the book value. Now under these cases you have to adjust your depreciation charges so that you get finally the amount of 2000 at the end of its life.

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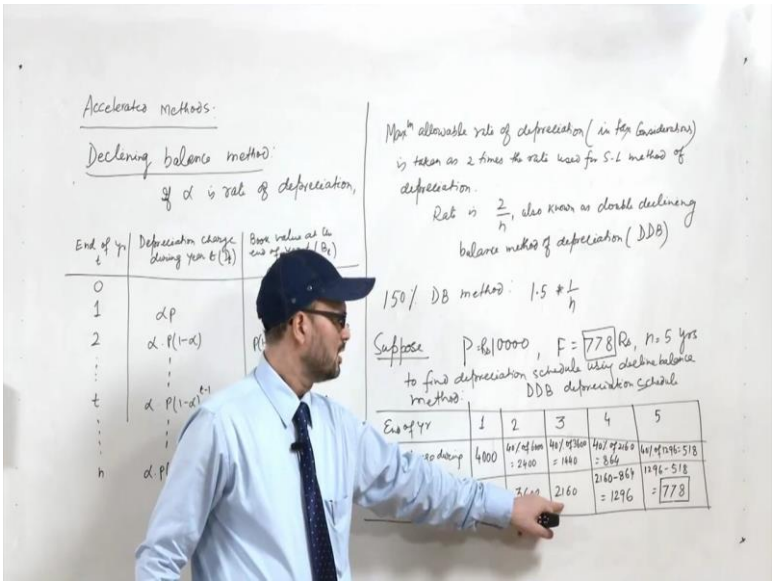

So these topics come under the topic of adjustment of depreciation charges during its life so that the book value and the salvage value become equal. There are 2 ways by which they can become equal, one is that the simple adjustment in this case. So we can adjust here itself, you can directly come to 2000, for that you have to keep the depreciation charge of only 160 during the fourth year and the value of the asset at the end of fourth year will become 2000.

And during the fifth year the charge can be taken as 0 and it will be 2000. Another way is by switching to the straight-line method that we will discuss in our next class. Thank you.