Depreciation, Alternate Investment and Profitability Analysis.
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Lecture-10.
Alternative Investment Annual Cost Method - II.

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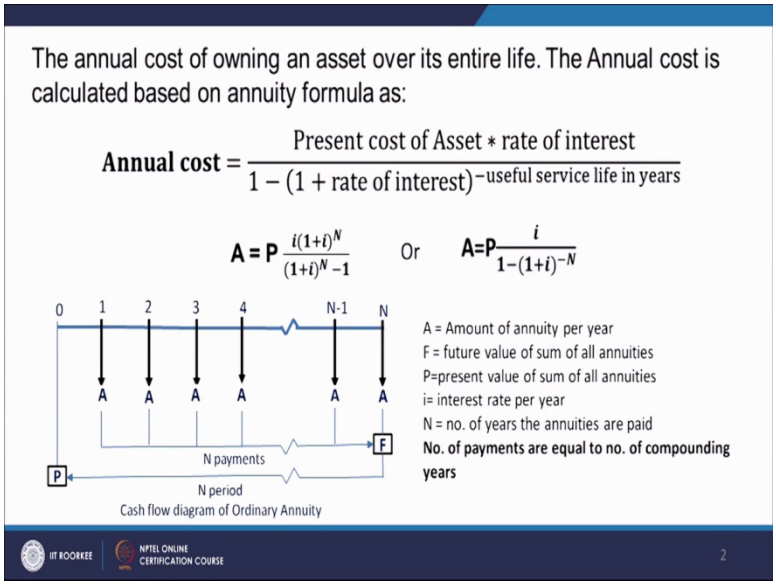

Welcome to the course Depreciation, Alternate Investment and Profitability Analysis. In this lecture we will be covering module two which is alternative investment and in this module we will cover annual cost method part two. In this part two we will take some difficult problems and will solve it using annual cost method. Now in the first slide I have shown the formula, in the first slide I have shown how to derive the formula for the annual cost method and based on this formulae we will solve our numericals.

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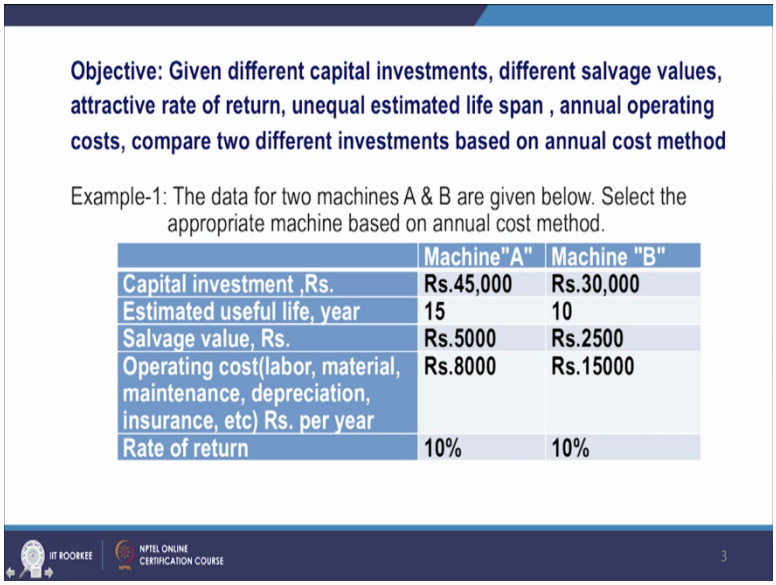

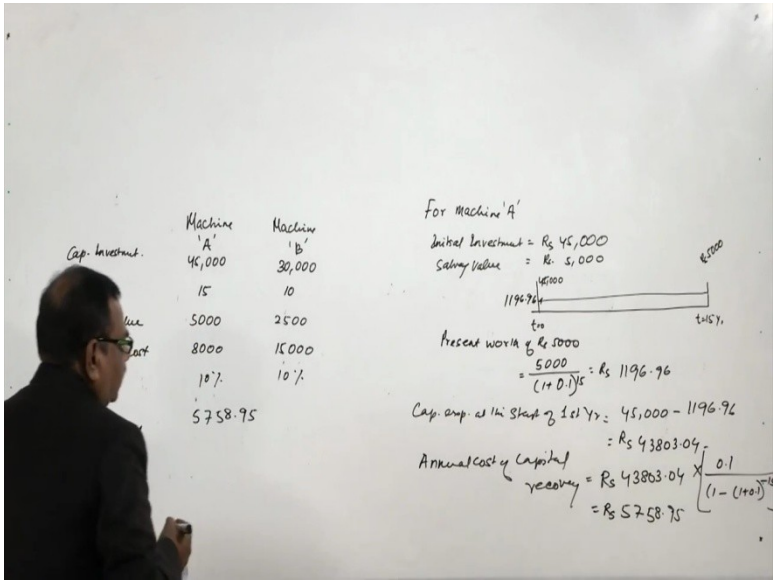

Now this is the first numerical and this objective of this numerical is given different capital investments, different salvage values, attractive rate of return, unequal estimated life span, annual operating cost, compare two different investment based on annual cost method. Now here again we have machine A and machine B, now capital investment is 45,000 this is 30,000 estimated useful life that is N value is 15 and 10 in earlier cases we have taken N to be same, salvage value this is 5,000 and this is 2,500 this is also different. Operating cost this is 8,000, this is 15,000.

Now we see that though the machine B requires less capital investment that is 30,000, it needs more operating cost that is 15,000 and here it takes more capital investment 45,000 but less operating costs and hence in such type of problems basically we need annual cost method

to decide upon whether we should go for machine A or machine B. Now the investment for machine A, the initial investment is equal to rupees 45,000 the salvage value is 5,000.

Now if I take the timeline at t equal to 0, I am investing 45,000 t equal to 0 and at t equal to 15 years I am getting rupees 5,000. So in this case the depreciable amount is not 45,000 - 5,000 because they are at different time periods. So what we have to do, we have to bring this 5,000 to this timeline t equal to 0 and then we deduct from 45,000 to find out the value of the initial investment basically.

Now if I want to do this so I have to find out the present worth of this, present worth of rupees 5,000 is equal to 5,000 divided by 1 + the interest rate is 10 percen,t I am sorry I have left it, this is 10 percent this is 10 percent is equal to 01 due to 10 percent to the power 15 and this converts into rupees 1196.96 that means when I take this 5,000 to t equal to 0 to present value is becomes 1196.96.

So the capital expenditure at the start of first year, this is a start of first year is equal to 45,000 - 1196.96 that comes out to be rupees 43,803.04. Now I have to find out the annual cost of capital recovery, annual cost of capital recovery is equal to capital investment this is rupees 43,803.04 into 0.1 divided by 1 - 1 by 0.1 to the power - 15. This is my capital recovery factor and this gives me rupees 5758.95, so here I can write down my capital recovery factor that is capital recovery per year is 5758.95.

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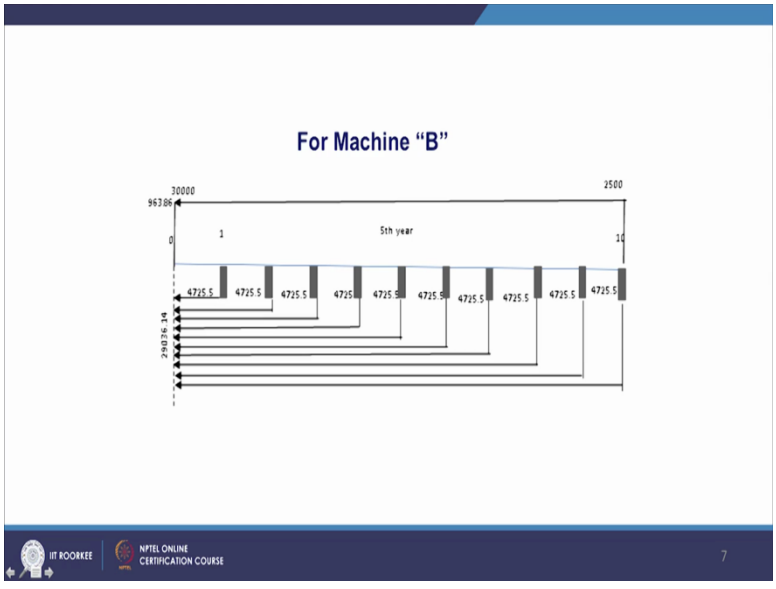

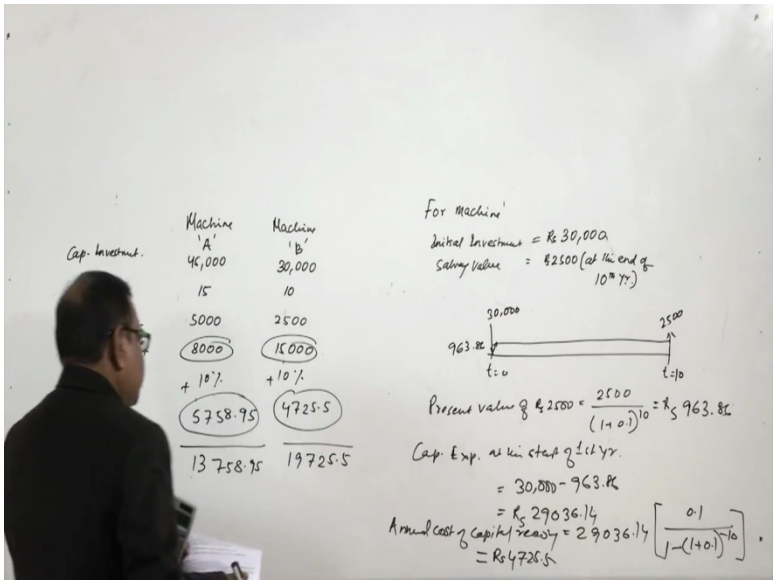

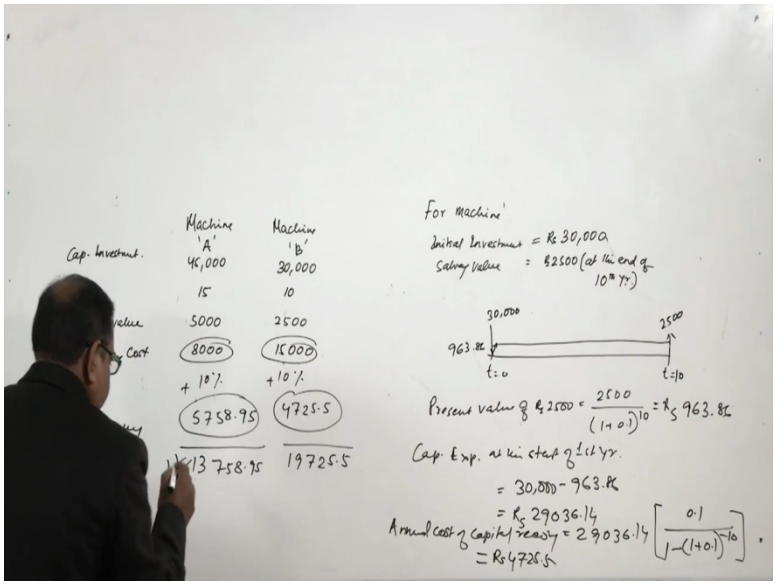

Similarly I should calculate for machine B. Now for the machine B this is rupees 30,000 and salvage value is 2,500 and this 2,500 I am going to get at the end of tenth year. So in the timeline at t equal to 0, this is t equal to 10, I am getting 2,500 here and t equal to 0, I am investing 30,000. So I am sinking this 30,000 here and I am getting 2,500 here, so this has to be brought to my zero timeline that means I have to find out the present value of 2,500.

So present value of rupees 2,500 is equal to 2,500 divided by 1 by 0.1 to the power 10 and this comes out to be rupees 963.86. So when I ported from here to here this becomes 963.86. So the capital expenditure at the start of first year is equal to 30,000 - 963.86. It comes out to be rupees 29036.14. Now annual cost of capital recovery, annual cost of capital recovery equal to this 29036.14 into this factor i that is 0.1 from - 1 + 0.1 - 10 and this comes out to be rupees 4725.5.

So here this becomes 4725.5, now to calculate the total annual cost I have to add the operating cost, so I have to add this operating cost with this and I have to add this with this. So if I add this is 8,000 + 5758.95 equal to 13758.95 and if I add this 15,000 + 4725.5 this is 19,725.5. As the annual cost of machine A is less than machine B so my selection will be machine A. Now let us take another example.

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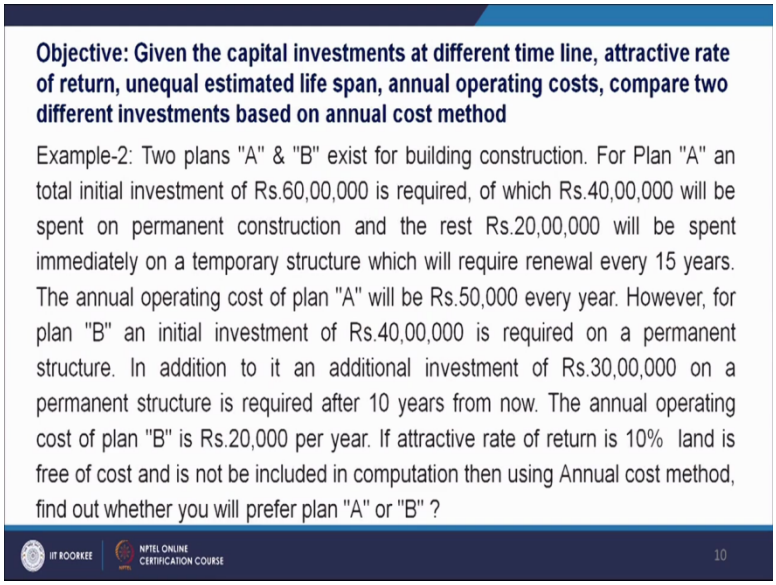

Now the objective of the example two is that given the capital investment at different timeline, attractive rate of return, unequal estimated life span, annual operating cost. Compare two different investments based on annual cost method. Now the example two tells, two plans A and B exist for building construction. For plan A an total initial investment of 60,00,000 is required, of which 40,00,000 will be spent on permanent construction now this is a trick. Permanent construction means life span N is equal to infinite.

Now how to handle the cases which has got N equal to infinite and how to calculate the capital recovery factor will pose some problems and we will tackle this, and the rest 20,000 will spent immediately on a temporary structure which will require renewal every 15 years. The annual operating cost of plan A will be 50,000 every year however for plan B an initial investment of 40,00,000 is required on a permanent structure, again permanent structure, in addition to it an additional investment of 30,00,000 on a permanent structure is required after 10 years from now.

So after 10 years again a investment of 30,00,000 will be done on permanent structure, is required after 10 years from now. The annual operating cost of plan B is 20,000 per year, if

attractive return, attractive rate of return is 10 percent, land is free of cost and is not to be included in computation, then using annual cost method find out whether you will prefer plan A or plan B. So complication in his plan has come due to this permanent structure, in this problem investments are done in different timeline and these are to be brought into one timeline before the application of annual cost method.

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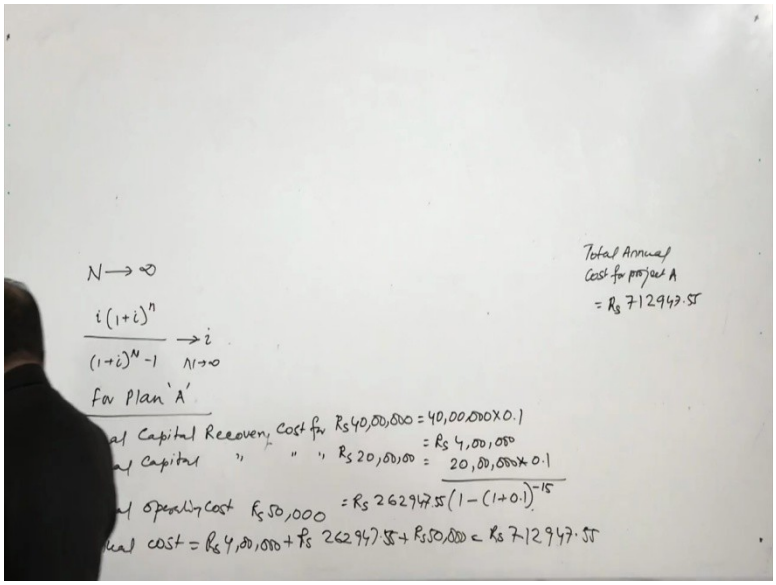

While finding annual capital recovery of permanent structure is assumed, in a permanent structure it is assumed that the N will tend to infinite and if this N tends to infinite than i 1 + i to the power n divided by 1 + i to the power N - 1 that will tend to i. Thus the case becomes a case of perpetuity if you remember in the perpetuity to find out the perpetuity we multiply the investment with i so it becomes a perpetuity. So for plan A , A if we calculate the annual capital recovery cost for rupees 40,00,000 and at 10 percent interest rates will be 40,00,000 into 0.1, why 0.1, because this is the value of i and here we have seen that while to convert this factor which is used for capital recovery, the whole factor moves towards i when N moves towards infinite.

So the annual capital recovery cost for a permanent factor can be calculated by multiplying its cost with the value of i which comes out to be rupees 4,00,000. Now another capital recovery another 20,00,000 is being done, life of the structure is 20 years, so annual capital recovery cost for rupees 20,00,000 is easy to calculate, this is 20,00,000 into 0.1 divided by 1 - 1 + 0.1 to the power - this is 15.

Here in the question the renewal will be required every 15 years, so it is 15. Now this comes out to be rupees 262947.55, now after 15 years this structure has to be rebuild and when it will be rebuild at that time also the annual capital recovery will remain this 262947.55, provided the cost of the structure does not change. Now annual operating cost is rupees 50,000 so to find out the annual capital cost ,sorry annual cost this is total annual cost, we will add all these three that is rupees 4,00,000 + rupees 262947.55 + rupees 50,000 this comes out to be rupees 712947.55.

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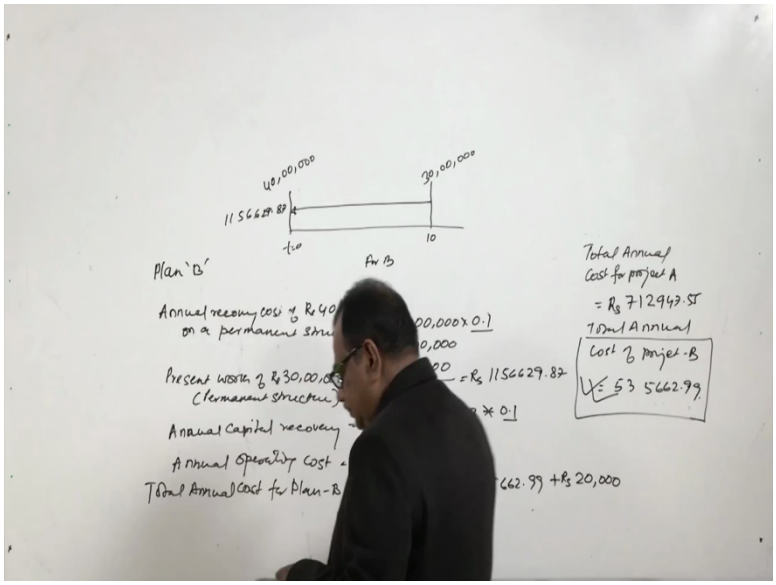

So annual cost for A is this, total annual cost of project A is equal to rupees 712947.55. Now let us do it for now for plan B. If we see the problem plan B, plan B is also investing 40,00,000 rupees on a permanent structure at t equal to 0. So annual recovery cost of rupees 40,00,000 on a permanent structure is equal to 40,00.000 into 0.1 which is the value of i. Now this becomes 4,00,000, now the present worth now if you see the timeline for B at t equal to 0, when we investing 40,00,000, after 10 years when investing 30,00,000 on a permanent structure.

So first we have to do bring this to this timeline and then multiply with the i. So the present worth rupees 30,00,000 is equal to 30,00,000 divided by 1 + i to the power 10 and this comes out to be rupees 1156629.87, so the present worth is this 1156629.87. Now taking this structure to be permanent, this is a permanent structure, so the annual capital recovery, recovery is equal to rupees 1156629.87 into the value of i which is 1 because this is a permanent structure, so annual capital recovery will be equal to the value at t equal to zero into 0.1, that comes out to be rupees 115662.99.

Now we have annual operating cost is equal to rupees 20,000. So the total annual cost for plan B is equal to rupees 4,00,000 + rupees 115662.99 + rupees 20,000 and when we add this up then it becomes rupees 535662.99.

So here total annual cost of project B is equal to 535662.99 as the annual cost of project B is less than project A. This project is selected. Let us summarize this, common problem confronted in engineering economics are those where alternative comparison between two or more mutually exclusive alternative investment compete involving different series of capital disbursement, that means the disbursement are at different time. In the present lecture, I have taken one of the methods which is called annual cost method to tackle such problems and to select one of the alternatives from mutually exclusive alternatives and this annual cost part two we have taken some difficult problems and we have shown how to tackle this using annual cost method. Thank you.