Depreciation, Alternate Investment and Profitability Analysis.
Professor Dr. Bikash Mohanty.
Department of Chemical Engineering.
Indian Institute of Technology, Roorkee.
Lecture-7.
Depreciation Sinking Fund Method.

Welcome to the course Depreciation, Alternate Investment and Profitability Analysis. We are continuing with module one that is depreciation. In today's lecture I will be covering a depreciation method which is called Sinking-Fund Method. Sinking-Fund Method is also known as Depreciation-Fund Method or Amortization-Fund Method, is a technique for depreciating an asset in book keeping records while also generating money to procure a replacement for the same asset where it reaches the end of its useful life.

Now the Sinking-Fund Method is the only method in which we use time value of money, that means when a depreciation amount is cut then that depreciation amount is invested and it earns money. Under the Sinking-Fund Method the business sets aside an amount of money to invest annually so that the principle + the interest earned in the fund will be enough to replace the asset.

Whereas Sinking-Fund Method helps to strengthen financial position of a firm, it is not common and is not desirable when interest rates cannot be predicted reasonably, because in the Sinking-Fund Method we take a constant value of the interest rates and that interest rate is considered to be remain constant throughout the life span of the equipment. And based on that a yearly payment is being calculated and hence if the interest rates is fluctuating randomly or heavily during the life span of the equipment then it is not a good method to be used.

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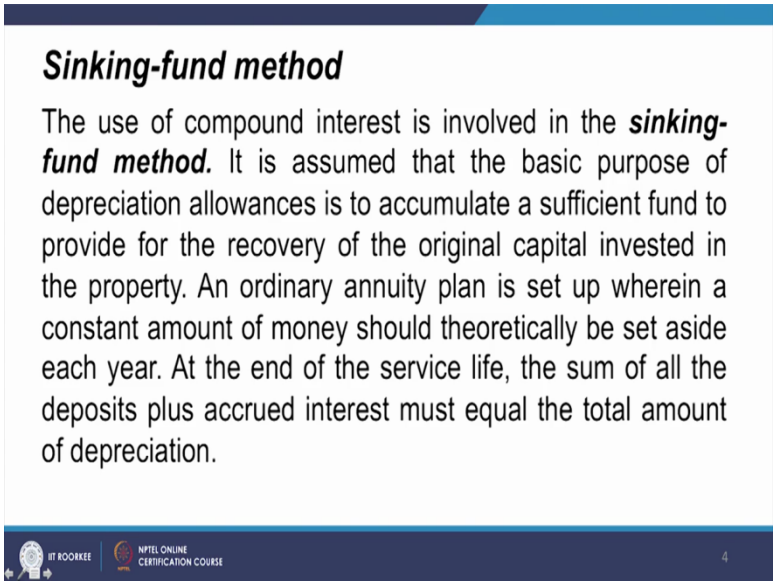

Now let us see Sinking-Fund Method, the use of compound interest is involved in the Sinking-Fund Method that is why we say that the Sinking-Fund Method uses the time value of money. It is assumed that the basic purpose of depreciation allowance is to accumulate a sufficient fund to provide for the recovery of the original capital invested in the property. An ordinary annuity plan is set up wherein a constant amount of money should theoretically be set aside each year.

At the end of the service life, the sum of all the deposits + accrued interest must equal the total amount of depreciation. Based on this philosophy, the amount yearly amount or we say the annuity is being computed for Sinking-Fund Method, now let us go for the derivation.

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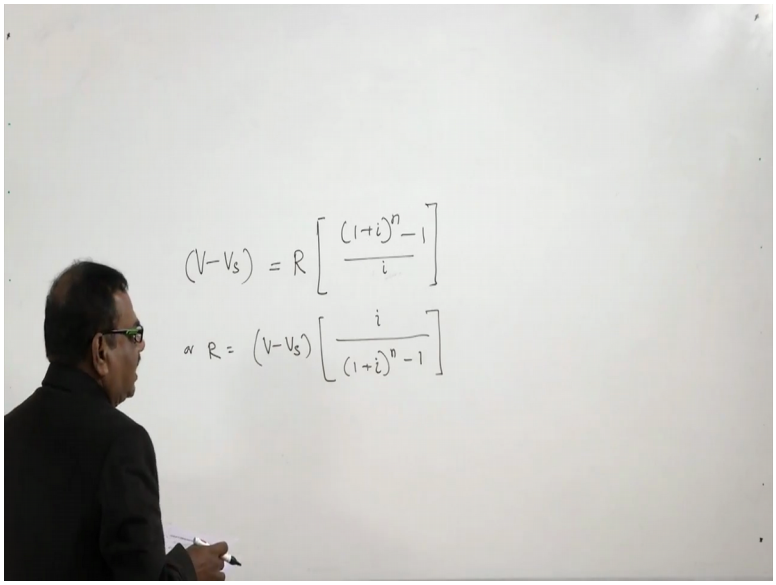

Total amount of depreciation after **a** years = V – Va

Or $(V - Va) = R\left[\frac{(1+i)^a - 1}{i}\right]$ ... (3)

Replacing the value of R from Eq.(2) we have

$(V - V_a) = (V - V_s)\left[\frac{i}{(1+i)^n - 1}\right]\left[\frac{(1+i)^a - 1}{i}\right] = (V - V_s)\left[\frac{(1+i)^a - 1}{(1+i)^n - 1}\right]$ ... (4)

Book Value after "a" years = $V_a = V - (V - V_s)\left[\frac{(1+i)^a - 1}{(1+i)^n - 1}\right]$ ... (5)

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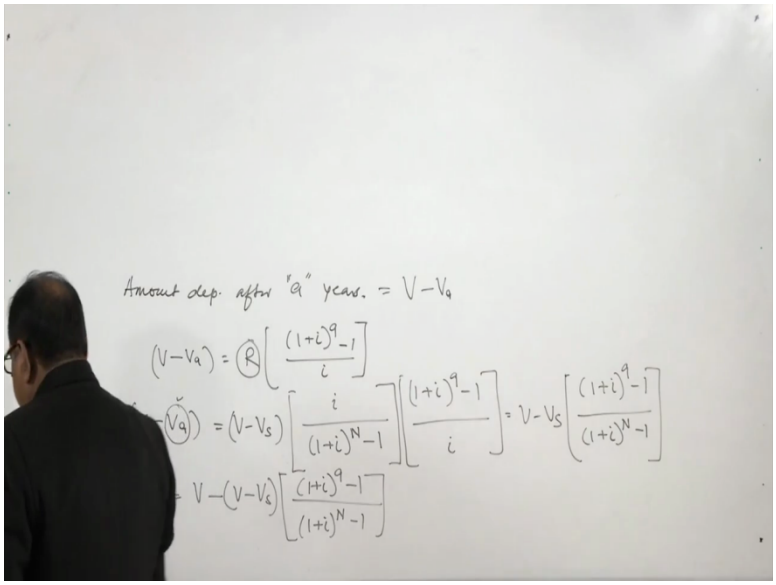

Now the fund that needs to be depreciated is V - Vs and we know that if this V - Vs then if R is annuity the formula is this, 1 + i to the power n - 1 divided by i or R is equal to v - Vs i 1 + i to the power n - 1, where i is the annual interest rate expressed as a fraction, R is the uniform annual payments made at the end of each year.

This is the annual depreciation cost. V - Vs is total amount of the annuity accumulated in an estimated service life of n years, that the original value of the property - the salvage value at the end of the service life. Now we can derive other equations which are used here, now the amount depreciated after a years is equal to V - Va and you can write down V - Va is equal to R, 1 + i to the power a - 1 divided by i.

Now replacing the value of R from the earlier equations we can write down V - Va is equal to V - Vs, V - Vs, i 1 + i to the power N - 1 into 1 + i to the power a - 1 divided by i which is

equal to V - Vs into 1 + i to the power a - 1 divided by 1 + i to the power N - 1. From here I can calculate this book value. This book value Va is equal to V - V - Vs 1 + i to the power a - 1.1 + i to the power N - 1.

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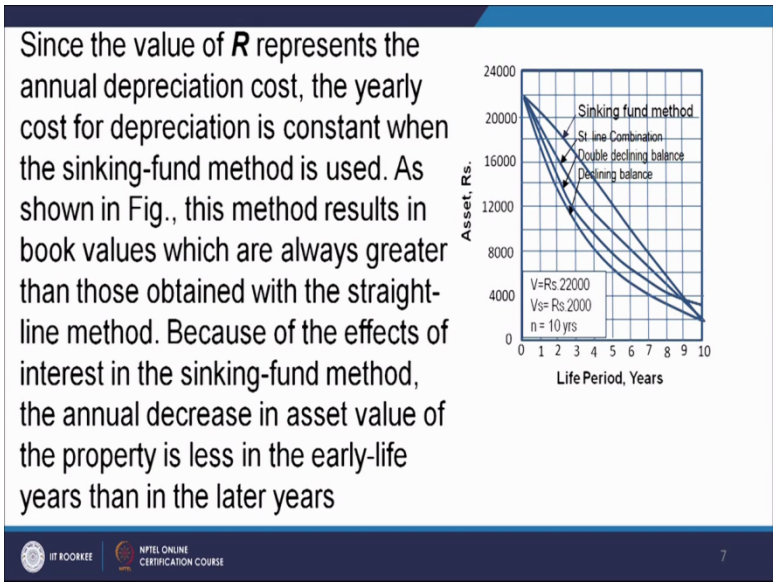

So this gives me directly calculate the book value after one year or after a years. Since the value of R represents the annual depreciation cost, the yearly cost of depreciation is constant when the Sinking-Fund Method is used. As in the earlier methods which do not use the time value of money we have seen like some of the Years-Digit method, Double-Declining Balance Method, the depreciation amount was changing with time but here in the Sinking-Fund Method as we are finding out the value of R which is a constant value, the depreciation is constant for all the years.

As this is shown in the figure, this method results in book values which are always greater than those obtained with the straight line method. Because of the effect of interest in the Sinking-Fund Method, the annual decrease in asset value of the property is less in the early life years than in the later years. This can be clear from this figure which is shown in the right hand side.

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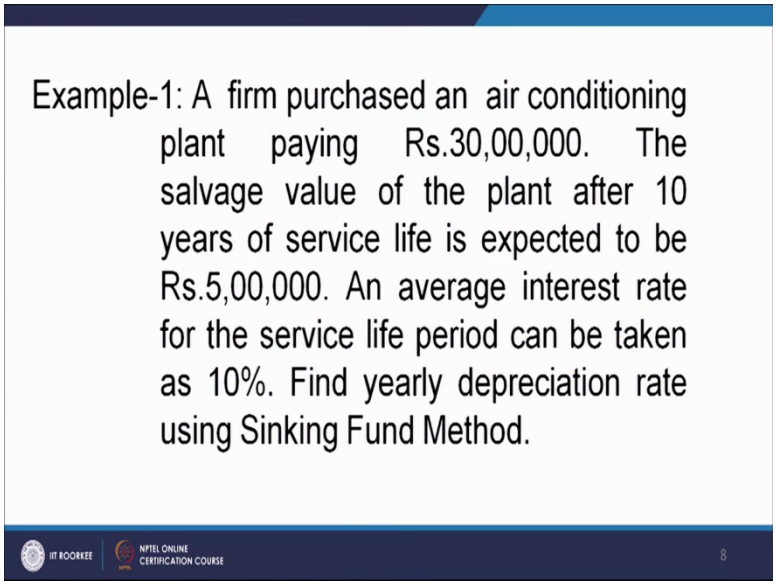

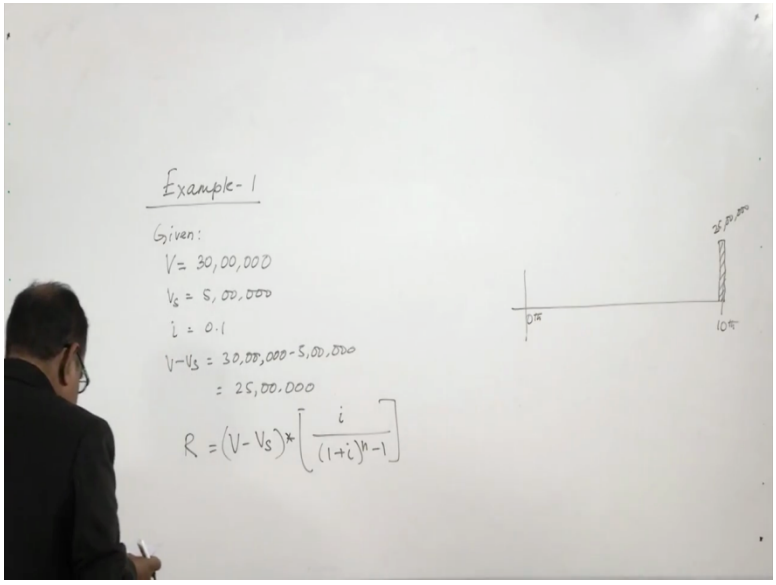

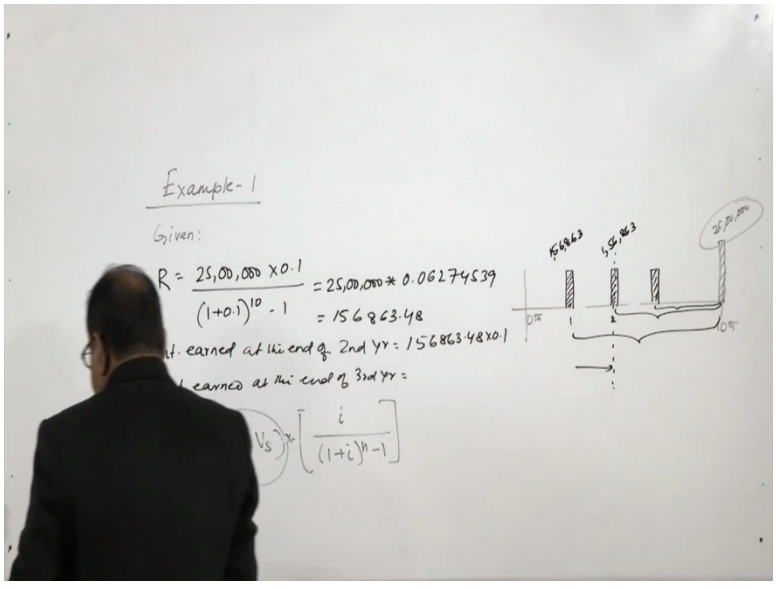

Now let take some examples. Example 1, A firm purchased an air conditioning plant paying 30,00,000 of rupees. The salvage value of the plant after 10 years of service life is expected to be 5,00,000. An average interest rate for the service life period can be taken as 10 percent. Find yearly depreciation rate using Sinking-Fund Method. So we start with the example 1, now given are V is equal to 30,00,000, Vs is equal to 5,00,000, i is equal to 10 percent in fractions so this is 0.1.

So V - Vs is equal to 30,00,000 - 5,00,000 is 25,00,000. So depreciable amount is 25,00,000. This the 25,00,000 cost this should be accumulated at the end of the tenth year this 25,00,000 is needed at the end of tenth year. This is tenth year this is zeroth year, so here I want a sum of 25,00,000. So this 25,00,000 is a future value and what I will get each year I will get annuity.

So my equation is R which is the annuity payment, depreciation payment each year is equal to V - Vs into i 1 + i to the power n - 1. Where this V by Vs this is nothing but this value which is a future value. So the value of R can be computed from using this formula. Now R is equal to 25,00,000 into 0.1 divided by 1 + 0.1 to the power 10 - 1. This comes out to be 25,00,000 into 0.06274539 and this value comes out to be 156863.48 that means each year this much amount of depreciation will be charged.

This is year 1 this is year 2 and this value is 156863 that is 1,56,863. This is this will be the payment each year for depreciation. Now what will happen this payment will earn interest up to this year. This payment will earn interest of up to this year and may be that if a payment is here this will earn an interest up to this year. So when we add all this values and interest this comes out to be 25,00,000.

So now interest earned at the end of second year is 156863.48 into 0.1. If I am calculating the interest earned by this amount in one year this part I am calculating. This value will earn an interest in one year will be equal to this.

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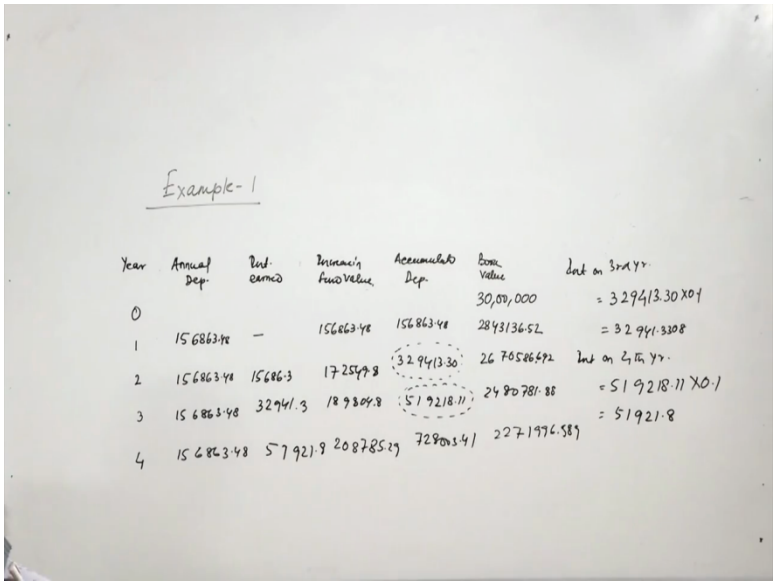

Year	Annual Dep. Computed	Interest earned	Increase in fund value	Accumulated Depreciation	Book Value
0					30,00,000
1	156863.48	-	156863.48	156863.48	2843136.52
2	156863.48	15686.3	172549.8	329413.30	2670586.692
3	156863.48	32941.3	189804.8	519218.11	2480781.881
4	156863.48	51921.8	208785.29	728003.41	2271996.589
5	156863.48	72800.3	229663.8	957667.23	2042332.768
6	156863.48	95766.7	252630.2	1210297.43	1789702.565
7	156863.48	121029.7	277893.2	1488190.65	1511809.342
8	156863.48	148819.06	305682.5	1793873.20	1206126.796
9	156863.48	179387.3	336250.8	2130124.01	869875.9953
10	156863.48	213012.4	369875.88	2499999.885=	500000.1148

This method assumes that the cost of air conditioning plant will remain stagnant at Rs.3000000 even at the end of 10th year. It means the total depreciable cost (Rs.2500000) include the total interest earned amounting to Rs. 931365.09

Now interest earned at the end of third year will be, now if you see this table then you will find that, year, annual depreciation, interest earned, increase in fund value, accumulated depreciation and book value. Now this is the table which has been given as a solution to you and let us analyse this solution. Now in the year 0 at the start of the first year the book value is 30,00,000. Now in the first year, at the end of the first year the depreciation charged is 156863.48, there will be no interest earned. Now increase in the fund value is the same. Cumulative is depreciation is same and the book value is this - this comes out to be 2843136.52.

Now in the year two again I will have annual depreciation 156863 because it will not change with time but here this money will earn a interest which will be 10 percent of this is interest

earned is 15686.3 So when we add these two basically the fund value which we get is 172549.8 and the accumulated depreciation is 329413.30 and the book value is 2670586.692. Now the next year, in the third year the interest will be charged on this.

So if you see here interest on third year is equal to 329413.30 this is the value into 0.1 is comes out to be 32941.3308. So here the annual depreciation charge will be the same but the interest which will be accrued here will be 32941.3 and this becomes 189804.8 this becomes 519218.11 and this is 2480781.88. Now interest on fourth year, year will be charged on his value. So this will be 329413.308 into 0.1 because 10 percent will be 32941.3308.

So interest charged in the fourth year will be I have I have wrongly done it. This will be not be 329 this will be this value 519218.11 into 0.1 and this comes out to be 51921.8. So this will be 51921.8 and this will be 20,8529 this is 72800341 and this will be 2271996.589. So this is how this is computed and the results are obtained so I think you will be able to understand if you can analyse the whole table up to the tenth year, you will find that the way how this is been computed.

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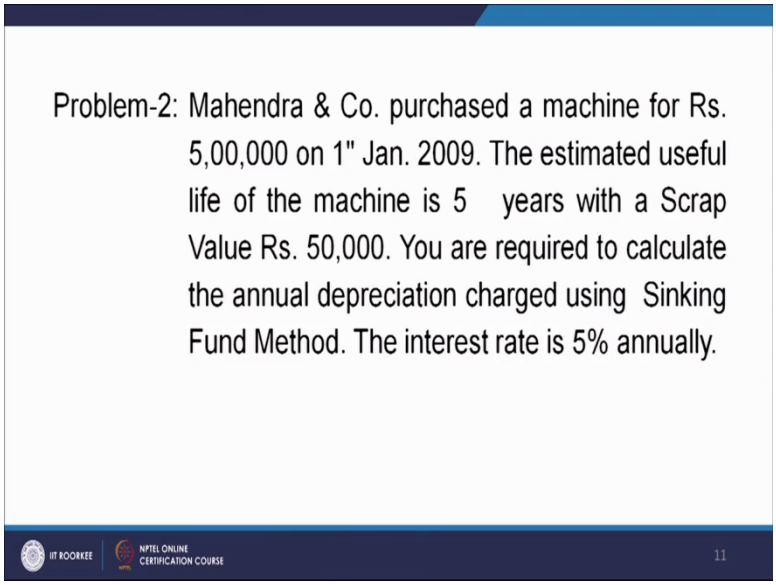

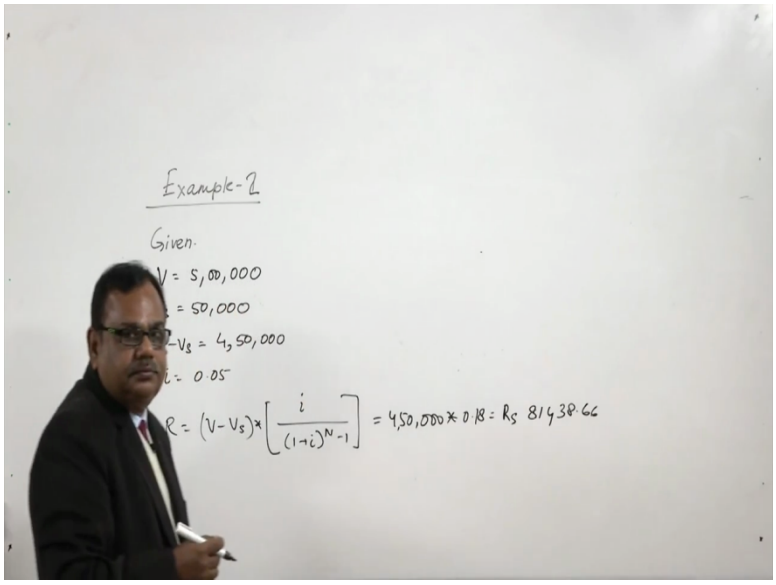

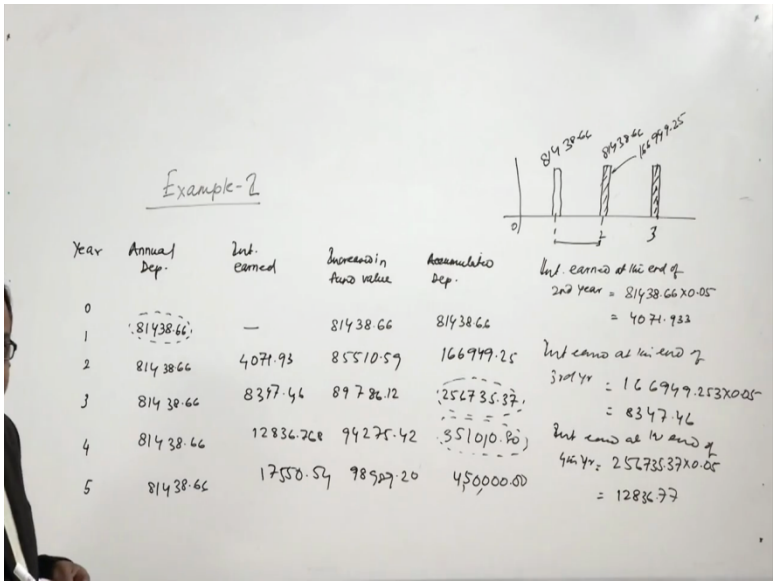

Now let us go to the problem number two. Mahindra and company purchased a machine for rupees 5,00,000 on 1 January 2009. The estimated useful life of the machine is 5 years with a scrap value of 50,000. You are required to calculate the annual depreciation charged using Sinking-Fund Method. The interest rate is 5 percent annually. This is example 2, now the given are V is equal to 5,00,000, Vs is equal to 50,000, V - Vs is equal to 4,50,000, i equal to 0.05 so R formalized R equal to V - Vs i 1 + i to the power N - 1.

So based on this if I compute the value of R, this is equal to 45 4,50,000 into 0.18 comes out to be rupees 81438.66. Now interest earned at the end of the second year is again we draw the same table. Annual depreciation, interest earned, increase in fund value, accumulated depreciation. If we do this when at year 0 we have the 5,00,000 as book value, now in one year the payment will be 81438.66 this is the value of R which we have calculated.

Now no interest earned, the fund value is 81438.66 and this is also 81438.66. Now in the year two again the payment of 81438.66 will be done but this value will now earn a interest of 5 percent. So when I find out the interest of 5 percent, so here interest earned at the end of second year, this is equal to 81438.66 into 0.05. And this comes out to be 4071.933. If I see the timeline this is 0, this is the payment which is being done at the end of the first year and this payment is 81438.66.

Now there will be another payment, second year this payment is also 81438.66 so on so forth. But this payment will earn a interest of for 1 year here at this point if I take interest earned at the end of second year. So this value will earn a 5 percent interest and this is this. So this interest is 4071.93. And this value is, this two when I add this is 85510.19 and accumulated depreciation is 166949.25. Now in the third year, now here at the second year, the accumulated value is this the second year the accumulated this + this + interest of this. It comes out to be 166999.25.

So this will pay interest of 1 year here. So interest earned at the end of third year is equal to 166949.253 into 0.05, that comes out to be 8347.46. So I will have interest here at the end of third year again 84138.66, interest earned will be 8347.46, this will add together this is 89786.12 and this one becomes 256735.37. So interest earned at the end of fourth year will be equal to this value, that is 256735 point37 into 0.05 comes out to be 12836.77.

So here at the end of fourth year this is 12836.768, this both added together this becomes 94275.42 and this cumulative becomes 351010.80. So interest earned on fifth year will be based on this value. So on the basis of this we will calculate, so this is fifth year this will be 81438.66 this is 17550.54 this is 98989.20 and this is 4500 4,50,000. Now if you see this, you will find that this method assumes that the cost of the machine will remain stagnant at 50,00,000.

There is an assumption in this method is that the 50,00,000 which is the cost of the machine remains constant when we purchase it after 5 years. It also means the total depreciable cost 4,50,000 it remains constant throughout the life and this 4,50,000 includes the total interest earned amounting to 42806.70 that means 42,000 the 4,50,000 which year I am saying the accumulated depreciation as got a interest component of this 42,806.70

Now let us summarize this is the last lecture of the module one that is depreciation, sorry this is the last but one lecture, in the last lecture we will come compare all the methods together.

This is the last but one lecture of the module one that is depreciation and here we have analysed the Sinking-Fund Method. The Sinking-Fund Method has a special characteristics that it is based on time value of money and that is why the depreciable amount which is accumulated at the end of the service life contains a heavy component of the interest, as in this case the 4,50,000 rupees which is the depreciable amount contains a interest of 42,806.76. Thank you.