Financial Mathematics
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Lecture – 32
Types of Depreciation: SL Method and Declining Balance Method

Welcome to the lecture on types of depreciation and in this lecture we are going to discuss about straight-line method and declining balance method of depreciation. So, we had some introduction about the straight-line method of depreciation where when we talked about the depreciation during year n total depreciation during n.

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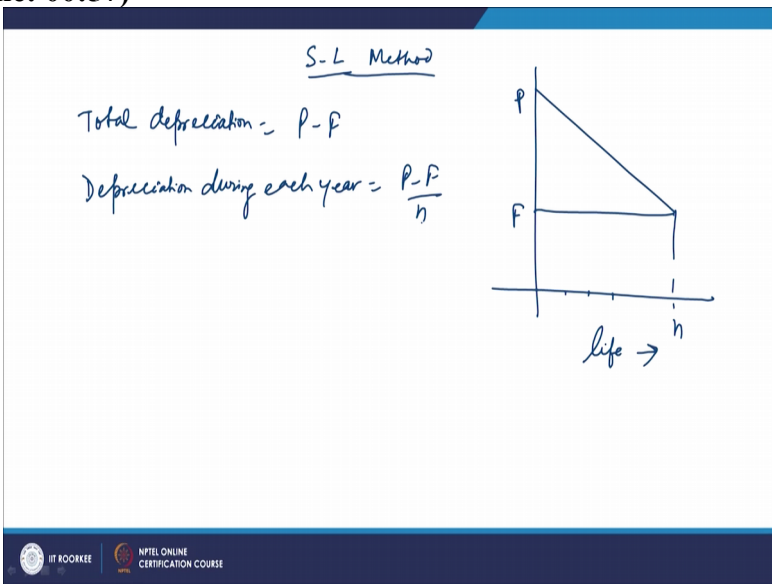

So, we can see that if you talk about straight-line method of depreciation in that case this function is a straight line. So, this is the value P and this is the value F so and this is your n so this is the life of the asset in years and this is the value in rupees or dollars whatever it be. Now in this case the total depreciation is P - F so this is the value P original cost of the asset and this is the final salvage value of the asset F.

And in this case your since this slope is same so the depreciation during every year will be same and in that case in every year if you have the assessment depreciation to be calculated the depreciation during each year it will be P - F / n and is the estimated life of the asset.

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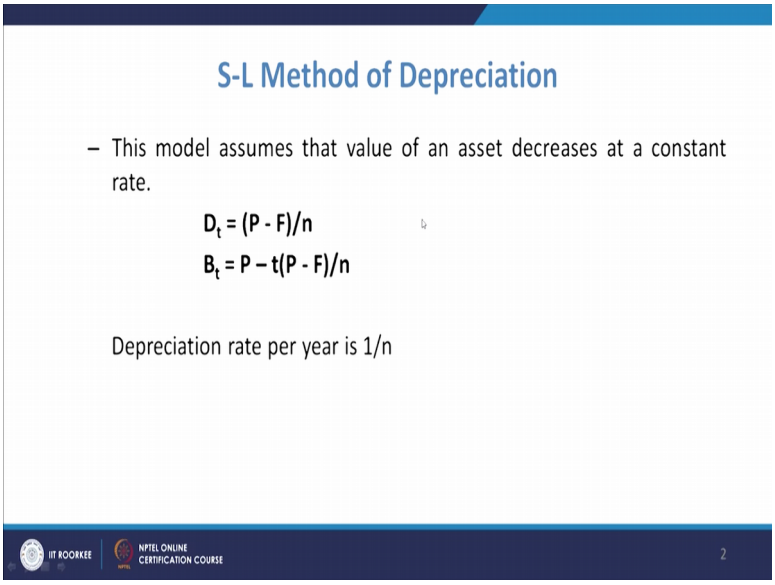

So, this straight line method the depreciation amount basically remains the same. So, that is why the depreciation amount during year t will be P - F / n and Book value at the you know and if you try to calculate the book value during any year in that case that also can be calculated and it will be Book value during at the end of year t will be P - t * P - F /n so that is how the book value is calculated.

Now one more terminology which will be you know very popular which will be normally used will be the rate of depreciation. And rate of depreciation is in general defined as 1 by n so n is the estimated life, so if the life is suppose you know 5 years in that case rate of the prices will be 1 / 5 that is 20%. So, that way rate of depreciation is another term which is normally defined. So, if you try to analyze this rate of this straight-line depreciation and if you see that how these depreciation schedules go?

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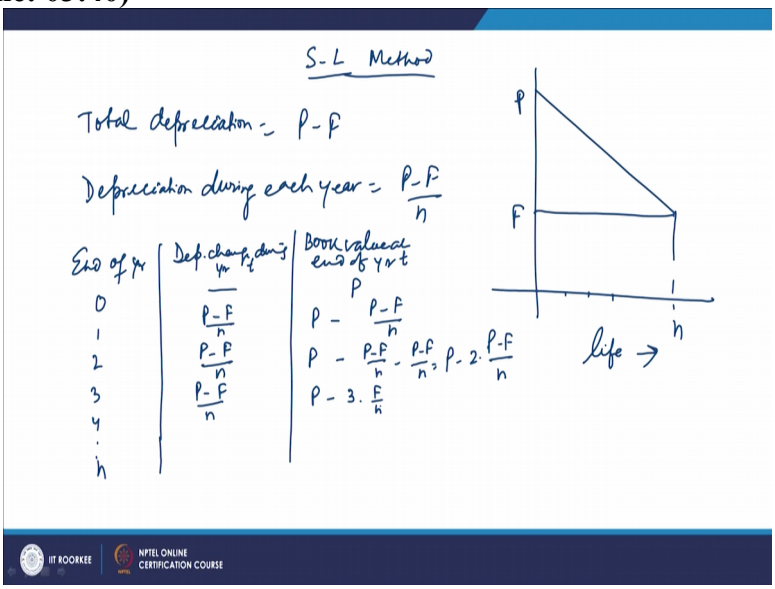

So, if you go for suppose 0 1 2 3 4 2 and now in this case what happens that; so if you calculate these depreciation charge during year t so and then you will have book value at the end of year t. so, at the end of year 0 the depreciation charge is nothing and the book value is certainly the first cost of the asset. So, as we know that in case of straight-line method of depreciation in the first year depreciation charge will be P - F / n so as we calculated.

Then the book value at end of first year will be P - P - F / n similarly in the second year again because if depreciation amount is same so it will be P - P - F / n -P - F / n so that is why it will be P - 2 into P - F / n so that is how it will move with the third year again depreciation amount will be P - F / n and this will be now P - 3 * F / n. So, that is why during year t you will have the depreciation P - and at the end of your t the book value will be P - t * P - F / n. So, that is how we calculate the depreciation in the case of straight-line methods.

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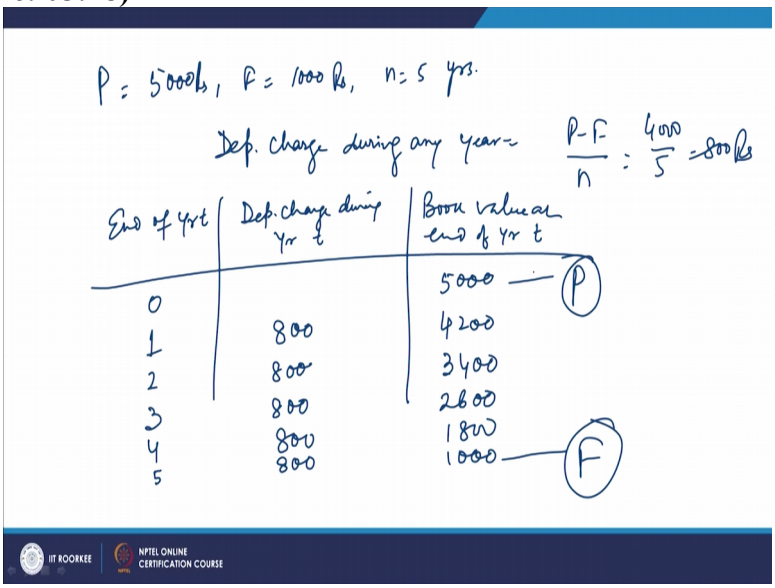

Now we can take suppose one example like say you have one object one asset whose present cost or first cost is 5000 and it is salvage value is 1000 rupees basically so it will be rupees and the life of the asset is supposed 5 years. Now in this case if you are required to have the calculation of the depreciation schedule basically that they talks about every year how much is the depreciation charge and at the end of particular year what will be its Book value.

So that you can calculate and in this case you can say that the depreciation charge during any year and here will be P - F / n so P - F / n will be 4000 by 5 so it will be 800 so it means at the end of first year you know if you have end-of-year t now in this case depreciation charge during year t and this is book value at end of year t. So, what you can see that in the end of 0 you have 5000 and then at the end of year 1 no depreciation every year is 800 so it will be 4200. Now year 2 it will be again 800, so it will be 3400, 3 it will be again 800 so it will be

2600 then 4, 800 so it will be 1800 and in the end of year 5 again you have 800 and it becomes 1000.

So, that is your F and this is your P so this is how the depreciation schedule goes depreciation will starting once the; it goes under the service and initial value is 5000 and then finally you get to 1000 and that is how you can find these values at any point of time. Suppose P - 2 * P - F / n so 2 * 800 so that will give you that is 400. So, book value can be calculated at any point of time.

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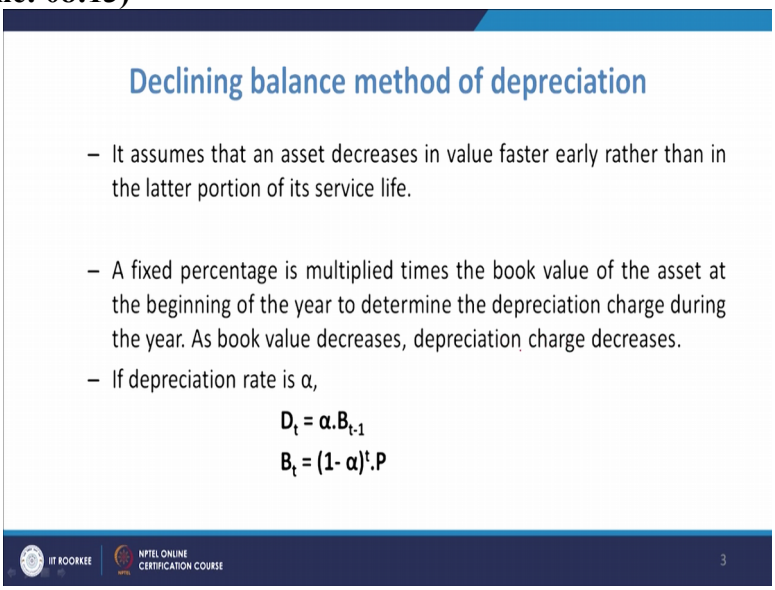

Now we will move to another kind of the depreciation that is your, declining balance method of depreciation. Now declining balance method of depreciation assumes you know it based on the assumption that the asset will decrease in its value faster early rather than in the latter portion of a service life. So, the depreciation is assumed to be larger in its early time then the later time. So, in these cases what is happening that your 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.

And so as the time will progress since a percentage value is fixed so since the book value is decreasing so the amount of depreciation will certainly be less. So, that is how the depreciation amount will be going on decreasing. So, if the depreciation rate is alpha in that case D t will be alpha into be t - 1 so if the first cost is P the depreciation charge during the first year will be alpha * P.

Similarly so your book value will be P - alpha P that is P * 1 - alpha so that is how the things move and your depreciation schedule can be calculated because you have P at one place and then P * 1 - alpha will be the book value at the end of first year then similarly P * 1 - alpha to

the power 2 like that it will go in the second year so how you can get it we can even see that but before that what we see is that the depreciation during the tth year will be alpha into B t -1 and B t will be 1 - alpha * raised to over t * P how it comes? That if it can be understood.

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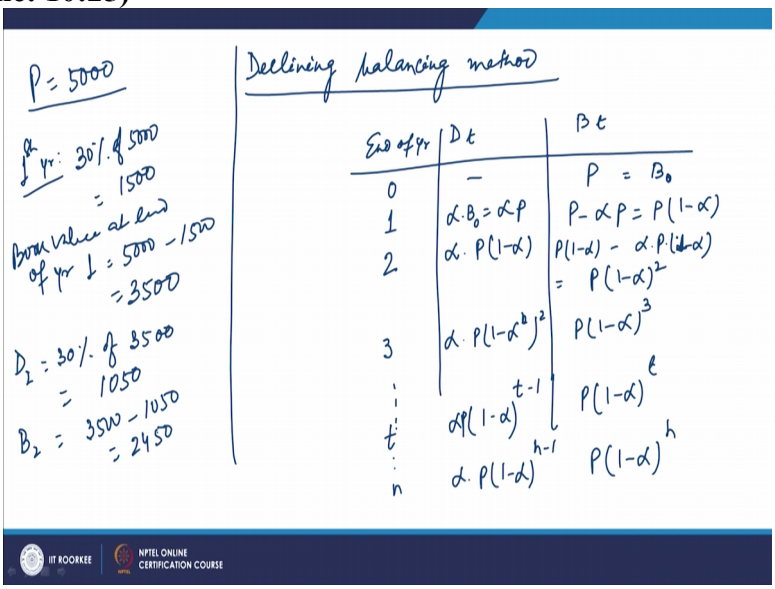

So, you know we are talking about the declining balance method and it is also known as fixed percentage method of depreciation. So, many in many books you will also come across this term known as the fixed percentage method of depreciation where a percentage a fixed percentage will be multiplied with the book value at the beginning of the year to calculate the depreciation during that year.

So, if you look at the depreciation schedule in that so again you have end-of-year then you have depreciation charge during year t D t and then you have book value at the end of year t B t. Now in this case alpha is the rate of depreciation now in at the end of the year 0 your value of the asset is P so depreciation certainly is of no meaning at this point. Now in the first year if you look at the; if alpha is the you know so P is nothing but book value at the 0 time so it is also defined as B naught or B 0.

Now this will be alpha * B 0 or alpha * P so that will that will lead to the book value at the end of year t so it will be P - alpha P so it will be P * 1 – alpha. Then at the end of year 2 this is now its book value in the beginning of year 2 and now it will the depreciation will be alpha times its book value so alpha times P * 1 - alpha so the book value at the end of here t will be P * 1 - alpha - alpha * P * 1 – alpha.

So, now P * 1 - alpha will be common and again 1 - alpha will come so P * 1 - alpha raised to the power 2. So, similarly in 3 alpha into P * 1 - alpha square and once you further subtract it will be P * 1 - alpha raised to the power 3. So, this way your depreciation amount will be

changing and then book value also will be changing and at the end of year t it will be alpha P * 1 - alpha it is not it is here 2 it is here 2 so raised to the power t - 1 and then it will be P * 1 - alpha raised to the power t.

So, you can further extend to n so ultimately alpha P 1 - alpha n - 1 and the book value will be P * 1 - alpha raised to the power n. So, that is how you get and P can be seen as; so that is how B t will be 1 - alpha raised to the power t * P you are coming to this formula in such situations and you are getting these values. So, if you take the example of these declining balance methods. Now suppose you have an asset whose first cost is 5000 and you have the certain salvage value then how the declining balance method how you will calculate this you know Book value or the depreciation amount.

So, suppose you have 30 percentage the rate of depreciation so for P as 5000 and if your depreciation amount is so is to be calculated and n is suppose 30 so alpha is 30% in that case you know in the first year depreciation will be 30% of 5000 so it will be 1500. So, book value at the end of year 1 will be 5,000 - 1500 so it will be 3,500. Similarly depreciation charge during year 2 will be 30% of 3,500 so it will be 1050 and Book value at the end of year 2 will be 3500 - 1050 so that will be basically 2450.

So, this way as you know that in the first year the depreciation was 1,500 second year the depreciation was 1050 and you can calculate the depreciation amount as the time progresses and you can find the accordingly the book value of the asset. Now what I require that many a times when we talk about these declining balance method we know that it will be going as certain percentage of the book value and ideally it will never come to 0.

Because and we cannot get 0 as the final salvage value. Also if you use this constant percentage fixed percentage of depreciation in that case not necessarily always the final salvage value and the book value at the end will be equal. So, many a times you need to do the adjustment in the depreciation schedule and it can be done by switching to a straight-line method at appropriate time.

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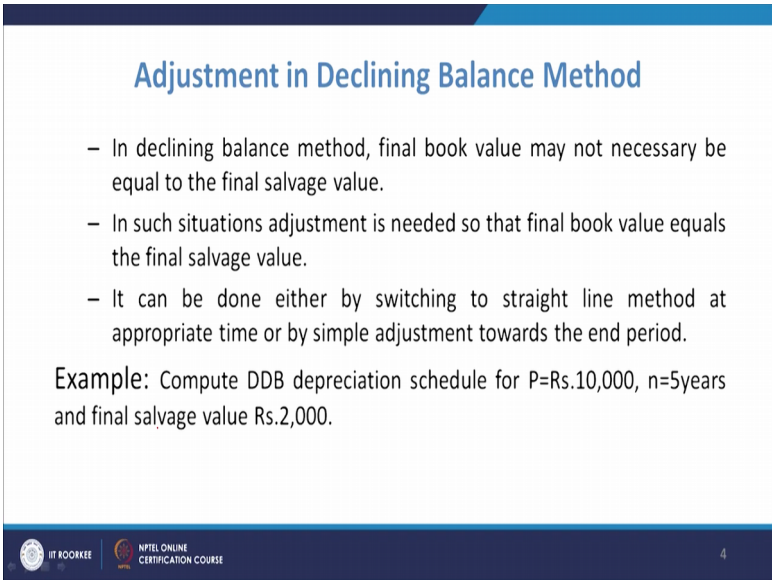

Or by simple adjustment towards the end period so there are methods by which we try to come to that you know adjustment now for that normally what we do is that as we know that if you take this example now in this case D 2 will be 1050 and B 2 will be 2450 then further you can find D 3 B 3 d 4 B 4 and D 5 B 5 and its value will be coming something close to 840. Now if not necessarily the material has the salvage value the same as it 40.

So, you need to have the adjustment and that method we must know that how these adjustments are being done. Now in that what we do is that there are certain conditions by which this is to be you know going you know this is to be practiced so that your final salvage value and book value at the end is meeting. One more thing which is required to be understood is the; you know term like double declining balance method or 150 percent declining balance method.

So, when we talk about if you know the life of the asset and that is supposed to do if you know the life of the asset has 5 years now in that case your rate of depreciation is 20%. So, double declining balance method means the rate of depreciation will be 2 times 20% that is 40%. Similarly 150% declining balance method means the rate of depreciation will be 30% like that so these terminologies are also going to be used in the later portion in the coming lectures where these terminologies like DDB or 150 % DB all this is required to be used.

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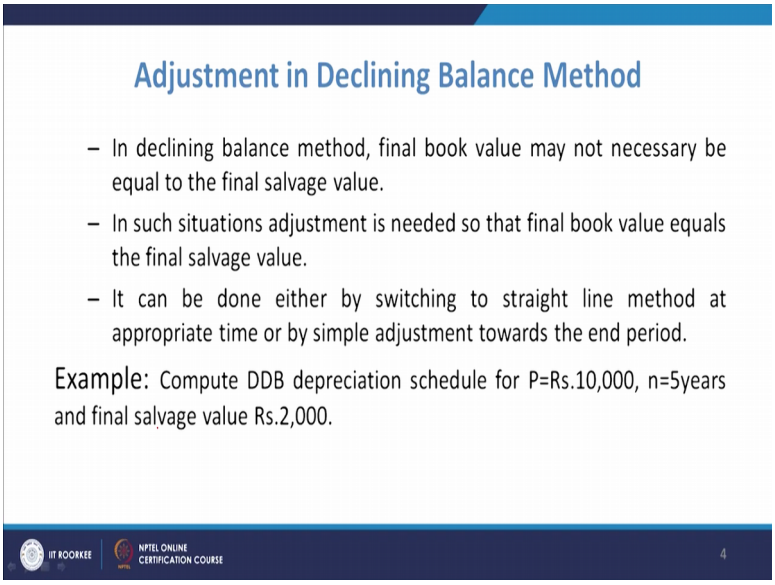

Now we are coming to the; you know declining balance method switching to straight line. So, what is done is that when it is anticipated that there will be you know you are you have to match this book value at the end to the salvage value in that case you will have to see that you have to switching to a straight line and then it will come to that particular value. And for that the normal rule is that the declining balance depreciation is less than straight-line depreciation on un-depreciated balance.

So, what happens that when we are moving we start with the declining balance method and at every point of time we calculate the depreciation schedule also using the depreciation amount using straight-line method? And when we find that the depreciation amount calculated using declining balance method is becoming less than that being calculated by straight-line method then that time we are switching to a straight line.

And in that case we ensured that we have showed ourselves that we are coming to the book value same as salvage value. So, if you know that during the in the declining balance method we know that it will be alpha * B t - 1 will be the represent amount and in this case you have B t - 1 - F / n - t - 1 so that way what we do is we calculating the straight-line method during any year t so you have the depreciation amount using the declining balance method you have this one and using the straight-line method you have this one.

And when this is basically becoming less or even equal in that from that time onwards we take this value as the straight-line method of depreciation. So, now if we try to take you know one example and try to see that when that switching is to be you know the switching has to occur so that can be seen. Now if suppose you have an example where the P is defined as

5000 and your salvage value F is defined as 0 which cannot come in any case using that declining balance method.

But if suppose F is required to be brought to 0 and n is given as 5, so now if you take as the; you know 150% declining balance method so in that case we can have calculation of the depreciation amount. Now see that when you have t = 1 in that case if you use the declining balance method so depreciation using declining balance will be you know alpha * P so it will be 30% of you know 5000 so that is your 1500 and if you take the depreciation using straight line.

So in the straight-line method as we know that you have 5 years of time so you will have 5000 P - F / n so it will be 5000 -0/5 is 1000. Now what we see is that the declining balance method of depreciation is 1500 so since it is larger so we will take this depreciation as the one in the depreciation schedule. Now coming to the position at t=2 now if this is your depreciation in the first year then book value at the beginning of year 2 will be 3500.

So depreciation using you know declining balance method so that will be 30% of the book value at the end of year one that is 5000 - 1500 is 3500 so 30% of 3500 that is 1050 now if you try to find the depreciation for the problem by using the straight line method then depreciation using straight line method it will be; so you have life you book value at 3500 and final book value is 0 and it would life is 4 it is 875.

So, still what we see that you are not able to switch because this is larger and this is smaller so we are still not switching and we will continue with the declining balance method of depreciation. Now at t = 3 now your book value is basically 3500 - 1050 that is 2450 so depreciation using declining balance it will be 30% of 2450 so it will be 735 so that is your depreciation amount using the declining balance method.

And if you calculate using the straight line method depreciation using straight line method it will be 2 years you know it will be a 3 years left so it will be 2450/ 3 so it will be 817 now what you see is that this is my larger and declining balance method has gone down so it is coming as the smaller value. So, from year 3 onwards you are going to consider the depreciation using the straight line method.

So there is switching of the you know the depreciations rule and it will be switching from declining balance method to straight-line method and on further onwards for 4th and 5th year we are going to have the depreciation amount as 817 itself.

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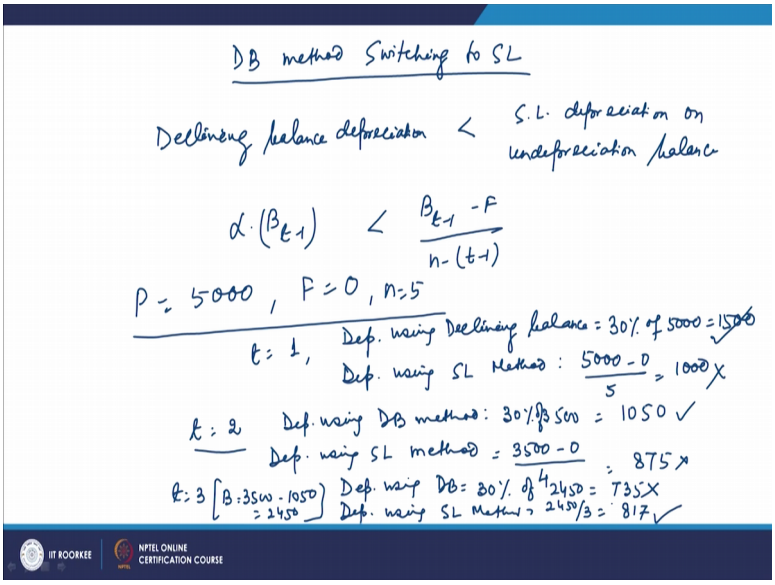

Now if you see from the 2450 if you take t = 4 your you know book value comes as 2450 - 817 so it is nothing but it is 1/3 portion of this so it will be 1633 now the thing is that now onwards we will be using only straight-line method of depreciation. So, depreciation using the 4th year will be 1633 - 817 and depreciation using in the 5th year will be your again 816 so this way so your book value will be 816 and here certainly 816 will be there.

So, B 5 will be 0 so that is how you get 0 because otherwise you could not have got ever this 0 value as the depreciation amount. So, this way you are basically switching to a straight line so if you look at the; you know depreciation schedule and you can summarize it like this. So, end of year and then you have the appreciation during year t and then book value at the end of your t. So, if you see you have in the year 0 it will be 5,000.

Then in the year 1 you have 1500 that is using declining balance so book value will be 3500 then in the second year you will have again 30% of 3500 so 1050 that we are using declining balance so you are coming to 2450 then in the third year onwards 3rd 4th and 5th year onwards you are taking moving to switch the straight-line method and you are going to 817 that is straight line so it will be 1633.

Then again 817 that is your straight line that is 816 and then finally you are going to taking 816 as a straight line and you are coming to 0. So, you see that this concept of switching to straight line will be used for coming to the particular value of the book value a particular book value a particular salvage value which otherwise you cannot get in the case of typical straight I mean declining balance method of depreciation.

And for that you have to do this adjustment and that is why it is known as the you know declining balance method switching to straight line method of depreciation for getting that

particular book value and the salvage value equal. So, this is how you can do it now coming to this problem again you can see here you have 10000 you have 5 years and final salvage value is 2000 and this is double declining balance method of depreciation so you can solve this because your n = 5 so rate of depreciation will be 40%.

And so in the first year it will be 4000 so it will be 6000 where as if either salvage value then further 2400 like that so you can solve this problem and get the depreciation schedule and finally you can come to use this switching to straight-line method for finding this so you can practice it and getting more and more acquainted thank you very much.