Time value of money-Concepts and Calculations

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Lecture – 03
Simple interest

Welcome to the course, Time value of money-Conception Calculations. This lecture is devoted to Simple Interest.

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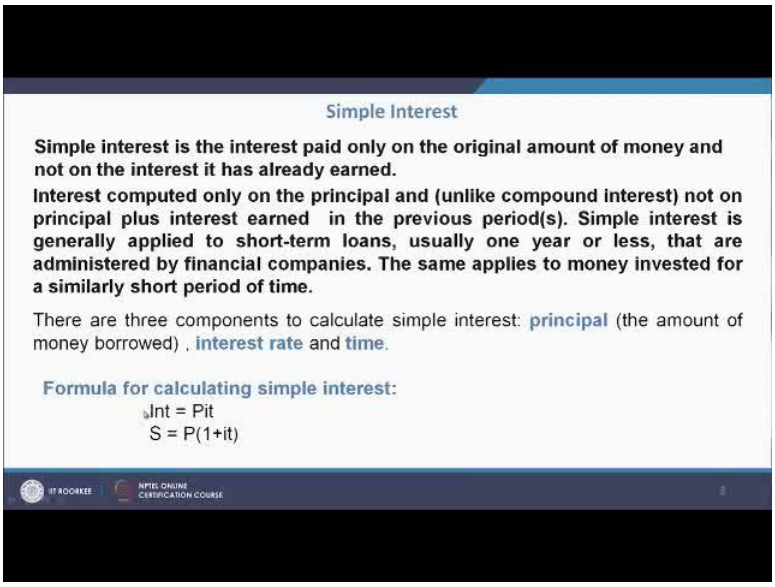

Simple interest is the interest paid only on the original amount of money and not on the interest it has already earned. Interest computed only on the principle and unlike compound interest not on the principal plus interest earned in the previous periods. Simple interest is generally applied to short-term loans usually 1 year or less, that are administered by financial companies. The same applies to money invested for a similar short period time.

There are three components to calculate simple interest. The first is principal the amount of money borrowed, the second is interest rate and the third is time. Now these three variables are given in equation that is interest int interest is equal to P into i into t, where P is principal, i is the interest rate and t is the time. And the final value is equal to P into 1 plus i t.

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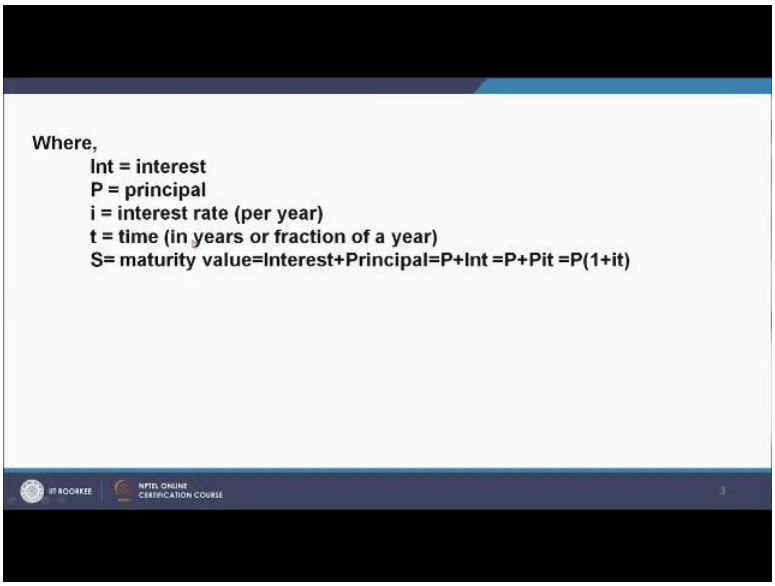

Where int is the interest, P is the principal, i is the interest rate per year and t is the time in years or fraction of a year, S is the maturity value which is equal to interest plus principal. So, you can write down here P plus int and P plus Pit. So, you can take P common and you can write down in the brackets i 1 plus i t. Now there are two equations we have same interest equal to Pit which we call equation 1 and S is equal to P into 1 plus i t in brackets which is we call it equation number 2.

So, now let us see from these two equations what type of problems can be formulated to through these equations. The above the equation which contains 4 variables can be solved to find out the value of a single variable only when other three variables are known. Because using one equation I can solve only for one unknown and these equations are 4 variables. So, I can solve it only for one unknown variable and hence three other variables has to be known. Thus, 4 types of problems can be generated out of these equations. The problem matrixes for these equations are shown bellow.

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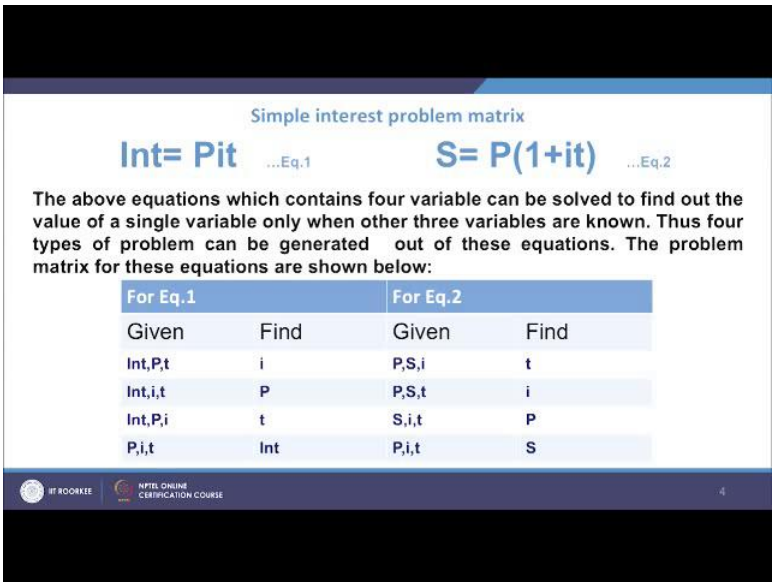

Now for equation 1; if interest P and t is given then I have to find out i, if interest i and t are given then I have to find out P. And if interest P and i is given I can find out t. And if Pit is given i can find out interest int. Now this is for equation number 1. For equation number 2 similarly I can write down the problem matrix if P S and i are given then I have to find out t. P S and t is given I have to find out i. S i and t are given I have to find out P. And Pit is given i have to find out S.

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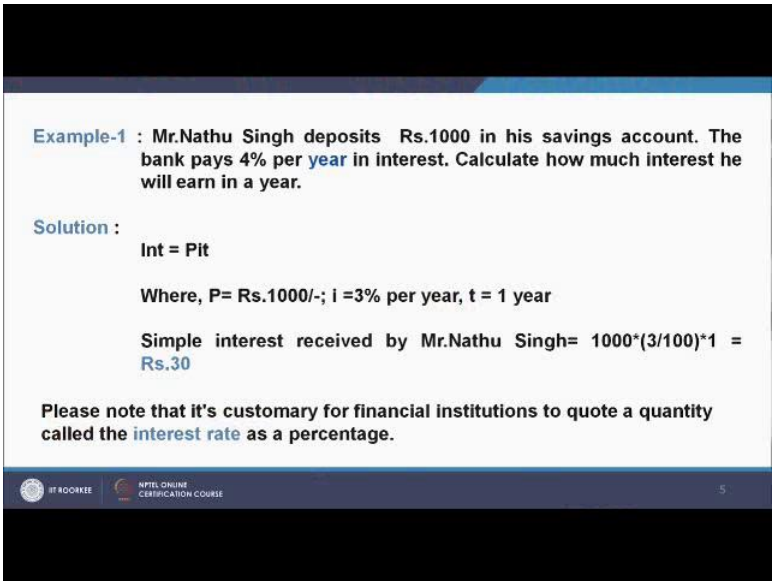

Let us take an example Mr. Nathu Singh deposits Rupees 1000 in his savings account. The bank pays 4 percent per year interest. Calculate how much interest you will earn in a year. So, interest is equal to Pit this is our formula where P is equal to 1000, i is equal to 3 percent per year and t is equal to 1 year. So, simple interest is received by Mr. Nathu Singh will be 1000 into 3 by 100. Because it is customary to by financial institute to quote the quantity called interest rate as percentage, but when it is used in equation it is converted in to a fraction.

So, 3 percent is equal to 3 divided by 100 and 1 year time so 1000 into 3 by 100 into 1 is comes out to be 30. Simple interest is a handy is it to for estimating the interest earned or paid on a certain balance in 1 period. However, it does not take in to account the effect of compounding which is the process of earning interest on principal plus interest that was earned early year. This means it can grammatically understand the amount of interest earned or paid over time.

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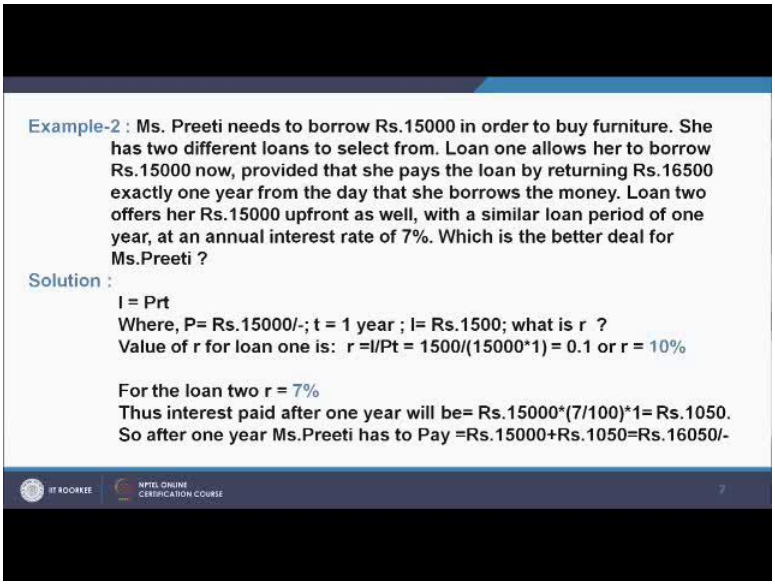

Let us take an example number 2. Ms. Preeti needs to borrow Rupees 15000 in order to buy furniture. She has two difference loans to select form. Loan one allow her to borrow Rupees 15000 now, provided that is she pays the loan by returning Rupees 16500 exactly 1 year from the day that she borrows the money. Loan to offers Rupees 15000 upfront as well, with the similar loan period of 1 year at an annual interest rate of 7 percent which is

the better deal from Ms. Preeti. Now use the equation i is equal to P r t where P is equal to 15000, t is equal to 1, and i the interest is equal to 15100 and what is the value of r.

So, if we calculate the value of r using this equation the value of r is equal to i by Pt is equal to 15100 divided by 15000 into 1 or come out to be 0.1 or 10 percent. So, for the first loan the interest rate is 10 percent. However, for the second loan the interest rate is 7 percent. So, that is a difference in interest rate. Thus the interest paid after 1 year will be 15000 into 7 by 1 100 into 1 equal to 1050.

So, after 1 year Ms. Preeti has to pay Rupees 15000 plus Rupees 1050 that is 16050 Rupees. This value is less then what Ms. Preeti will have to pay she takes loan number 1. Thus the loan 2 is a better deal for Ms. Preeti as she has to pay less interest on the borrowed principal. From the interest rates also the same conclusion can be done. So, from the interest rate same conclusion can also be made. As the interest rate charges for loan two is less than loan 1 loan 2 is a better deal.

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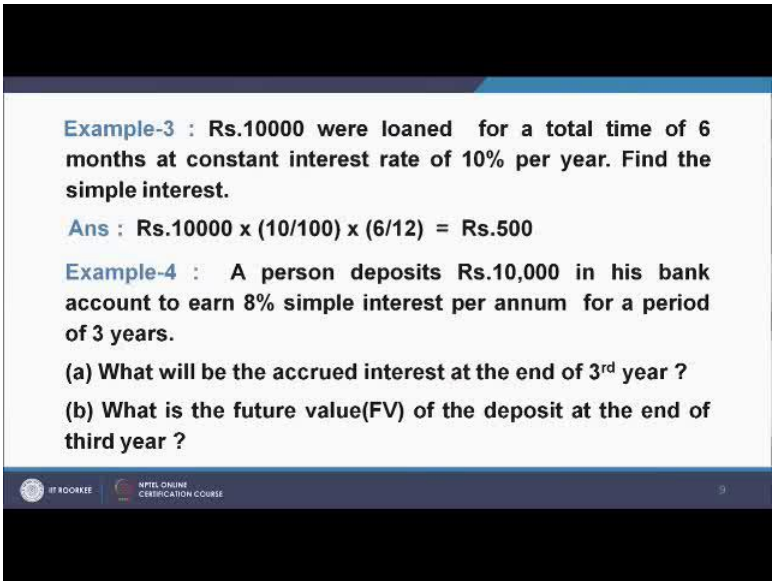

Let us take to third example; Rupees 10000 where loaned for a total time period have 6 months at a constant interest rate of 10 percent per year find the simple interest. So, the answer is 10000 into 10 divided by 100, so converting the interest rate to fraction into 6 divided by 12 because 6 months is being converted into years and it is multiplied so comes out to be Rupees 500.

Now example 4; a person deposits Rupees 10000 in his bank account to earn 8 percent simple interest per annum for a period of 4 years. So, what will be the accrued interest at the end of 3rd year? What is the future value of the deposit at the end of 3rd year?

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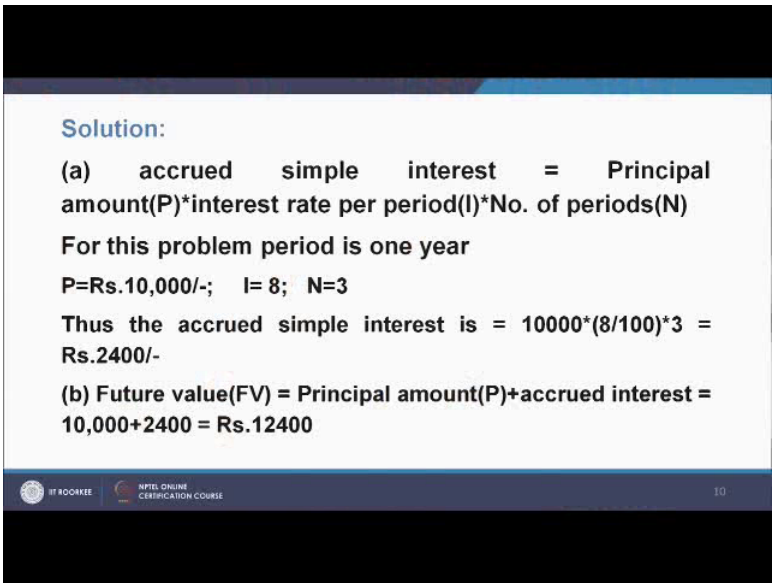

The solution is accrued simple interest is equal to principal amount into interest per period into number of periods. So, for this particular problem period is 3 year for this problem. So, P is equal to Rupees 10000, i is equal to 8 percent and N is equal to 3. Thus the simple interest is 10000 into 8 divided by 100 into 3 which come out to be 2400. The future value FV is equal to principle amount plus interest which is equal to 10000 plus 2400 which is 12400.

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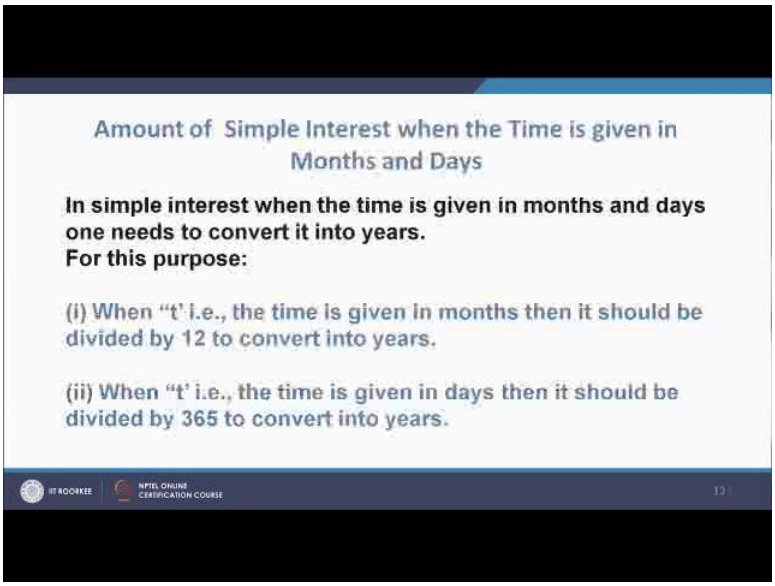

Amount of simple interest when time is given in months and days; what you will do if the time is given in month and days. So, the answer is very simple. In simple interest when time is given in months and days were need to convert this into years. For this purpose when t that is time is given in month it should be divided by 12 to convert into years. And when t is given in days it should be divided by 365 to convert into years

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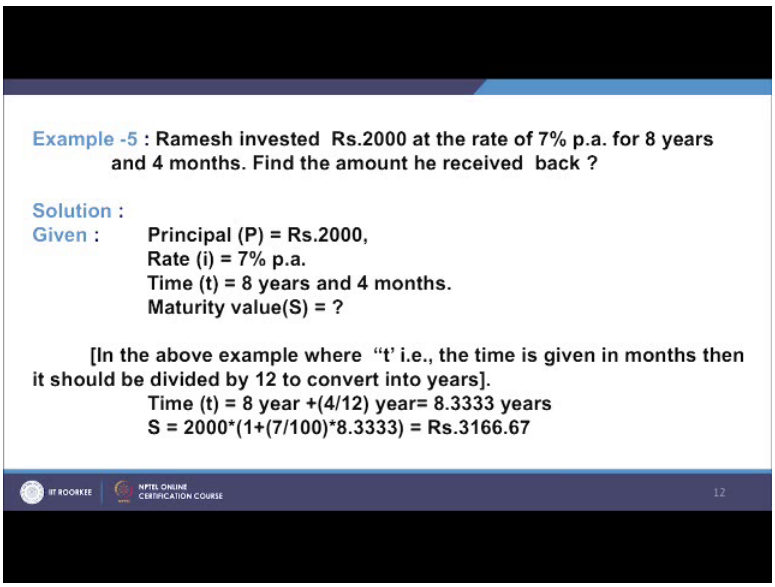

Let us take some examples. Ramesh invested Rupees 2000 at the rate of 7 percent per annum, for 8 years and 4 months. Find the amount he received back. So, my principal

amount is Rupees 2000, rate is 7 percent per annum, time t is 8 years and 4 months, maturity value is required. So, in the above examples t that is the time is given in months then it should be divided by 12 to convert it into years.

So, time is 8 years and 4 months, so 4 months has to be converted into years. So, that is why we have divided 4 by 12 to convert it into years. So, the total time converts into 8.3333 years. So, S is equal to that is maturity value is equal to 2000 into in brackets 1 plus 7 divided by 100 into 8.3333 years which comes out to be Rupees 3166.67.

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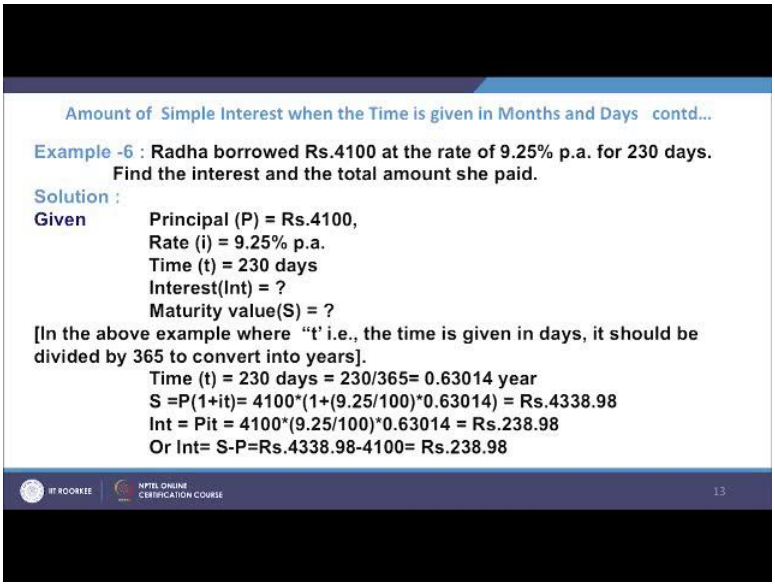

Now, let us take another example where time is given in days. Radha borrowed Rupees 4100 at the rate of 9.25 percent per annum for 230 days. Find the interest and the total amounts she paid. So, in the question principal P is given as Rupees 4100, rate i is 9.25 percent per annum, time t is equal to 230 days. So, we have seen that it is day given in days it has to be converted into years, what is the interest and maturity value?

In the above the example t is the time given in days it is should be divided by 365 to convert into years. So, time t is equal to 230 days is equal to 230 divided by 365 is equal to 0.63014 years. So, S is equal to P in bracket 1 plus i t is equal to 4100 in brackets 1 plus 9.25 divided by 100 because every time we have to convert the interest right into fraction into 6 0.63014 comes out to be Rupees 4338.98 and interest is given by Pit which comes out to be 4100 into 9.25 divided by 100 into the time 0.6314 it comes out to be Rupees 238.98 or interest can be calculated in the different way S minus P. So, we

know the P we know the S we can calculate the interest Rupees 4338.98 minus this is P 4100 is comes out to the Rupees 238.98.

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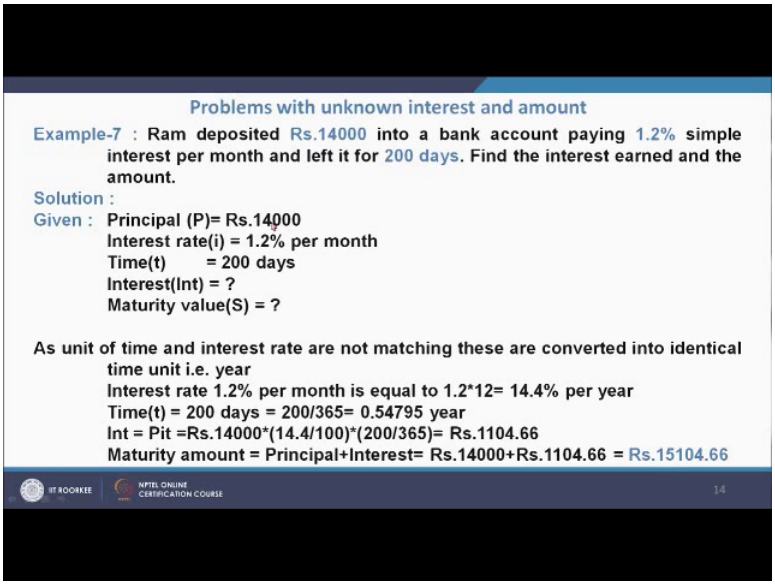

We take another example; the problems with unknown interest and amount. Ram deposited Rupees 14000 in to a bank account paying 1.2 percent simple interest per month and left it for 200 days find the interest earned and the amount. So, principal is 14000, interest is 1.2 percent per month and time is 200 days so we have to calculate what is the interest amount and what is the maturity value. As the unit of time and interest rates are not matching these are converted into identical units that is per year.

So, interested 1.2 percent per month is equal to 1.2 into 12 that is 14.4 percent per year. And similarly the time is converted into years, so time is equal to 200 days. So, 200 divided by 365 converts it to 0.54795 year. Now, we can apply our equation or co interest is equal to Pit that is 14000 into 14.4 divided by 100 into 200 divided by 365 is equal to Rupees 1100 that is 4.66. So, maturity amount is equal to principal plus interest is equal to 14000 plus Rupees 1104.66 which comes out to be 15104.66.

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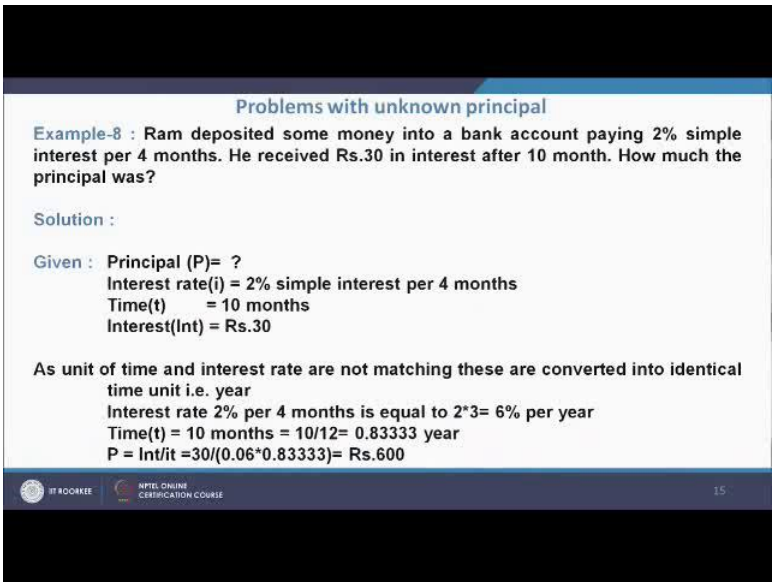

Problem with unknown principle, Ram deposited some money in to a bank account paying 2 percent simple interest per 4 months. He received Rupees 30 in interest after 10 months how much the principal was. So, principal is unknown. So let us call it P, P is unknown interest rate is equal to 2 percent simple interest per 4 months, time is 10 months and interest earned is Rupees 30.

As the unit of time and interest rates are not matching these are converted into identical time unit that is in 2 years. Interest rate is 2 percent per 4 months which is equal to 2 into 3 that because in a year there will be 12 months, so in 4 months it is 2 percent. So, in a year it will be 2 into 3 is equal to 6 percent per year. Time t is equal to 10 months, so it is converted into years again 10 divided by 12 which are 0.83333 years. So, again we are using the equation P is equal to interest divided by it. So, interest is known 30 Rupees divided by the value of i and t it gives you the principal as 600.

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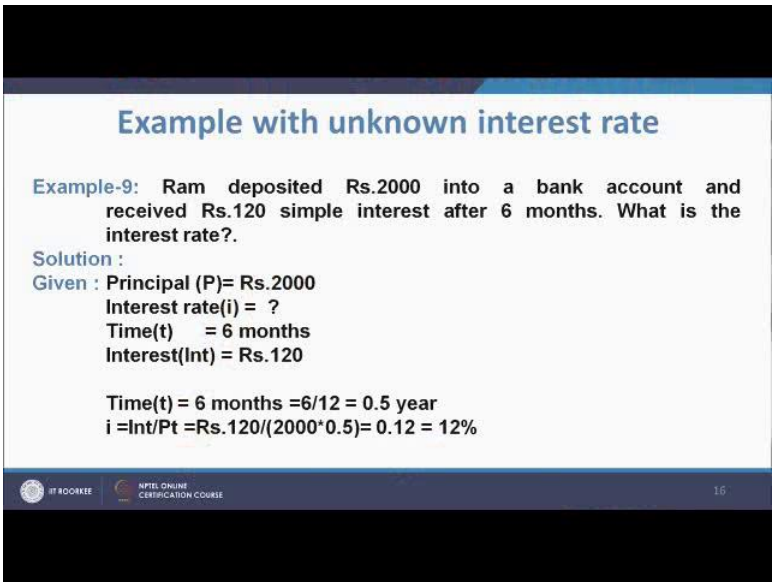

Now let us take an example number 9. This example is for unknown interest rate Ram deposited Rupees 2000 in to a bank account and received Rupees 120 simple interest after 6 months. What is the interest rate? The principal year is 2000, interest rate is unknown time t is equal to 6 months, and interest earned is 120 Rupees. So, time t is 6 month so it has to be converted into years.

So, 6 months divided by 12, so the time period is converted to 0.5 years, interest i, that is interest rate i is equal to interest earned divided by Pt is equal to Rupees 120 divided by 2000 into 0.5. So, it comes out to be 0.12 and hence interest rate is 12 percent.

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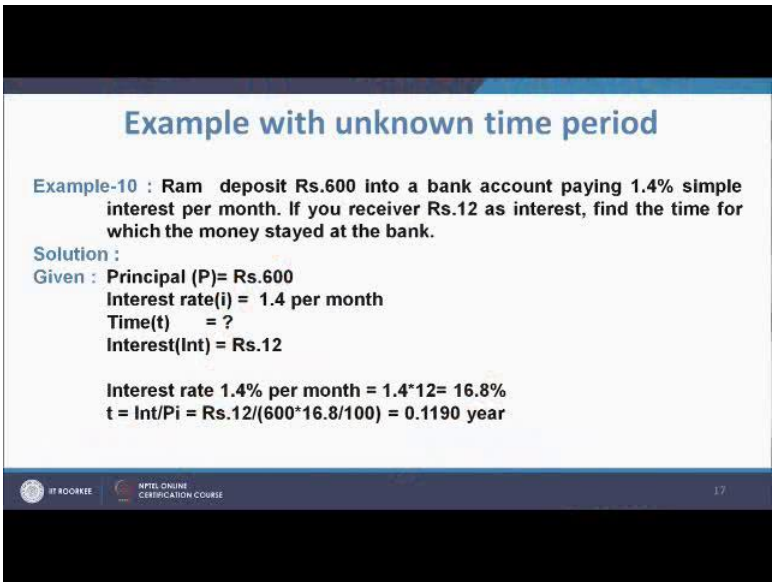

Example with unknown time period; Ram deposited Rupees 600 into a bank account paying 1.4 percent simple interests per month. He received Rupees 12 as interest and the time for which the money is stayed at the bank. So, principal is Rupees 600, interest is 1.4 percent per month, time is unknown, and interest earned is Rupees 12.

Interest rate 1.4 percent per month is converted into interest rate per year so 1.4 into 12 is equal to 16.8 percent. So, time is interest divided by P i, so is equal to 12 divided by 600 into 16.8 divided by 100 in brackets, it comes out to be 0.1190 year.

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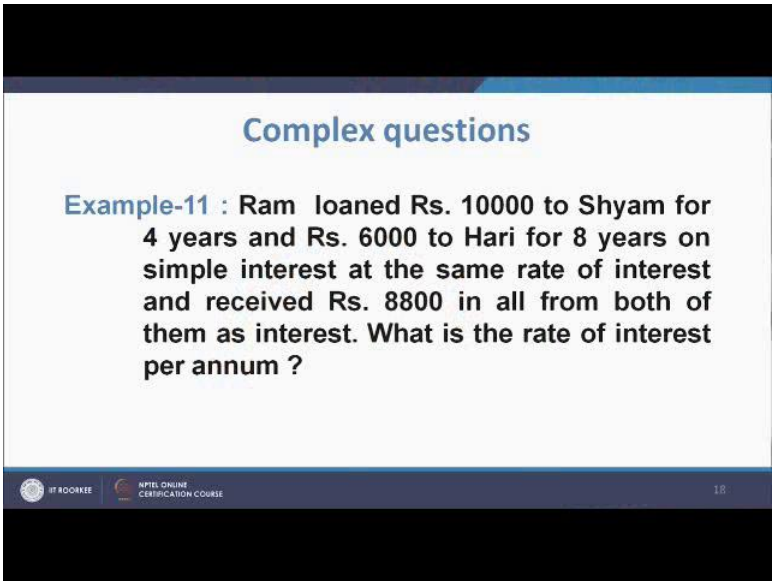

Now, let us see some complex questions of simple interest. Ram loaned Rupees 10000 to Shyam for 4 years and Rupees 6000 to Hari for 8 years on simple interest at the same rate of interest. And received Rupees 8800 in all from both of them as interest. What is the rate of interest per annum?

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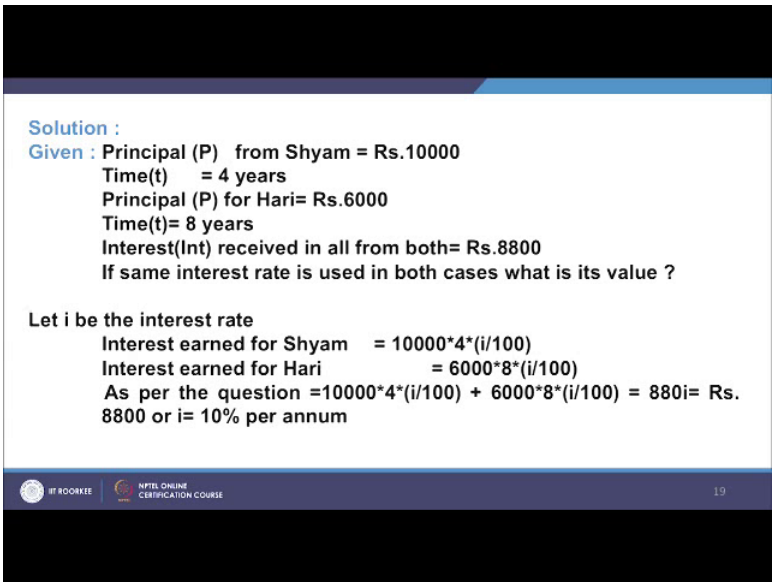

Given that principal P for Shyam is 10000, time given is 4 years, principal P for Hari is 6000, time is 8 years, interest received in all from both is 8800 that means interest received for Shyam as well as Hari when put together is 2200. If same interest rate is used for both cases what will be its value.

So, let the interest rate be i. So, interest rate interest earned from Shyam is 10000 into 4 that is 4 years i divided by 100. Interest earned from for Hari is 6000 into 8 years into i by 100. As per the question this two interest rates r equal to 8800. So, when we add them together it becomes 88 i which is equal to Rupees 8800, so i is 10 percent per annum.

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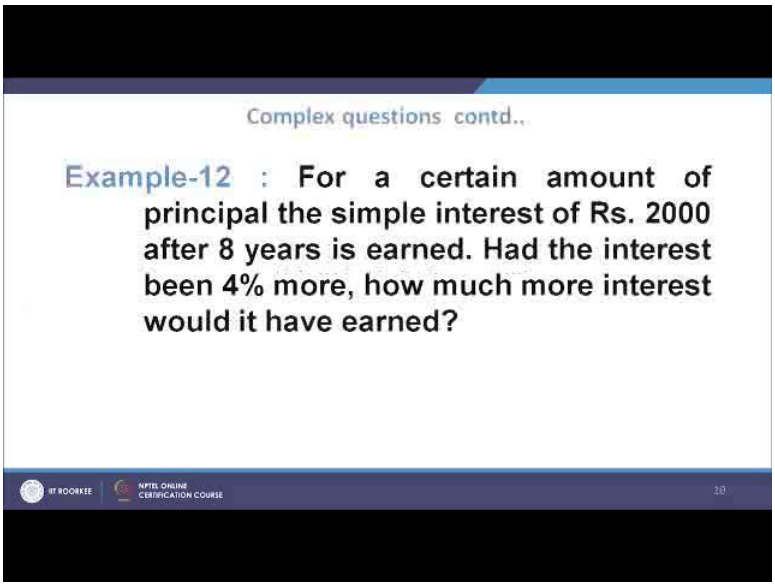

Again one another complex question, the example number 12; for a certain amount of principal the simple interest of Rupees 2000 after 8 years is earned. Had the interest been 4 percent more, how much more interest would have been earned?

So, for this question principal P is unknown, time is 8 years, interest received after 8 year is Rupees 2000. Had the interest been 4 percent more, how much more interest would it have earned.

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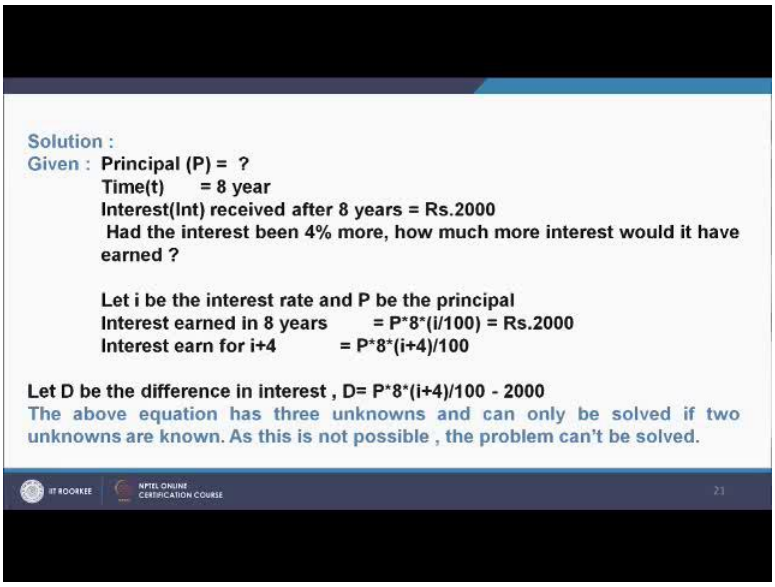

So, if interest rate is i be the interest rate and P to be the principal then interest earned in 8 years is equal to P into time 8 years into i divided by 100 and this is equal to 2000. Interest earned for i plus 4 percent which is P into 8 years again into i plus 4 divided by 100. Now the difference is if I consider difference to be D then difference will be P into 8 into i plus 4 divided by 100 minus 2000.

Now, if you see this question and the formulated equation the above equation has 3 unknowns that is D, i and P and can only be solved if two unknowns are known. As this is not possible the problem cannot solved, because we do not have we do not know P and we do not know i. And we may do not know the D, so this problem cannot be solved.

Another complex question example number 13. Hari invested an amount of the Rupees 14000 divided in two difference schemes A and B at the simple interest rate of 16 percent per annum and 12 percent per annum respectively. If the total amount of simple interest and in 4 years be 7680, what was the amount invested in scheme B?

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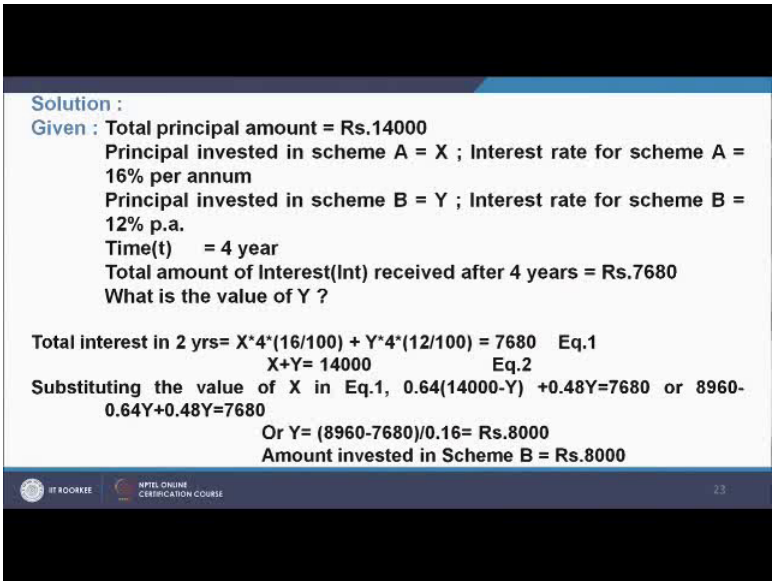

The total principal amount is 14000. The principle invested in scheme A let us considered it to be X, interest rate for this scheme A was 16 percent per annum. Principal invested in scheme B; let us say Y interest rate for scheme B is equal to 12 percent per annum. Time t is equal to 4 years. Total amount of interest received after 4 years is in both the schemes is Rupees 7680. We want to know; what is the value of y. So, the total interest in 2 years is equal to x into 4 16 by 100 plus Y into 4 12 by 100 is equal to 7680

let us call it equation 1. And there is the second equation x plus y is equal to 14100 we call it equation 2.

Substituting the value of x in equation 1 it become 0.64 into 14000 minus y plus 0.48 Y is equal to 7680 or 8960 minus 0.64 Y plus 0.48 Y is equal to 7680. Or Y is equal to 8000. Now if the y is equal to 8000 then amount invested in scheme B is 8000.

Now another complex question; Hari borrowed some money at the rate of 5 percent per annum simple interest for first 2 years at a rate of 8 percent per annum, and the next 3 years and at the rate of 12 percent for the period beyond 5 years. If he pays a total interest Rupee of Rupees 10000 at the end of the 9 years, how much money did he borrow?

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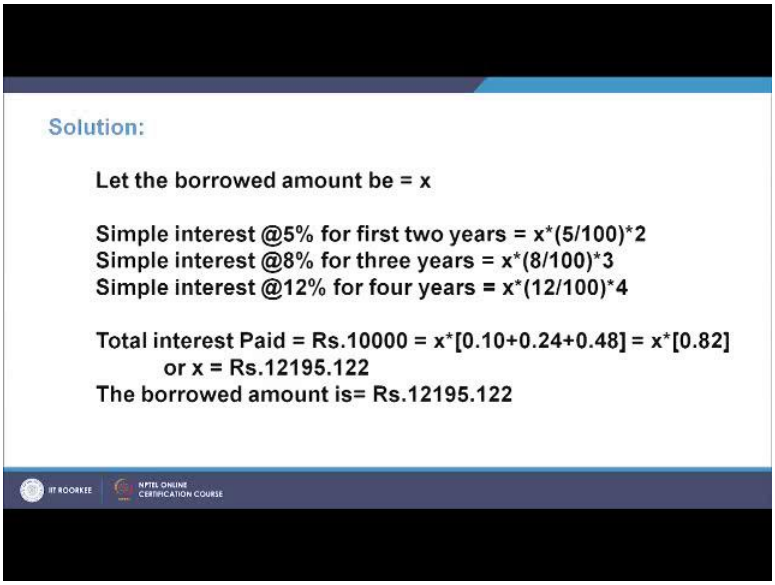

And the solution; let the borrowed amount to be x, so simple interest at the rate of 5 percent for first 2 years is x into 5 divided by 100 into 2. Simple interest at the rate of 8 percent for 3 years is equaled to x into 8 by 100 into 3. Simple interest at the rate of 12 percent for 4 years is equal to x into 12 by 100 into 4. So, total interest paid is 10000 so we sum of these values and we can calculate the value of x which comes out to be 12195.122.

Thank you.