Time value of money-Concepts and Calculations

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Lecture - 01
Introduction

Welcome to the course Time value of money-Concepts and Calculations. This lecture is devoted to the introduction of this course. The present massive open online course objectives are to illustrate basics of mathematics of finance; that is time value of money.

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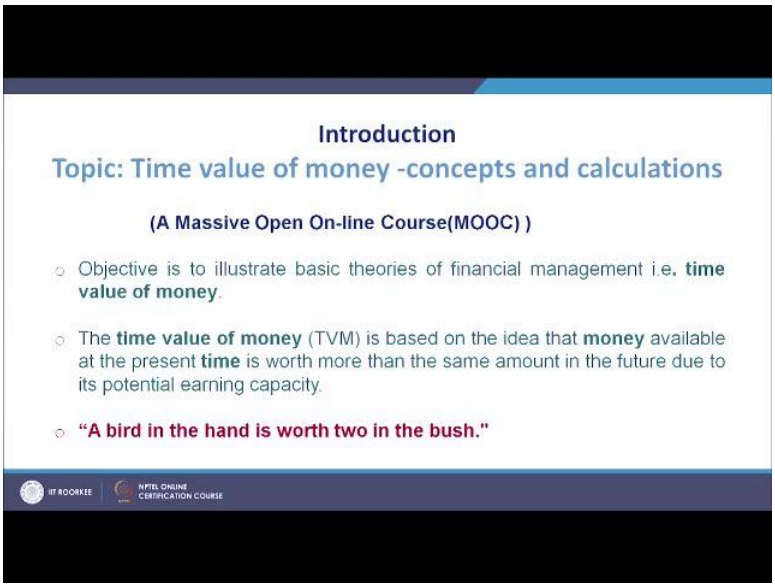

It is one of the basic theories of financial management. The time value of money or in short TVM is based on the idea that money available at the present time is worth more than the same amount in the future, due to it is potential earning capacity. In a lighter way, we can say that a bird in the hand is worth two in the bush. This quote principle, finance holds that provided money can earn interest inflation is 0, any amount of money is worth more the sooner it is receipt. This may sound simple, but it underpins the concept of interest.

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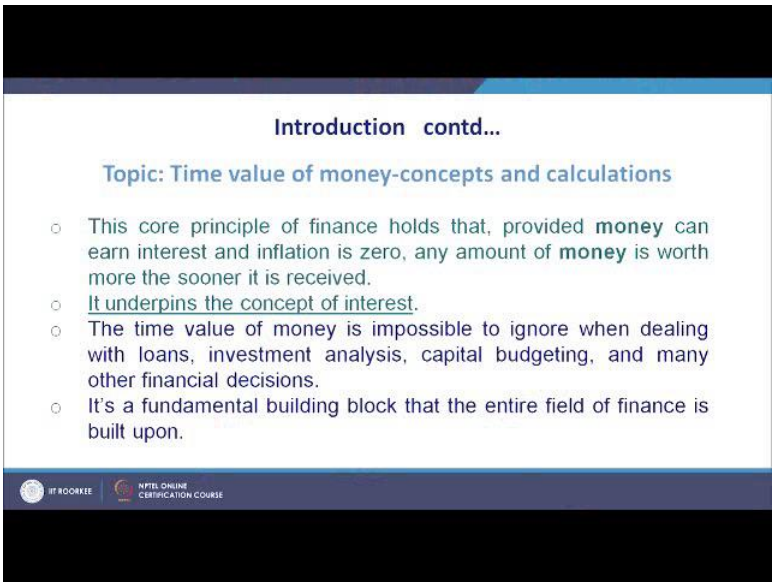

The time value of money is impossible to ignore when dealing with loans, investment analysis, capital budgeting and many other financial decisions. It is a fundamental building block that the entire field of finance is built upon. For example, if given a choice between receiving Rupees 100 today or Rupees 100 a year after now, you should take the money today. Lets analysis why? Because you could invest that 100 and even if you only earned a, 8 percent annual return on your investment you still would have 108 Rupees a year from now; obviously, more than Rupees 100 you would have received if you have waited.

If you did not invest that 100 at all, but simply spent it, you should still be better off because of inflation the Rupees 100 usually will have more buying power today than in the future clearly.

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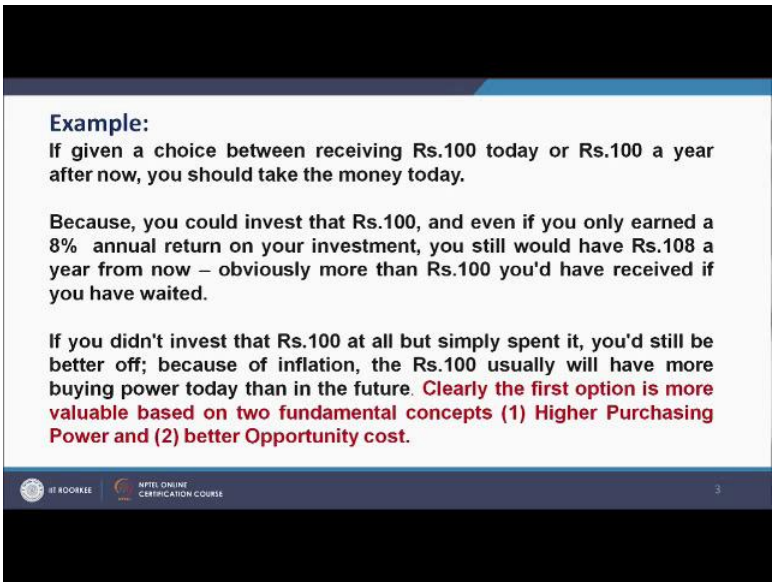

The first option is more valuable based on two fundamental concepts; one higher purchasing power and second better opportunity cost. Let us, explain what is higher purchasing power? And what is opportunity cost? Higher purchasing power because of inflation Rupees 100000 can be exchanged for more goods and services today than Rupees 100000 in 100 years.

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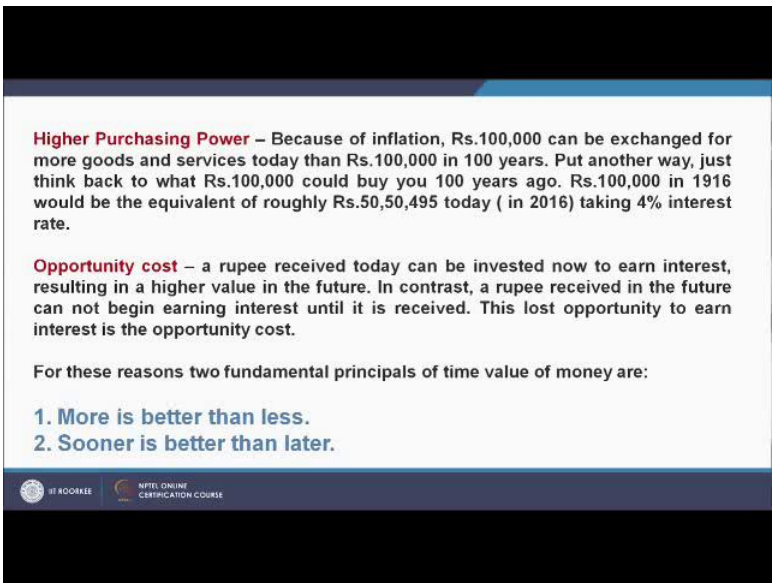

Putting another way just think back, to what Rupees 100000 could buy you 100 years ago. Rupees 100000, in 1916 would be equivalent to roughly Rupees 50,50,495 today,

that is in 2016 taking 4 percent interest rate. Now the opportunity cost, a rupee received today can be invested.

Now, to earn interest resulting in a higher value in the future in contrast a rupee received in the future cannot begin earning interest until, it is received. This lost opportunity to earn interest is the opportunity cost. For these reasons two fundamental principles of time value of money are; the one more is better than less and the second sooner is better than later. Why the time value of money is so important in capital budgeting decisions? Time value of money is an important concept, in financial management. It can be used to compare investment alternatives.

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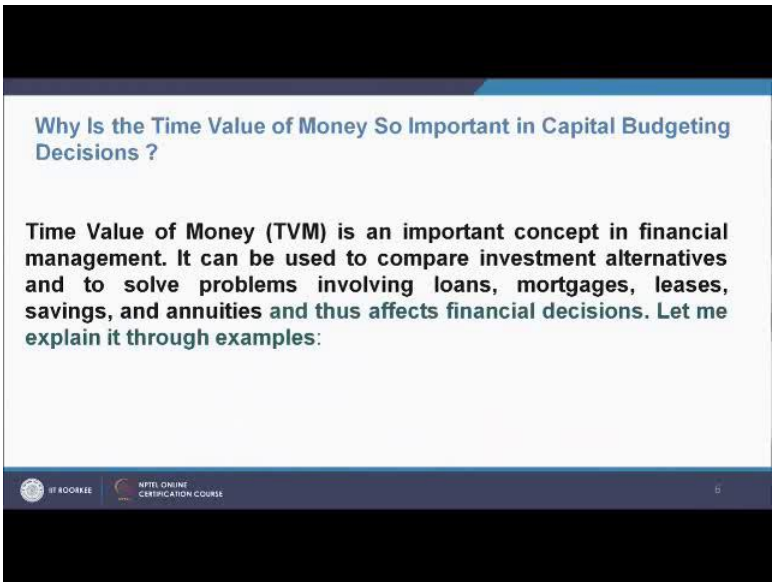

And to solve problems involving loans, mortgages, leases, savings and annuities and thus affects financial decisions. Let me explain it through examples. Suppose you take example consider a project that requires Rupees 400000 investment today.

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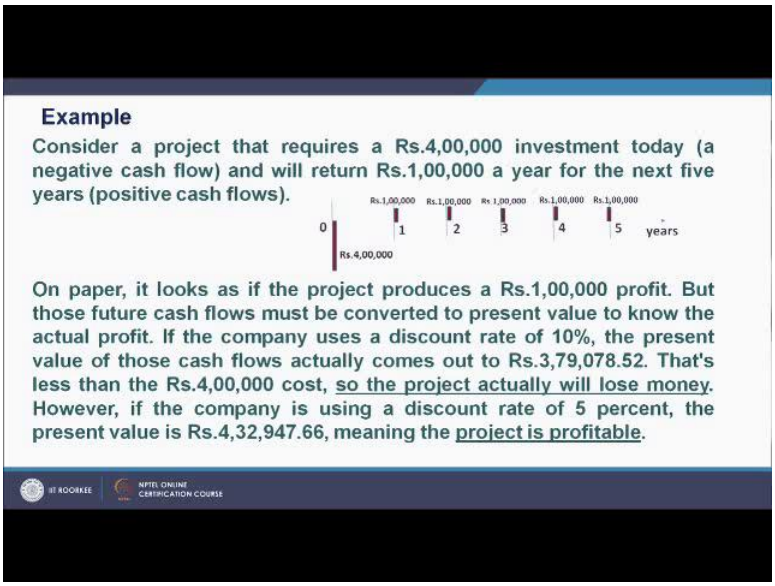

In a negative cash flows shown in the diagram and will return 100000 a year, for the next 5 years shown by positive cash flow. On paper, it looks as if the project produces Rupees 100000 profit because I am investing 400000 today and I am getting 100000, 100000 each year for 5 years, that amounts to 5,00,000. So, 5,00,000 minus 400000 is 100000 profit, but those future cash flows must be converted to present value to know the actual profit.

So, I cannot calculate the actual profit like this, I have to convert the future cash flows to present cash flow and calculate the profit. If it is does then, if the company uses a discount rate of 10 percent, the present value of those cash flows actually comes out to be 379078.92 that is less than 400000 costs. So, the project actually will lose money though it appears that it is gaining about 100000.

However, if the company is using a discount rate of 5 percent, the present value is 432947.66 meaning that the project is in profit. To decide between competing projects, time value of money can be used to decide between competing projects. Companies apply the time value of money in various ways to make yes or no decisions on capital projects as well as to decide between competing projects. Two of the most popular methods are.

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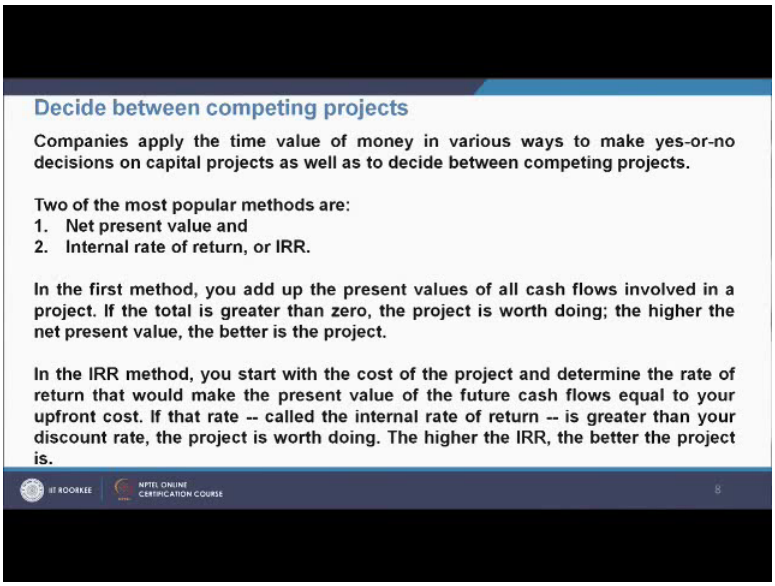

Net present value and internal rate of return or IRR; these methods are used take the decisions. In the first method, you add up the present value of all cash flows involved in a project, if the total is greater than 0, the project is worth doing. The higher the net present value, the better is the project. In the IRR method, you start with the cost of the project and determine the rate of return that would make the present value of the future cash flows equal to your upfront cost. If that rate called the Internal Rate of Return is greater than your discount rate, the project is worth doing. The higher the IRR, the better the project is paying the bills.

Another important factor in asserting time value of money is the level of debt you carry. If you have significant costly debt, it is more advantageous to get money in hand quickly.

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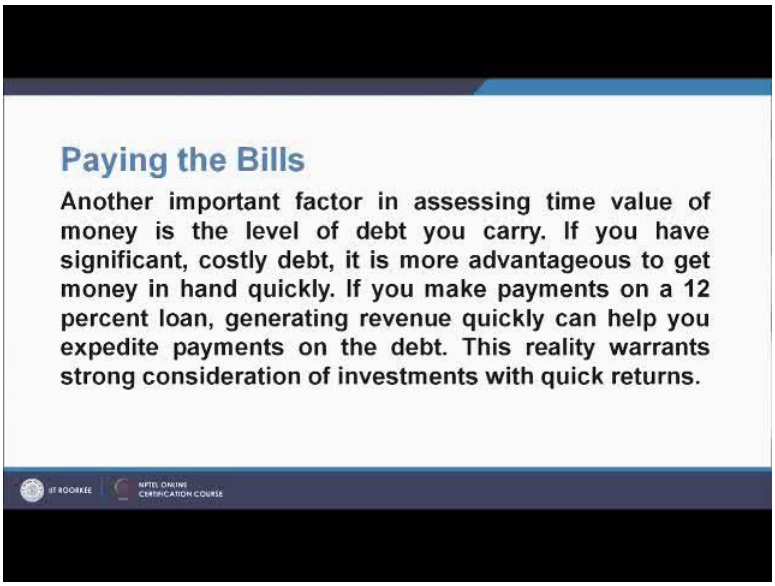

If you make payments on a 12 percent loan, generating revenue quickly can help you to expedite payments on the debt. This reality warrants strong considerations of investment with quick returns. Now the, we talk about the concept of time value of money. The purpose of the section is to introduce, the concepts, terminology and the mathematics of the time value of money. Understanding of this is crucial for understanding all sorts of solutions to financial problems in personal finance, investments, banking insurance, etcetera.

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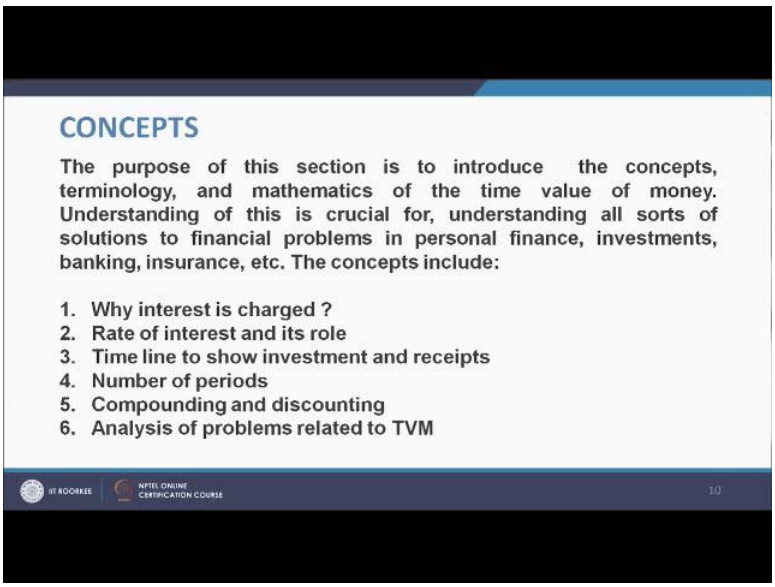

The concepts include, why interest is charged? Rate of interest and it is role, time line to show investment and receipts number of periods, compounding and discounting, analysis of problems related to time value of money.

Now, let us see the first one, why interest is charged? Interest is charged by lenders has compensation for the loss of the assets used and can be thought of as the price of money. If a borrower wants to spend more than his actual cash on hand, he will need to find someone to lend him additional funds. In the case of lending money, the lender could have invested the fund instead of lending them out.

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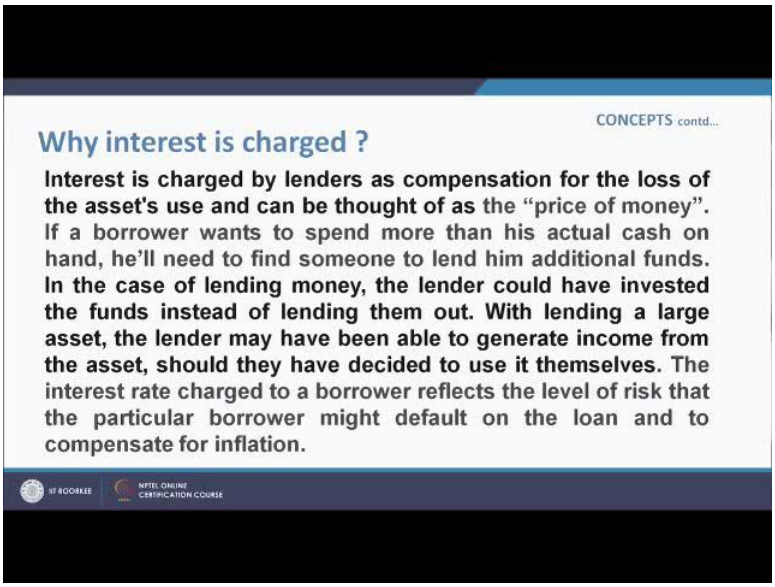

With lending a large asset, the lender may have been able to generate income from the asset should they have decided to use it themselves. The interest rate charged to a borrower reflects the level of risk that the particular borrower might default on the loan and to compensate for inflation. Rate of interest and it is role. Rate of interest is defined as the amount of interest earned by a unit of principal in a unit of time.

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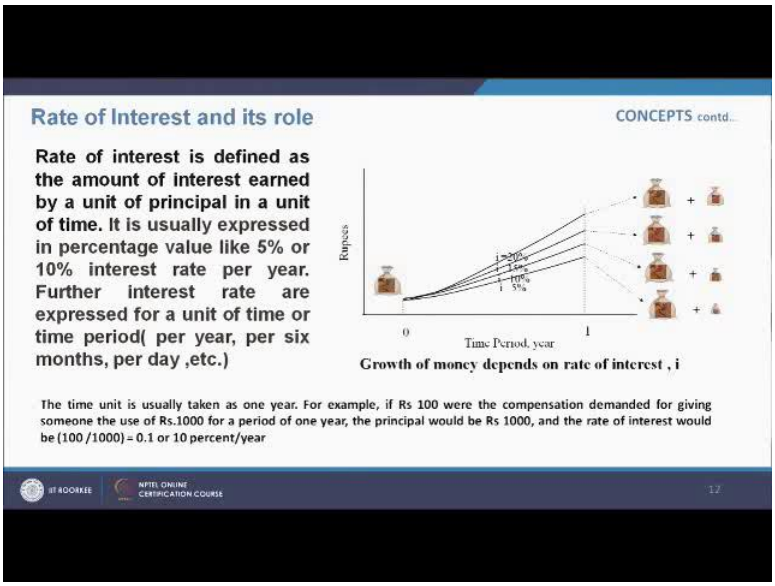

It is usually expressed in percentage value like, 5 percent or 10 percent interest rate per year. Further interest rates are expressed for a unit of time or time period like per year per 6 months or per day etcetera. This figure shows that, how interest rate grow the money? If you see, for i equal to 5, that is interest rate equal to 5, the growth is slow and for i equal to 20 percent the growth is faster.

The time unit is usually taken as 1 year for example, if Rupees 1 to 100 were the compensation demanded for giving someone the use of Rupees 1,000 for a period of 1 year. The principal would be 1,000and the rate of interest would be 100 divided by 1,000 which is equal to 0 point 1 or 10 percent per year. The time line, now from example we will draw a time line. Consider an example; consider a project that requires a 400000 investment today. So, 400000 will be shown as a negative cash flow at 0 year.

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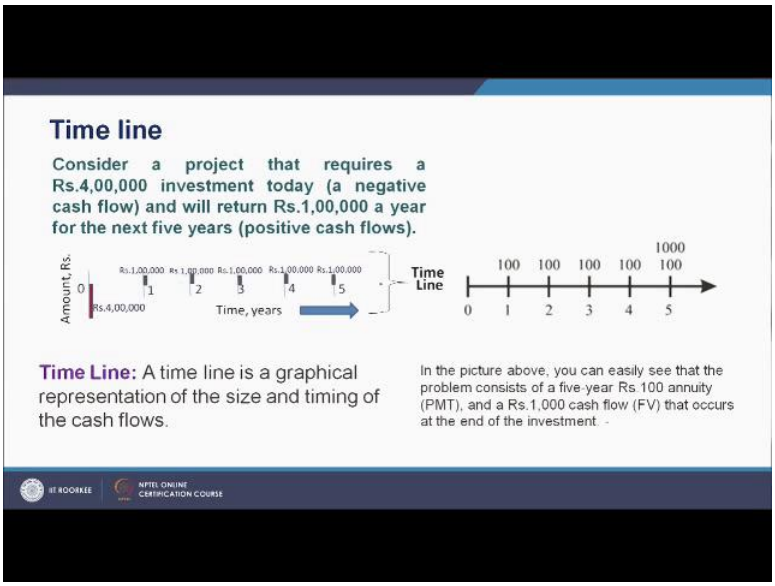

And will return 100000 a year for the next 5 years. So, in the next 5 years you will find that we are showing positive cash flows 100000 each. The time line is defined as a time line is a graphical representation of the size and timing of the cash flows.

Let us take a second example, in the picture above in the right and side you can easily see that the problem consists of a 5 year 100 annuity. So, in all the 5 years, we are showing positive cash flows of 100 each and a Rupees 1,000 cash flow, that occurs at the end of the investment. So, on 5th year who were showing, 100 as well as 1,000, 1,000 is returned at the top of 100. So, this is how the cash flows are shown in a time line.

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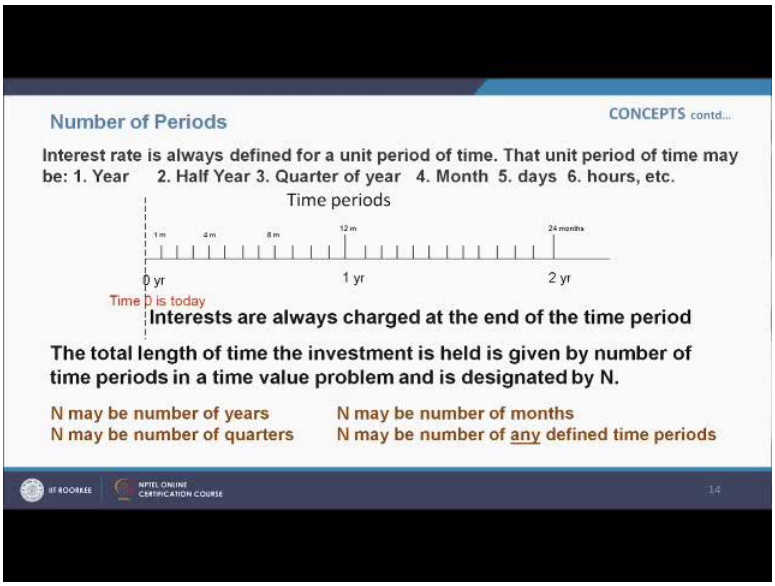

Number of periods: interest rate is always defined for a unit period of time. That unit period of time may be, 1 year, may be half year, may be quarter of a year, may be month day or hours as shown in this figure, we have shown number of years and number of months and at 0 year is considered to be today. Now once thing you should remember, those interests are always charged at the end of the time period.

The total length of time, the investment is held is given by number of time periods in a time value problem and is designated by capital N. Capital N may be, number of years, capital N may be number of months, capital N may be number of quarters and capital N may be number of any defined time period.

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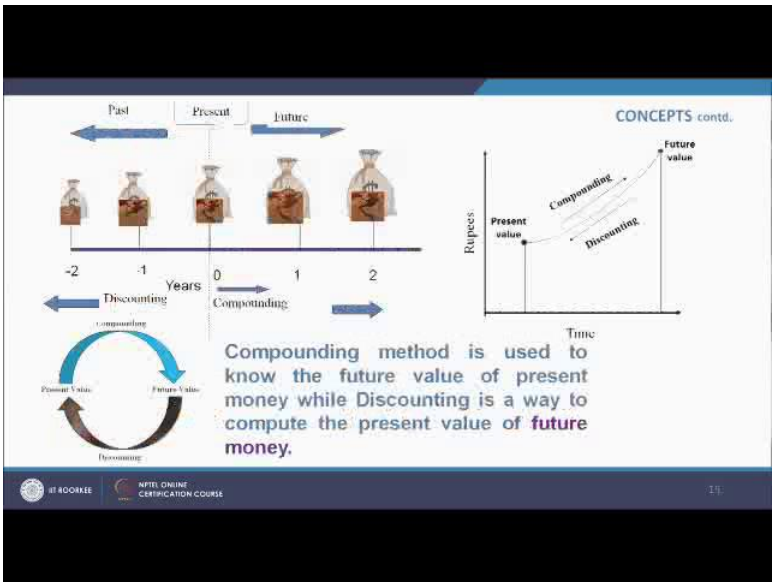

Now, let us considered the concept of discounting and compounding; now, at time equal to 0, if I am investing some money it will grow if I move to the future and this is called compounding. And if I move to the past then, it will decrease and this is called discounting. Compounding method is used to know the future value of present money, while discounting is a way to compute the present value of future money. Analysis of problem related to TVM, that is time value of money. Every time value of money problem has five variables.

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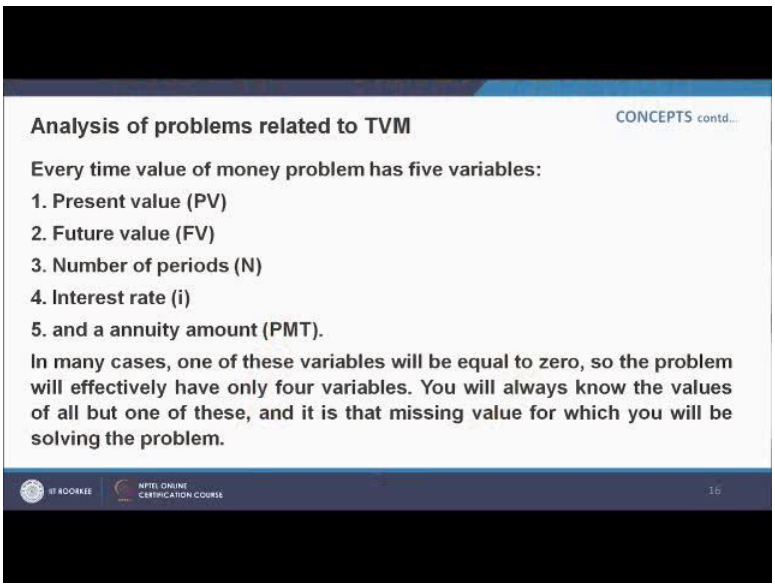

Variable number one is the present value or PV, then the future value FV, third variable is number of periods capital N, fourth variable is interest rate i and the fifth variable is annuity amount, which is shown by PMT. In many cases, one of these variables will be equal to 0. So, the problem will effectively have only one, only four variables. We will always know the value of all the four except one variable that is, missing value. For which you have to solve the problem.

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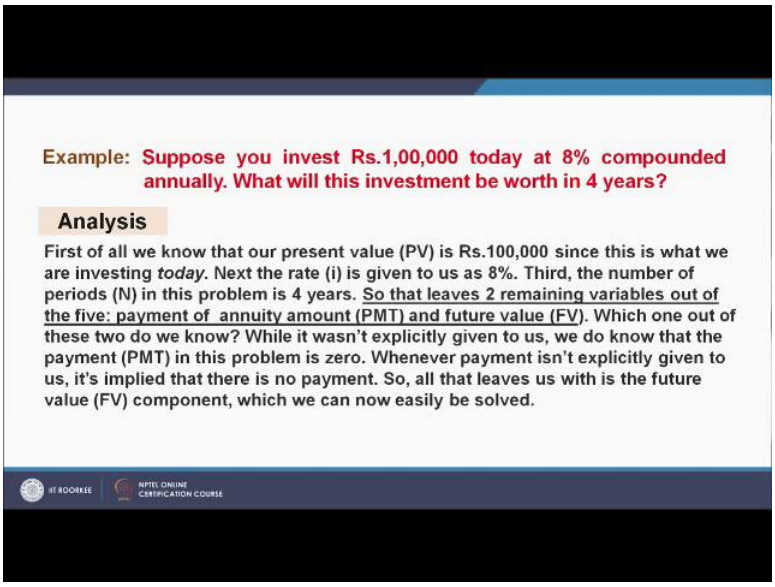

Let us take an example to substantiate this. Suppose you invest Rupees 100000 today at 8 percent compounded annually. What will this investment be worth in 4 years? Now you do the analysis of this example. First of all, we know that our present value PV is 100000. Since, this is what we are investing today. Next the rate i is given to us as 8 percent. Third, the number of periods end in this problem is 4 years. So, that leaves 2 remaining variables out of the 5, payment of annuity amount and future value.

These 2 we do not know and out of these 2, in this case 1 is 0. Which one out of these 2, we do not know while it was not explicitly given to us. We do know that the payment PMT, in this problem is 0. Whenever payment is not explicitly given to us, it is implied that there is no payment. So, all that leaves us with is the future value component, which can be now easily be solved because we have one equation and four unknowns and out of these four unknowns three unknowns are known. So, one equation can be solved very easily for single unknown.

Now, the different topics which will be included in the series of lectures on time value of money are interest rate. Interest rate is the amount charged expressed as a percentage of principal by a lender to a borrower for the use of his asset.

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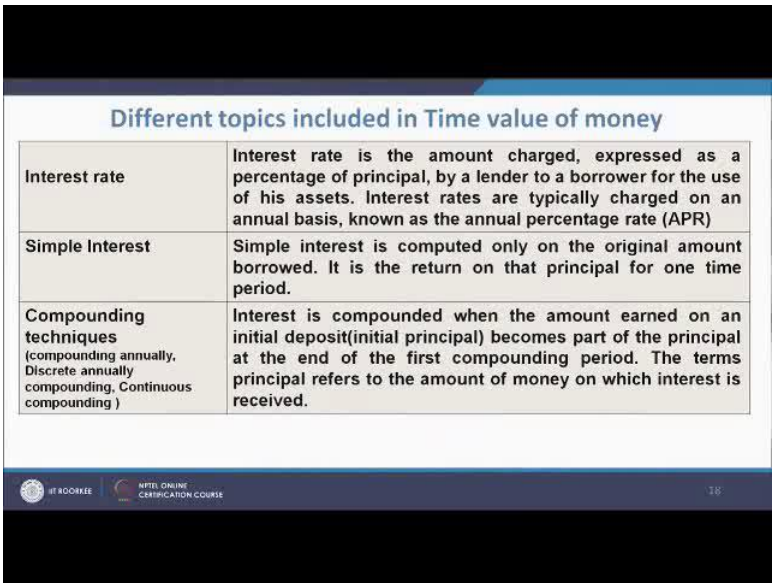

Interest rates are typically charged on an annual basis known as the annual percentage rate. The second topic is the simple interest. Simple interest is computed only on the original amount borrowed. It is the return on that principal for 1 time period. The third is the compounding techniques. In this compounding techniques, there are three sub headings; compounding annually, discrete annually, compounding and continuous compounding. Now in complaint compounding is defined as, in this interest is compounded when the amount earned on initial deposit.

That is initial principal becomes part of the principal at the end of the first compounding period. The terms principal refers to the amount of money on which interest is received. Now present value is an amount today that is equivalent to a future payment or series of payments that has been discounted by an appropriate interest rate. The future amount can be a single sum that will be received at the end of the last period or as a series of equally spaced payments an annuity or both.

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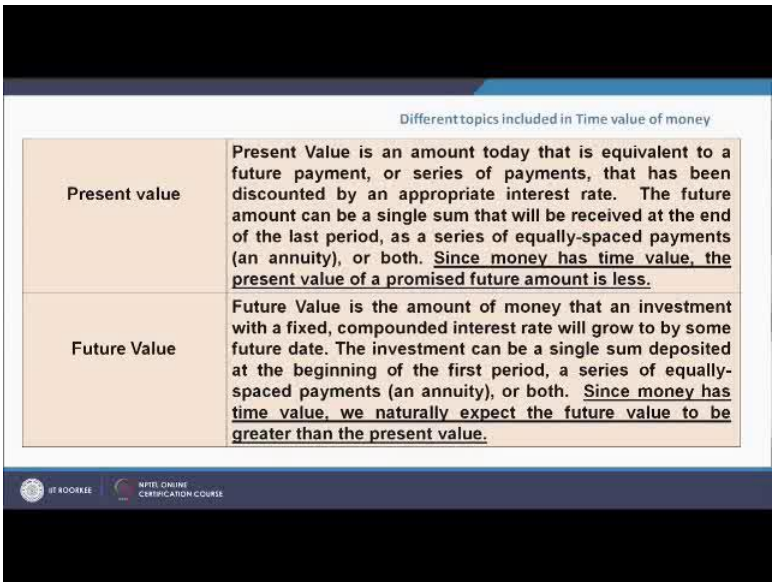

Since money has time value, the present value of a promised future amount is always less the future value. The future value is the amount of money that an investment with a fixed compounded interest rate will grow to by some future debt. The investment can be single sum, deposited at the beginning of the first period or a series of equally spaced payments or an annuity or both. Since money has time value, we naturally expect the future value to be greater than the present value.

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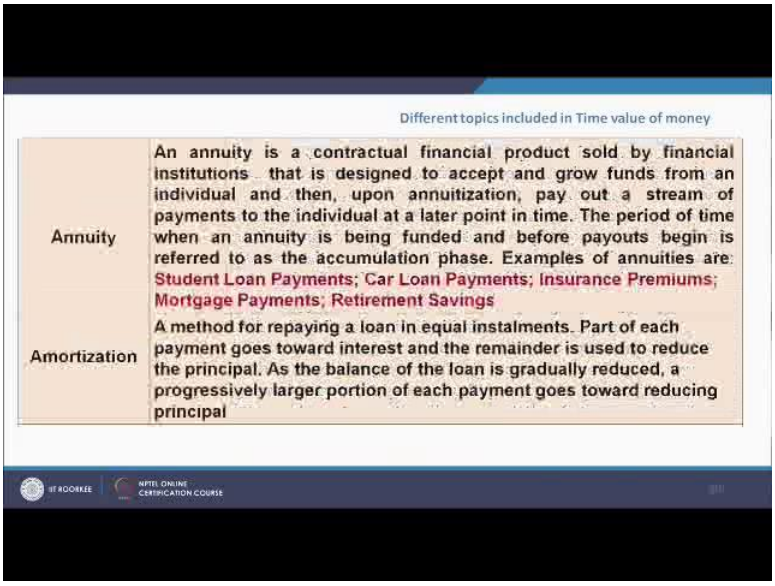

Now Annuity; an annuity is a contractual financial product sold by financial institutions that is designed to accept and grow funds from an individual and then upon annuitization pay out a stream of payments to the individual at a later point of time. The period of time when annuities are being funded and before payouts begin is referred to as the accumulation phase. For example, annuities are student loan payments, car loan payments, insurance premiums, mortgage payments and retirement savings. Amortization, amortization is a method for repaying a loan in equal installments.

Part of each payment goes towards interest and the remaining is used to reduce the principal. As the balance of the loan is gradually reduced a progressive large portion of each payment goes towards reducing principals. Perpetuities, perpetuity is simply and annuity that continuous forever.

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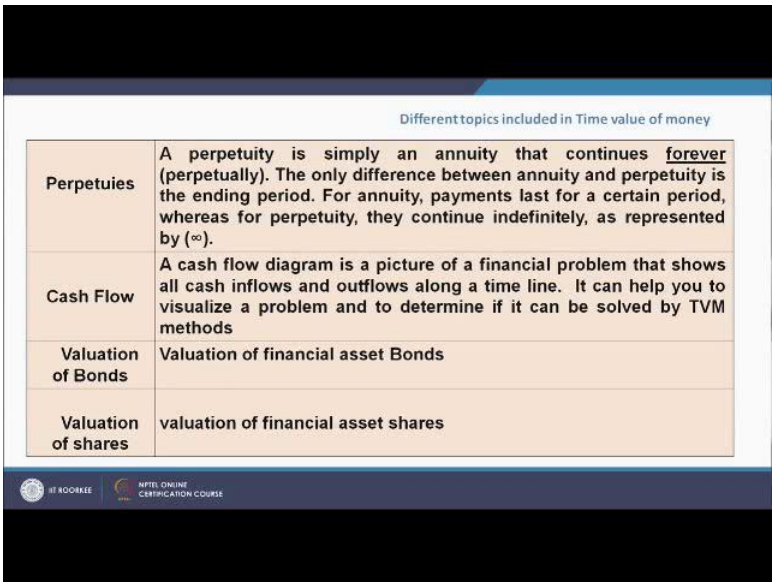

That is perpetually the only difference between annuity and perpetuity is the ending period. For annuity payments last for a certain period whereas, for perpetuity they continue indefinitely as represented by infinite. Cash flow, a cash flow diagram is a picture of a financial problem that shows all cash inflows and outflows along with time line. It can help you to visualize a problem and to determine it, determine if it can be solved by TVM method; valuation of bond, valuation of financial asset bonds, and valuation of shares, valuation of financial asset shares.

Thank you.