Engineering Economic Analysis
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Lecture 17
Proper Treatment of Sunk Cost in Replacement

Welcome tothe lecture on replacement analysis 2. So in this lecture we will discuss a case how to properly treat the sunk cost in cases of replacement analysis.

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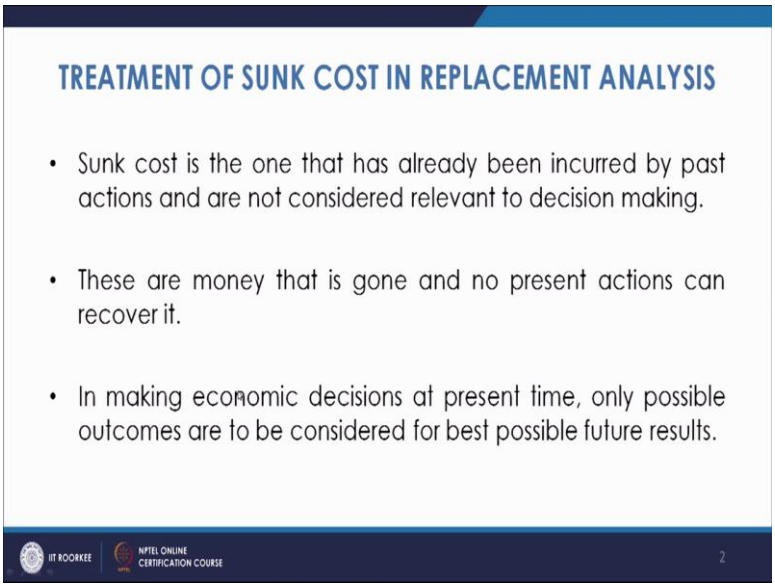

So we had certain idea about the sunk cost and we knew that sunk cost is the one that has already been incurred by past actions, are not considered relevant to decision making. So we have to forget what has been incurred in the past and we have to be in present for any decisions to be taken in future. So these are the money that is gone and no present actions can recover it.

In making economic decision at present time, only possible outcomes are to be considered for best future results. So it means the sunk cost has to be forgotten and the value at present only is to be considered and this valuation has to be done by the person who is supplying you the new equipment or by any outsider person.

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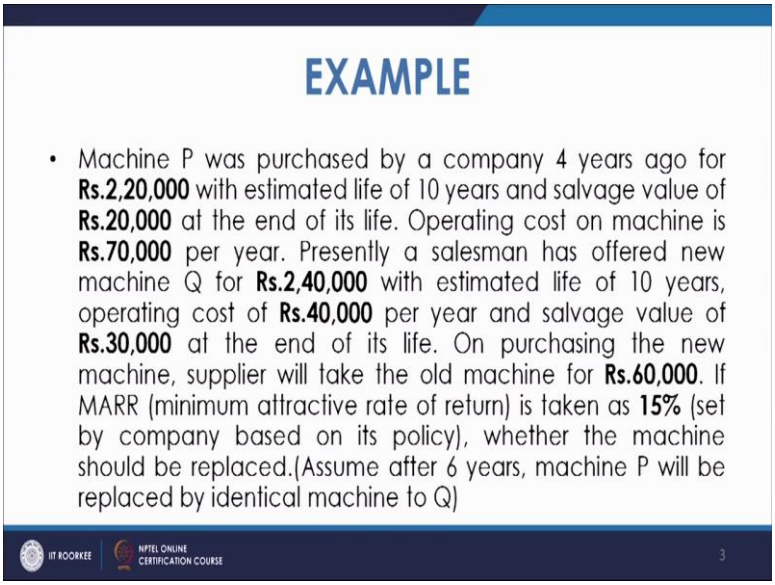

Let us discuss about a case where there is a machine P which was purchased by a company 4 years ago for Rs. 220,000 with the estimated life of 10 years. So when it was purchased, it had the estimated life of 10 years and it was purchased for years ago. It means the machine can further be used for another 6 years. Now machine has the salvage value of Rs. 20,000 at the end of its life.

Means after 6 years from now its life will be over and its cost salvage value will be Rs. 20,000. Operating cost on the machine is Rs. 70,000 per year. Now you are offered a new machine, so presently a salesman has offered new machine Q for Rs. 240,000 with estimated life of 10 years. So a salesman has come, he is telling you to replace the old machine and the new machine is in 2,40,000 and it has a life of 10 years. Its operating cost is Rs. 40,000.

You can see that the operating cost for the old machine was Rs. 70,000 per year but the operating cost of the new machine is Rs. 40,000. The certainly the cost of this machine is larger but the operating cost is smaller. Salvage value of the new machine is fixed as Rs. 30,000 at the end of its life. So its life is 10 years, after 10 years from now, its value will be Rs. 30,000. On purchasing the new machine supplier will take the old machine for Rs. 60,000.

So here comes the outsiders view point. The machine which you purchased 4 years ago for Rs. 2,20,000 now it will be taken at Rs. 60,000. It means the valuation of the old machine is done at Rs. 60,000. So the present cost of this machine is done as Rs. 60,000.

Now it minimum attractive rate of return which is governed by the policy, basically we have already discussed the rate of return and a minimum attractive rate of return is the one which the company sets because what return on its investment it expects the name of, on that basis minimum attractive rate of return is set by the company and it has been taken as 15%. So basically rate of interest is 15%.

Now it is to be decided whether the machine should be replaced or it should be kept intact. Now it is also assumed that after 6 years, machine P will be replaced by identical machine to Q. It means annual equivalent values will be same for that period. So let us solve this problem which needs the treatment of proper sunk cost.

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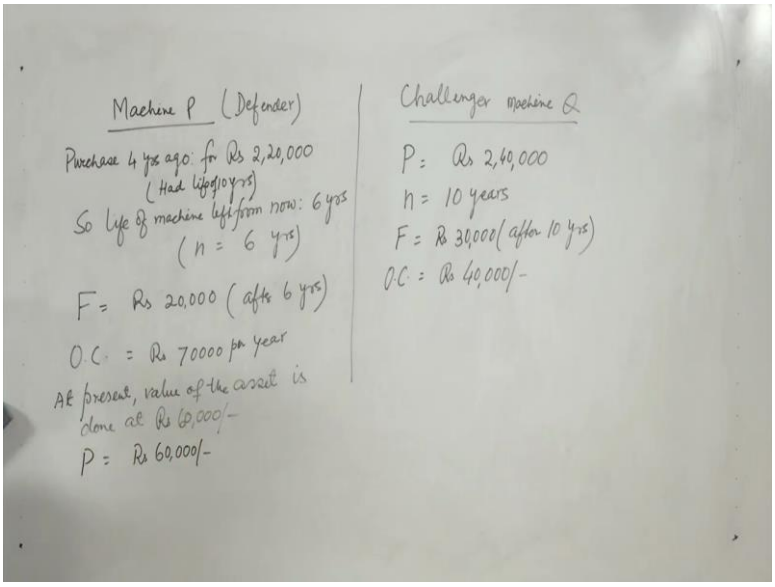

So let us see you have machine P, purchased 4 years ago for Rs. 220,000. Now it had that time had life of 10 years, so life of machine left from now is 6 years. So in this case, your n will be 6 years because we are to study in the future, now its future life is only 6 years. Then the estimated salvage value is 20,000 at the end of its life. So the salvage value is Rs. 20,000 after 6 years.

Operating and maintenance costs, so operating cost on the machine is Rs. 70,000 per year. Now you have another machine, so this is your defender. Now you have a challenger machine Q. This machine is purchased for Rs. 240,000, so its P is Rs. 2,40,000. It has life of 10 years, after its life it will have a salvage value of 30,000, so F will be Rs. 30,000 after 10 years and its operating cost is 40,000.

Now what it tells that once you purchase the new machine, the supplier will take the old machine for Rs. 60,000. So in that case, this 60,000 is basically the value of the present asset. So now at present, value of the asset is done at Rs. 60,000. It means for the replacement analysis, for the defender, the valuation is done by the supplier who is supplying the new machine and he is telling that the worth of this old machine is Rs. 60,000.

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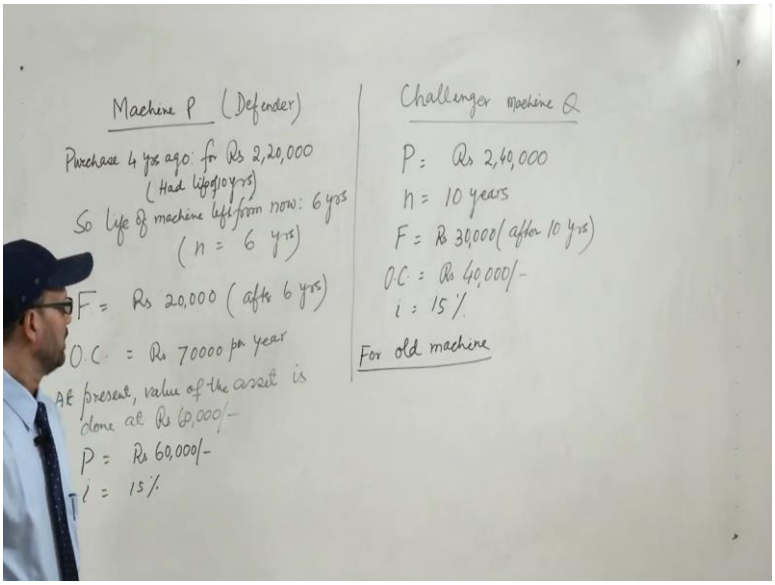

That is why P for this machine now, so P will be taken as Rs. 60,000. So since the value of the asset is evaluated at Rs. 60,000, for this asset P can be taken as Rs. 60,000. Now we have this formulation in which the old machine is having the present cost of 60,000, its salvage value is 20,000 after 6 years, n is 6 years, attractive rate of return minimum is set as 15%, so i will 15% for both the cases. Now what should be the decision, whether to replace it or not?

Since the study periods are differing, we will go for taking the study period which is shorter one that is n equal to 6 years because it is assumed that after 6 years, machine P will be replaced by identical machine that of Q. So let us see, based on study period of its life, what will be the annual cost which will be incurred by these machines.

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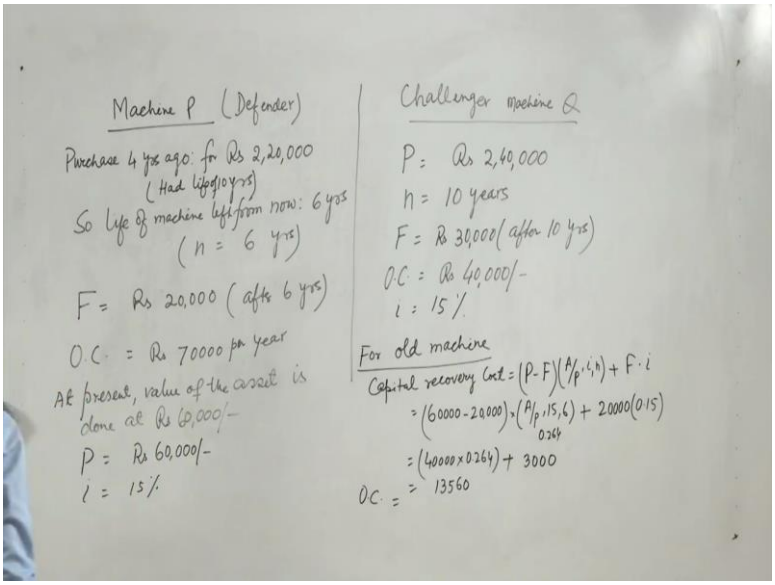

So basically you have 2 components of costs, one is the capital recovery with recrun cost and another is the operating cost which is the yearly cost. So now let us see for old machine, capital recovery cost can be taken as P - F A by P i n + F into i. So you have P as 60,000 - F, F is 20,000 multiplied by A by P. For the old machine i is 15%, anyway it is equal for both and n is 6 years + 20,000 into .15.

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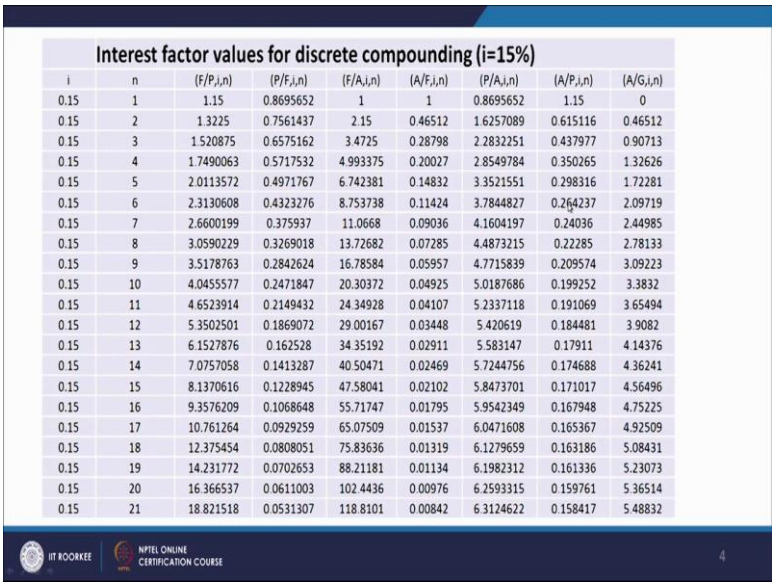

Interest factor values for discrete compounding (i=15%)

i	n	(F/P,i,n)	(P/F,i,n)	(F/A,i,n)	(A/F,i,n)	(P/A,i,n)	(A/P,i,n)	(A/G,i,n)
0.15	1	1.15	0.8695652	1	1	0.8695652	1.15	0
0.15	2	1.3225	0.7561437	2.15	0.46512	1.6257089	0.615116	0.46512
0.15	3	1.520875	0.6575162	3.4725	0.28798	2.2832251	0.437977	0.90713
0.15	4	1.7490063	0.5717532	4.993375	0.20027	2.8549784	0.350265	1.32626
0.15	5	2.0113572	0.4971767	6.742381	0.14832	3.3521551	0.298316	1.72281
0.15	6	2.3130608	0.4323276	8.753738	0.11424	3.7844827	0.264237	2.09719
0.15	7	2.6600199	0.375937	11.0668	0.09036	4.1604197	0.24036	2.44985
0.15	8	3.0590229	0.3269018	13.72682	0.07285	4.4873215	0.22285	2.78133
0.15	9	3.5178763	0.2842624	16.78584	0.05957	4.7715839	0.209574	3.09223
0.15	10	4.0455577	0.2471847	20.30372	0.04925	5.0187686	0.199252	3.3832
0.15	11	4.6523914	0.2149432	24.34928	0.04107	5.2337118	0.191069	3.65494
0.15	12	5.3502501	0.1869072	29.00167	0.03448	5.420619	0.184481	3.9082
0.15	13	6.1527876	0.162528	34.35192	0.02911	5.583147	0.17911	4.14376
0.15	14	7.0757058	0.1413287	40.50471	0.02469	5.7244756	0.174688	4.36241
0.15	15	8.1370616	0.1228945	47.58041	0.02102	5.8473701	0.171017	4.56496
0.15	16	9.3576209	0.1068648	55.71747	0.01795	5.9542349	0.167948	4.75225
0.15	17	10.761264	0.0929259	65.07509	0.01537	6.0471608	0.165367	4.92509
0.15	18	12.375454	0.0808051	75.83636	0.01319	6.1279659	0.163186	5.08431
0.15	19	14.231772	0.0702653	88.21181	0.01134	6.1982312	0.161336	5.23073
0.15	20	16.366537	0.0611003	102.4436	0.00976	6.2593315	0.159761	5.36514
0.15	21	18.821518	0.0531307	118.8101	0.00842	6.3124622	0.158417	5.48832

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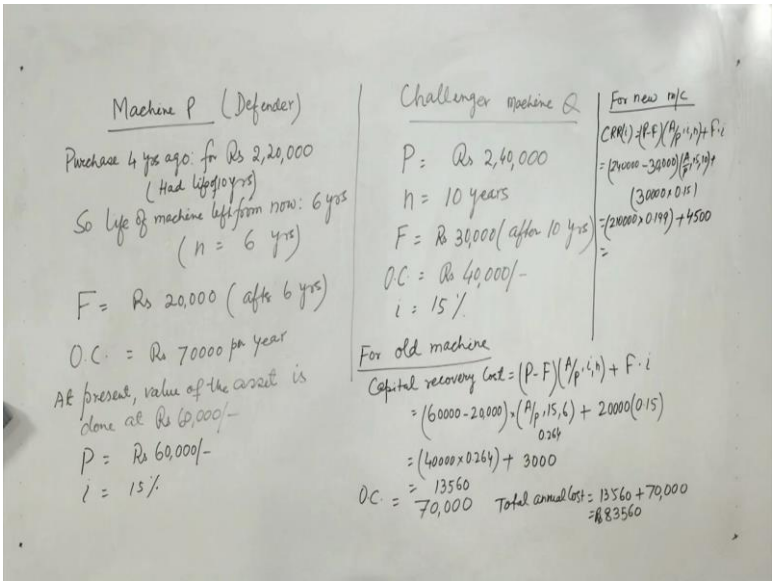

So we have to get the value of the factors A by P 15 6, so A by P 15 6 will be somewhere here and this is .264, so it will be .264. So it will be 40,000 multiplied by .264 + 20,000 multiplied by .15. 3000. So that will be equal to 13,560. This is the capital recovery cost for the old machine. Now there is another cost which is the operating cost, so operating cost is Rs. 70,000.

So total annual cost incurred by the old machine will be, total cost annual cost will be equal to 13,560 + 70,000 83,560. So for this machine we see the total annual cost AEi that will be coming out to be Rs. 83,560. Now we will calculate for the new machine.

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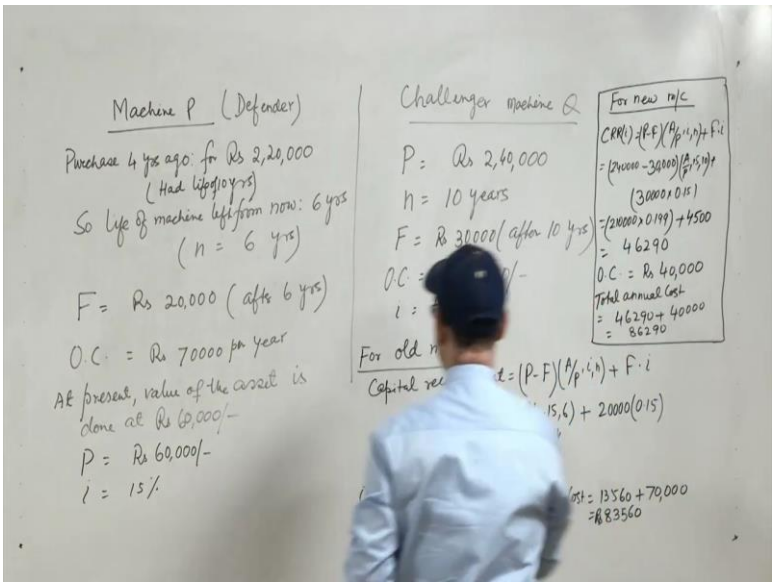

For new machine, for new machine similarly, capital recovery with return cost, this is coming out to be again P - F A by P i n + Fi. So in this case P is Rs. 240,000 - its estimated salvage value is 30,000 multiplied by the factor A by P 15 and n is 10 years for this case + F is again 30,000 into i so .15. Now we will see the value A by P 15 10, A by P 15 10 we can see from here.

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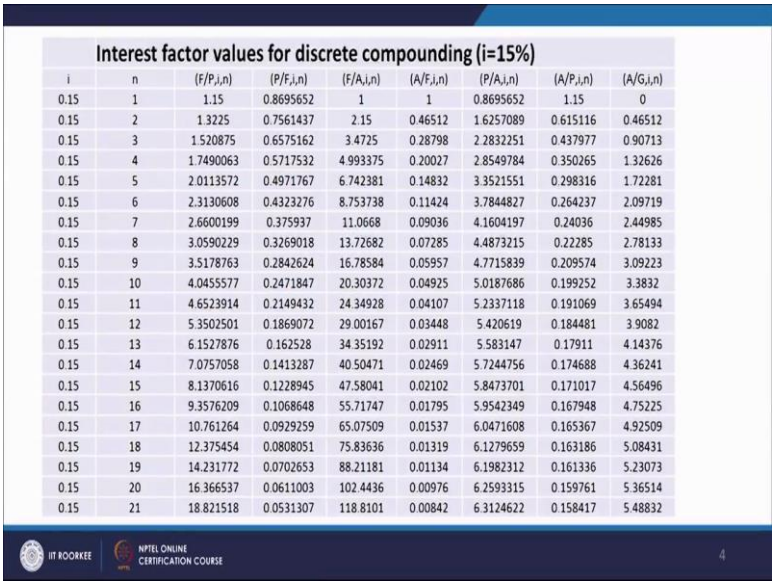

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This is n equal to 10, so we will come in this line A by P 15 10, it is .199. Okay? So it is .199, so it becomes 210,000 multiplied by .199 + 4,500. So it will be 46,290. This is the capital recovery with return cost, that is again annual equivalent cost but taking only the two capital costs P and F.

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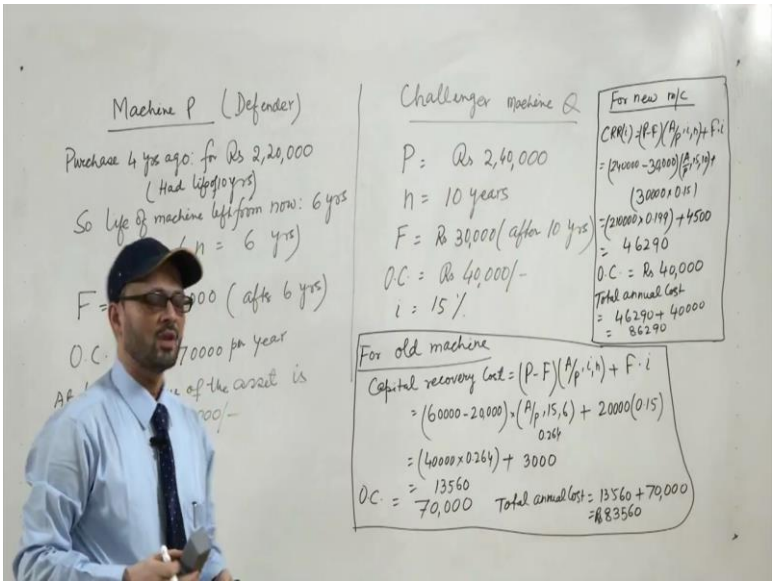

The next cost is the operating cost which is given as Rs. 40,000. So total cost, total annual cost will be 46,290 + 40,000 equal to 86,290. We have calculated for old machine in this box and for the new machine in that box. What we see is that the capital recovery cost for the old machine is coming out to be 13,560 and since operating cost is quite high but still your total annual cost comes out to be 83,560.

In the new machine, since it is a costly machine, even though it is used for larger time, the capital recovery cost comes out to be 46,290 but its maintenance cost is quite low but in spite of that, the total annual cost comes out to be 86,290. So we see that there is some difference in the total annual equivalent cost of the old machine over the new machine.

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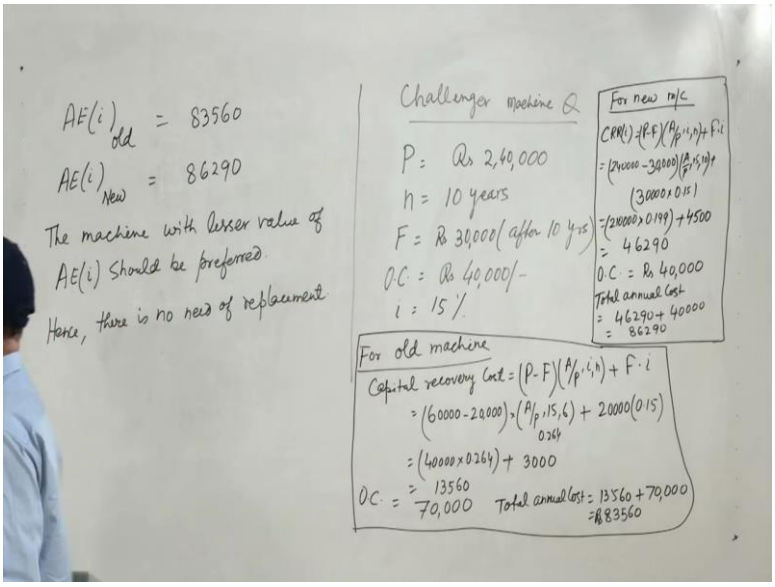

So what we can say, annual equivalent for old machine is coming out to be 83,560 and the annual equivalent of the new machine is coming out to be 86,290. Now these are basically the expenses, so the machine with lesser value of AEi should be referred, hence there is no need of replacement. Now what we see a is that, since you are annually having certain advantage of 86,290 - 83,560 which is nothing but 340 here + 2290 so something close to 2500.

So that will certainly give you the decision that there is no need of replacement. So these are the cases that you will come across many a times where you will have the conditions in which there has been a lot of expenditures on the existing asset but they are not to be taken. Its value is to be taken as the one for which it is evaluated.

Once you purchase the new machine, certainly there would be certain trading in and you may be given some value for your machine that will be actually the present cost of that machine and based on that you can have the analysis and come to certain decision.

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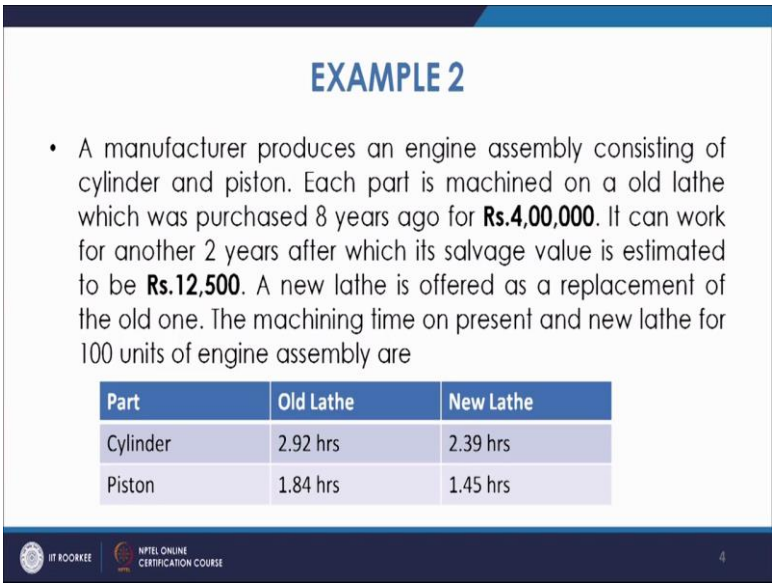

Next we can discuss about another problem which will deal with the change in the machine time and also other considerations like sunk cost. So in this question it is said that a manufacturer is producing an engine assembly which consists of making cylinder and piston and cylinder and piston is to be machined. Each part is to be machined on a old lathe which was purchased 8 years ago for Rs. 4,00,000.

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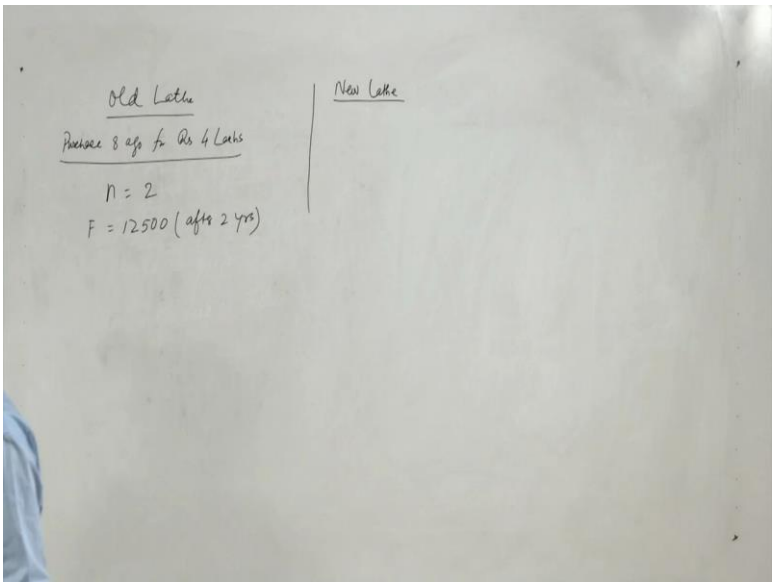

So again we can see, we had old lathe when it was purchased 8 years ago for Rs. 4,00,000. So basically it is a sunk cost, we have not to discuss about it. Only we have to consider this 8 years because it will tell us what is the life left of this machine. It can work for another 2 years, it means it has a life of 2 years left after which it salvage value is estimated as F equal to 12,500, after 2 years.

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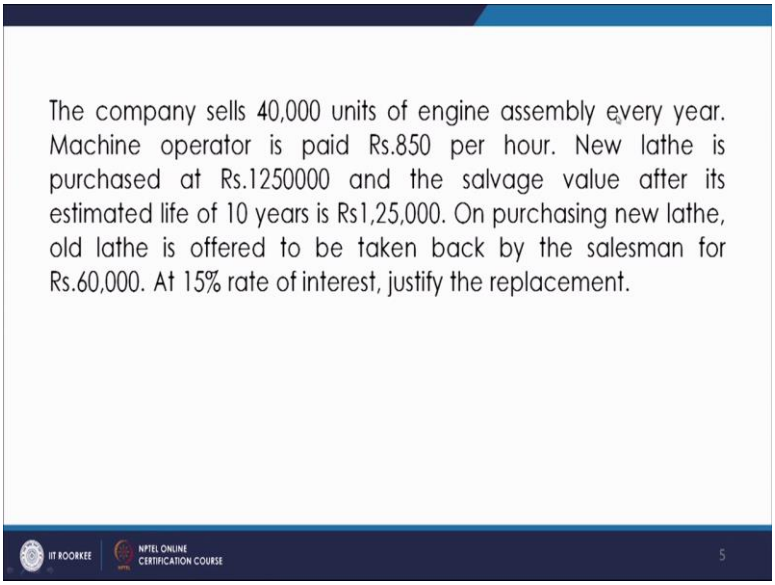

So because we are studying in present time, so after 2 years its salvage value is given as Rs. 12,500. Now a new lathe is there which is the challenger, this challenger is said to be the replacement. Now these are the times which the old lathe and new lathe take for 100 units of production or machining of the components and company is basically selling 40,000 units of engine assembly every year.

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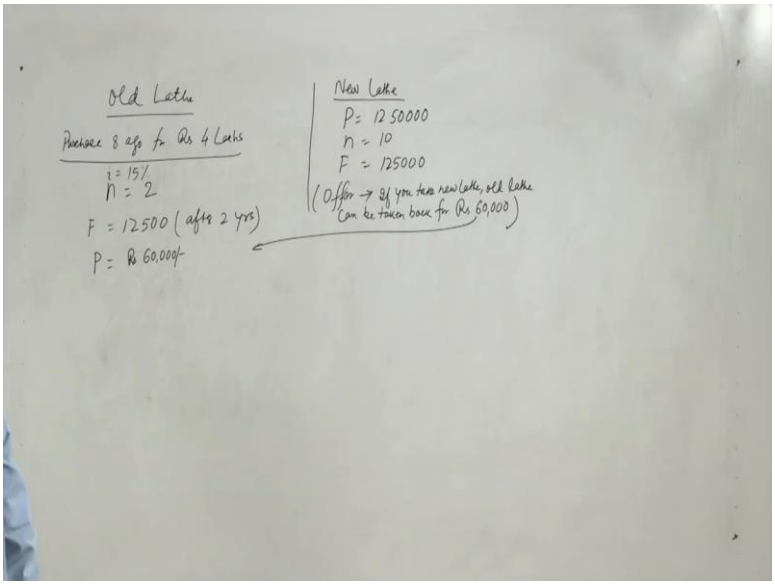

It means that will decide the total labour cost for 40,000 units and also the labour rate is Rs. 850 per hour. So this one part will be the labour cost per year. Now next is, the new lathe price is 12,50,000, so for this P is given as 12,50,000 and salvage value after 10 years, so after n equal to 10 F is given as 1,25,000. Now again it is told that on purchasing new lathe, old lathe can be taken back by the salesman at Rs. 60,000.

So offer is given that if you take new lathe, old lathe can be taken back for Rs. 60,000. Now this cost, this cost basically is nothing but the valuation done by the salesman for the old machine. So this comes here and that gives you P equal to 60,000. So now what we see is, you have P as 60,000, F as 12,500, n as 2 for the old machine and P as 12,50,000, F as 1,25,000 and n as 10 years for the new machine. i is taken as in the both the cases 15%.

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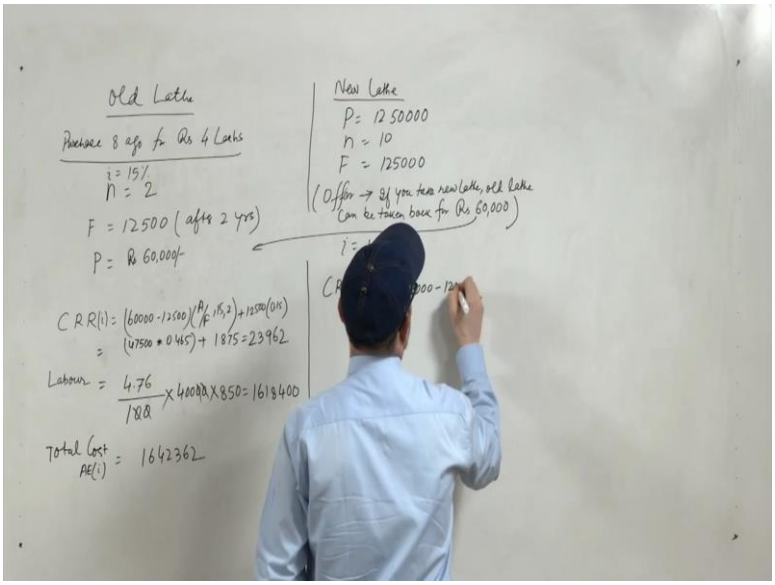

Now we have to go for the justification whether to go for it or not. So you have two part, one is capital recovery with return part, another is the labour part, it will be giving you the annual cost for these two parts. As we know, capital recovery with return part will be P - F, 60,000 - 12,500 A by P i n, so i is 15 and n is 2 + 12,500 into .15. So that will be, we have to refer to the table A by F 15 2.

So if we take A by F factor and 15 2 is .465, so it will be 47,500 into A by F 2 .465 + 12,500 into .15 so it is 1875, so it comes out to be 23,962. So this is the capital recovery part for the old machine. Now labour cost as we see, you have labour cost based on the time for which the label is applied. So the time for which the labour is applied is here 4.76 hours and in 4.76 hours, it is machining 100 units.

And total number of units it has to machine is 40,000, so this is the labour hour and for every hour he is putting Rs. 850. So it will be 1618400. So total cost AEi is coming as 1642362. Now let us see for the challenger. So for the defender we have got the annual equivalent value as total annual cost is equivalent to 16,42,362. Now let us see for the challenger.

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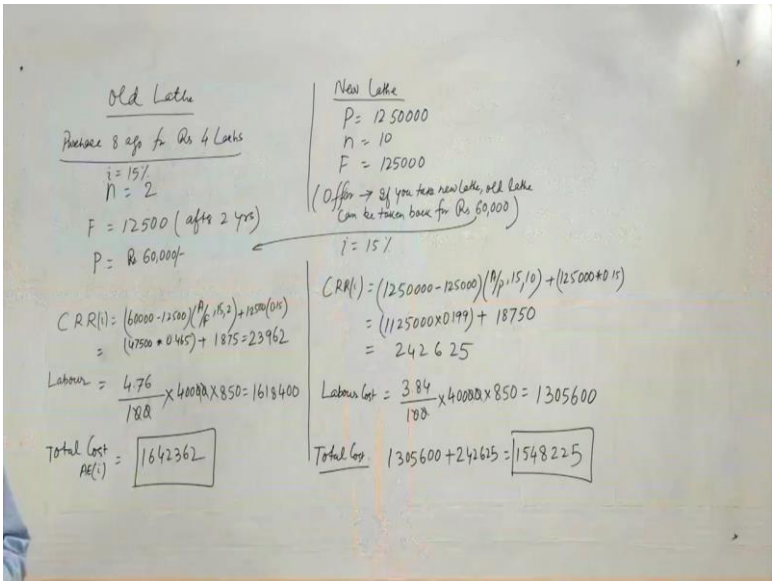

It will be capital recovery part that will be 12,50,000 - 1,25,000 multiplied by A by P 15 10 + 125 and its salvage value multiplied by interest rate. So it will be 1125 into A by P 15 10, we have again to refer to the table, A by P 15 10, so this is 10, in that line your A by P comes here, so it is A by P 15 10 is .199 +. So once we do that, this comes out to be 2,42,625.

Then the labour cost, this comes out to be in this case as we see the labour hours is 2.39 + 1.45 this is 3.84. 3.84 for 100 units multiplied by 40,000 units multiplied by 850, so it will be 13,05,600. So if you add total cost, 13,05,600 + 2,42,625 that comes out to be 15,48,225. Now let us see that in this case, you have the total cost coming out to be 16,42,362 and here it is 15,48,225.

So we see that the challenger is operating at a lower cost and that is why replacement is suggested. So this is how you have to tackle the problems which involves the treatment of sunk cost in appropriate manner and also you have to find the annual equivalent values, the annual costs which will be consisting of the capital recovery with return cost as well as other costs like operation and maintenance cost, labour cost and so.

And we can come to a conclusion whether the replacement is required or not. Thank you.