Quantitative Investment Management
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Lecture: 01
Overview & Introduction, Debt & Equity

Welcome to this course on Quantitative Investment Management. This has been brought to you by IIT Roorkee under the NPTEL program of the Ministry of Education, Government of India and I am J. P. Singh from the Department of Management Studies here at IIT Roorkee. Now, let us talk about the scope and proposed coverage of this course.

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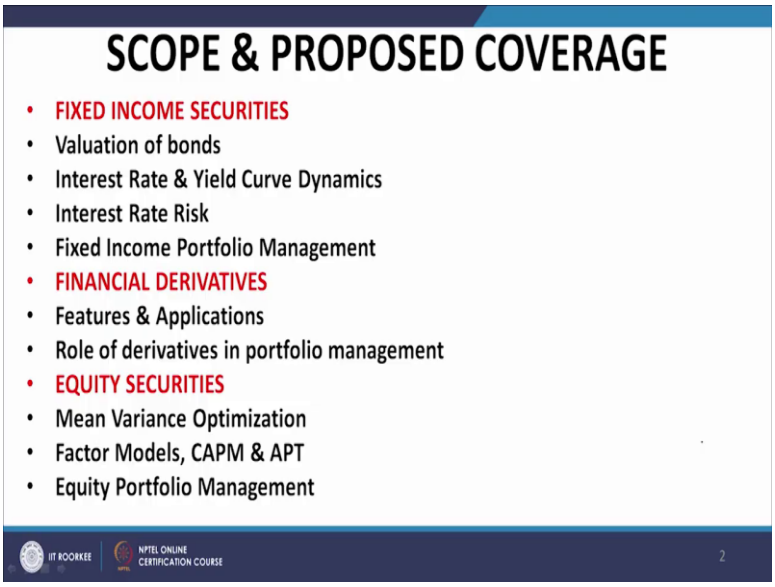

The course is divided into three broad segments; the fixed income securities segment, the financial derivatives segment, and the equity securities segment. We will start by discussing fixed income securities, including the valuation of bonds, embedded options, bond holding, interest rate risk, duration, and yield curve dynamics. We will also explore spot rates, forward rates, and swap rates.

Next, we will delve into interest rates, duration for individual securities and portfolios, and the role of duration in fixed income portfolio management. We will then move on to financial derivatives, covering their features and applications such as forwards, futures, options, and swaps. This will lead us to discuss the role of financial derivatives in managing portfolios.

The concept of equity securities is a very important topic from the perspective of this course. It is about the traditional mean variance optimization concept philosophy or procedure that was advocated by Markowitz. Next, we will see the capital asset pricing model of William Sharpe, which will tell about Arbitrage pricing theory and equity portfolio management and what strategies can be used for equity portfolio management. So, this is broadly the important part of this course on Quantitative Investment Management.

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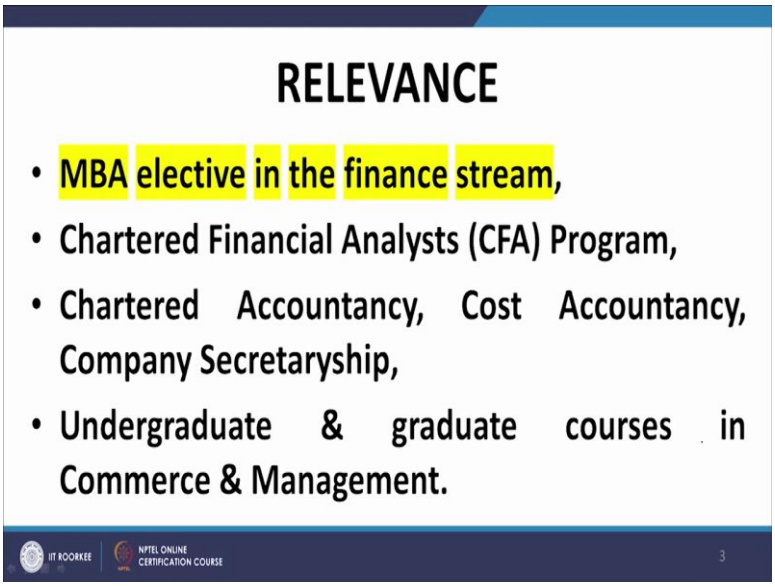

This course is extremely relevant for students who plan or who are in the process of doing the CFA program of the US in particular, the stage 2 and stage 3 of that program. MBA students will also find it immensely useful, particularly those who are specializing in finance and who have done a rudimentary work in security analysis and portfolio management. In this context, this course plans to build upon the Sapan framework that we traditionally offer at the MBA level.

Chartered accountant students, cost accountancy students, company secretaryship students will also find it useful as part of their curriculum preparation, undergraduate and graduate courses in commerce and fund management.

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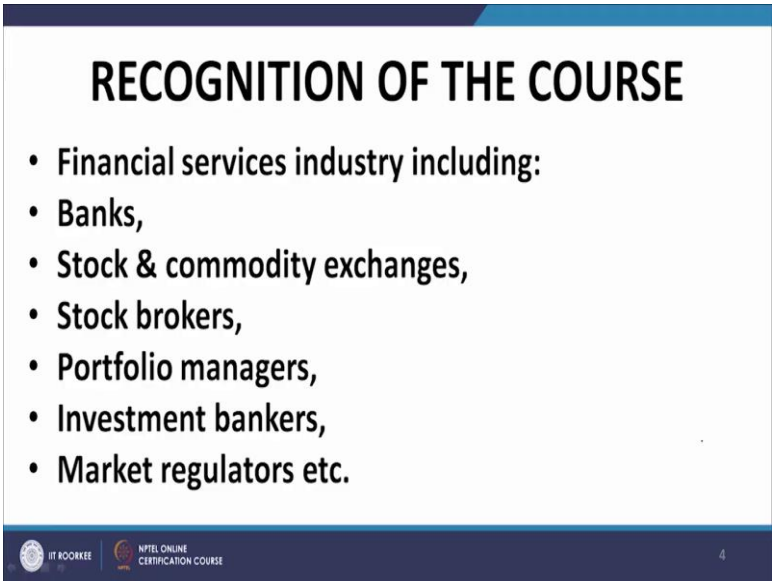

This course is expected to attract a recognition in the entire financial services industry. That includes banks, stock and commodity exchanges, stockbrokers, portfolio managers, investment bankers and market regulators as well.

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Now, we come to the recommended readings. The recommended readings are, in fact, part of the CFA reading list;

1. Introduction to fixed income analysis by Frank Fabozzi and Steven V Mann- for the fixed income part of this course.

2. Quantitative equity and investing by Frank Fabozzi and co-authors - this would cover the equity portfolio.

3. Options, Futures & Derivatives by John hull. – for derivatives.

4. I also would recommend that learners should visit the 2 courses. The first one on ***security analysis and portfolio management*** and the second one on ***financial derivatives and risk management*** offered by me in earlier years on the NPTEL platform.

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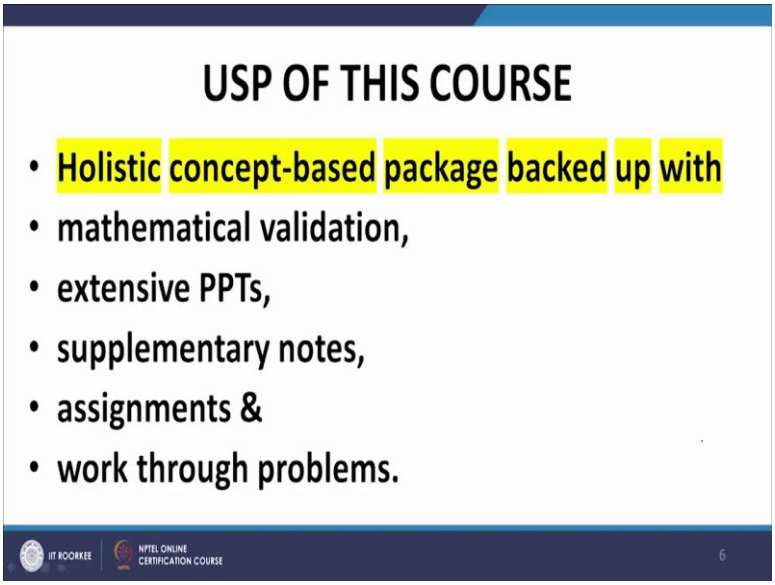

The USP of this course: a concept-based package backed up by mathematical validation of results. Wherever required, we should prove mathematical evidence, mathematical proof of results that have been utilized in practice and by practitioners. Then extensive PPTs will be there as is usually the case on the NPTEL platform. Supplementary notes will be provided wherever required assignments and work through problems will also be provided.

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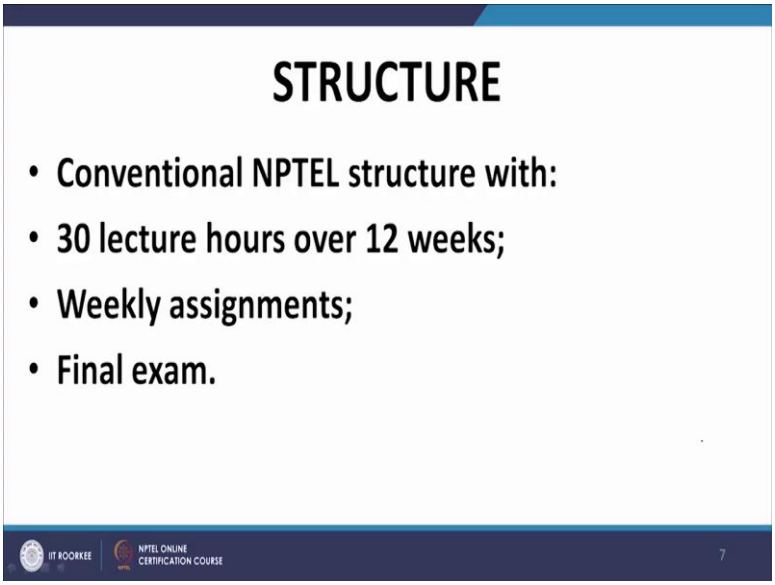

This structure is conventional in line with the NPTEL framework 30 lecture hours would be there spread over 12 weeks, and together with weekly assignments, which students must solve and submit on their own, and then we have a final exam, which will probably cover 60% of the weightage of the total course.

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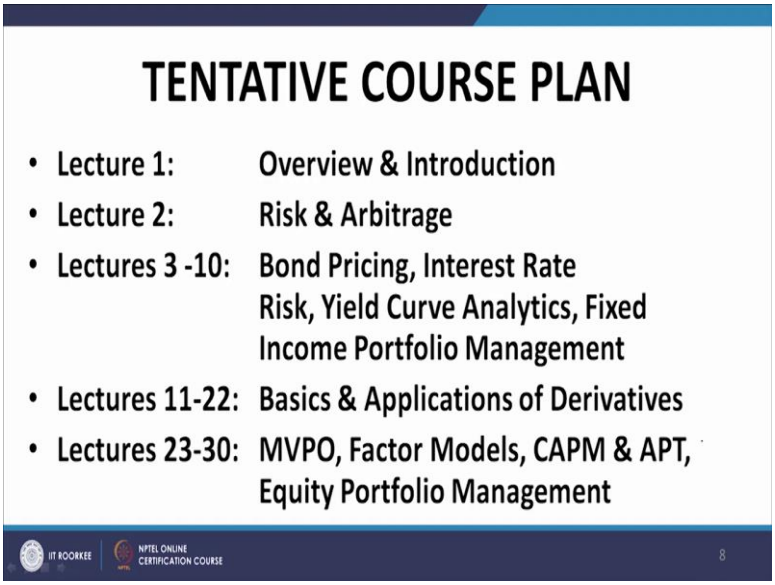

The tentative course plan is discussed. In the first lecture, I will cover overview and introduction. In the second lecture, I plan to introduce the concepts of risk and arbitrage. Then from lecture 3 to 10, we shall move into the fixed income segment of this course or fixed income security segment of this course. It would cover bond pricing, interest rate risk,

yield curve analytics, the various types of interest rates and the interrelationships between them.

Fixed Income Portfolio Management would also be covered in this segment of this course. From 11 to 22 lectures, I plan to cover derivatives, their applications, the basics of applications and their role in Portfolio Management. From lectures 23 to 30, I plan to discuss mean value, mean variance, portfolio optimization factor models, CAPM and APT, an equity portfolio management. So, this is the tentative course plan.

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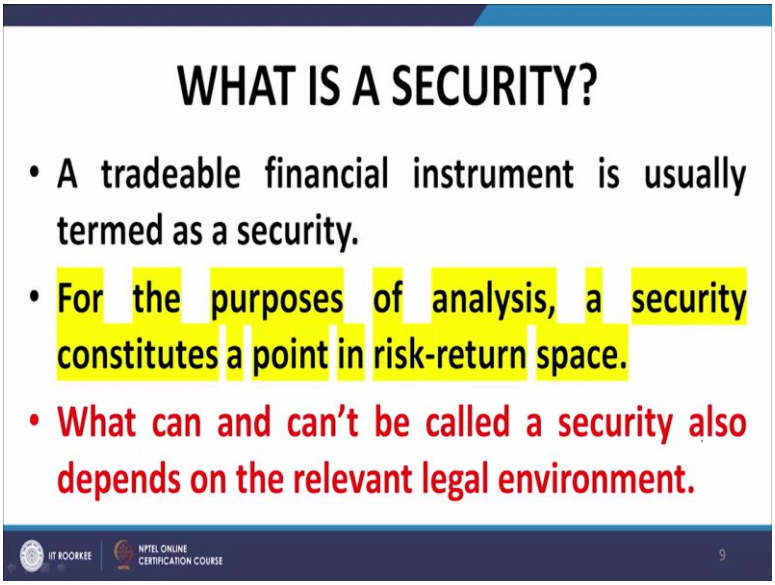

So, let us start with defining what exactly we mean by a security. In common parlance, we define a security or we talk about a security as a tradable financial instrument, which can be traded across on any appropriate exchange. Like we have shares, listed shares, we have the benches, bonds, and so on. We shall come back to it in a minute for the purpose of analysis that security constitutes a point in risk return space.

Let me give you contextual background of what exactly I mean by this. Whenever we talk about the appraisal of financial investments, whenever we talk about putting money in a project or in a particular security, we analyze the investment on 2 perspectives. We look at the expected return that we are going to derive from holding that security. And then we talk about what is the probability or what is the certainty associated with the realization of that expected return.

That takes us to the context of risk. In other words, when we talk about the evaluation of an investment proposal, we do it on 2 fundamental parameters. One is the expected return and

the second is the risk. For the moment, I will not talk about the measures of either of the 2 that will follow in due course, but expected return how much you are likely to derive by holding that security and what is the likelihood of realizing that particular expected return.

So, these are the 2 parameters that constitute the evaluation of investment proposals. So, we can define investments on a 2-dimensional framework with usually the x axis denoting the risk content and the y axis denoting the expected return context content. And on that basis, we can say that our security is identified by a point in risk-return space. Now, that definition of a security is also dependent or it is rather in fact primarily dependent on the legal environment in which that particular definition is being considered. For example, let me illustrate this point by an example.

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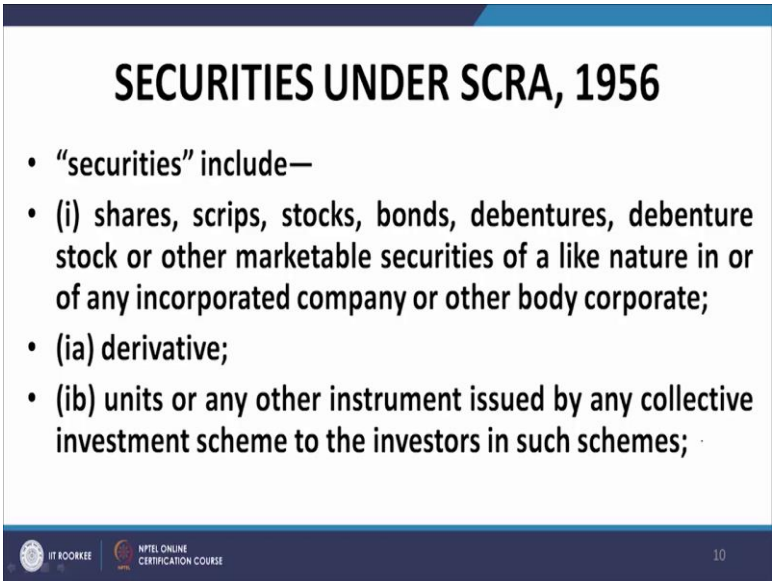

Securities are defined under the Securities contract regulation act of 1956 projects. Securities includes share, scripts, stocks, bonds, debentures, debenture stock or other marketable securities of a like nature in or of any incorporated company or other body corporate. It includes derivatives units or any other instrument issued by any collective investment scheme to the investors in such schemes also form securities.

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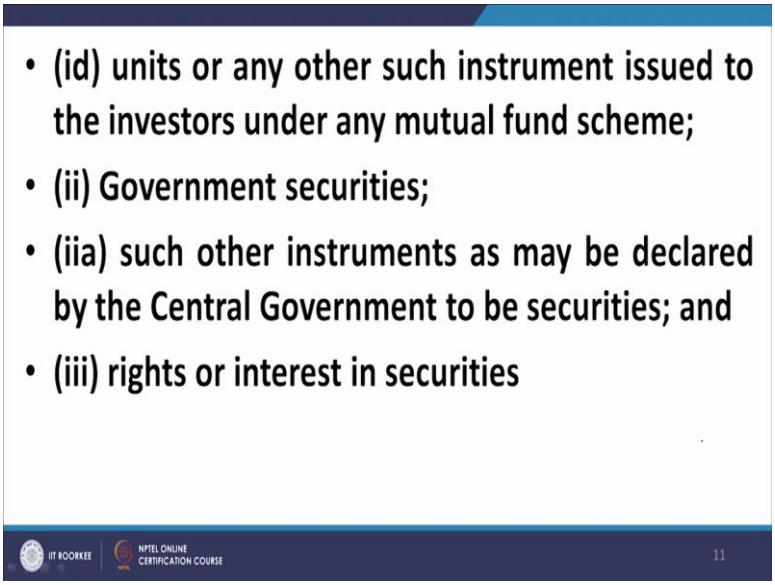

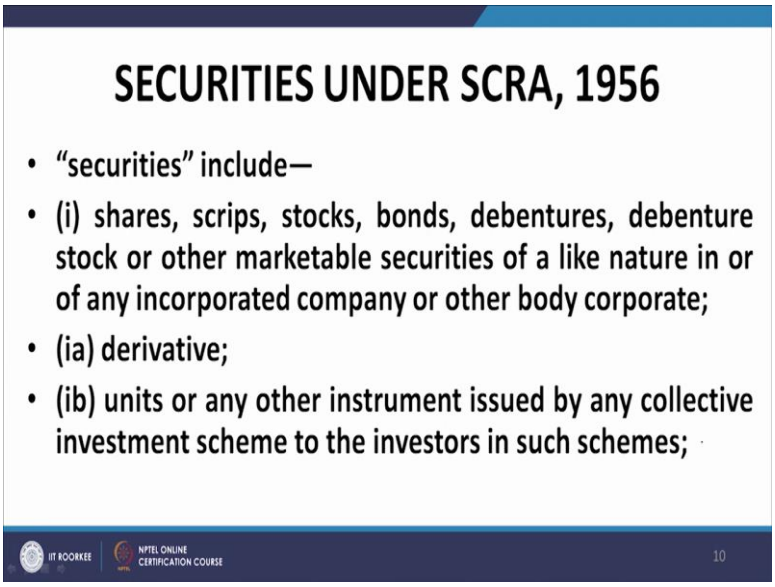

It also covered under the definition of securities units or any other such instrument issued to the investors under any mutual fund schemes. Government securities are naturally government securities, they are part of the definition of securities, such as their instruments, as may be declared by the central government to be securities rights or interest in security.

So, this is an inclusive definition and not an exhaustive definition. It is not an all-inclusive definition, it is a definition which illustrates what are the types of securities but of course, there could be securities, outside the classes that have been identified.

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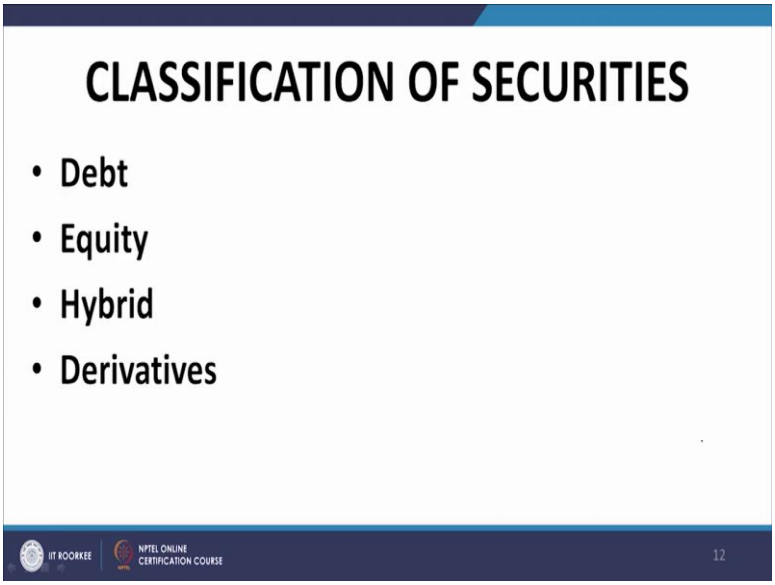

Classification of securities, the broad classification of securities that we have in the context of security analysis is we have debt securities that include bonds etc. We have equity securities, which is likely to be familiar with equity shares, we have hybrid securities preference shares form a typical example, a typical illustration of what hybrid securities are, we also have convertible securities which are hybrid, then we have financial derivatives. So, these are the 4 types of securities the 4 broad categories of securities that are identified for the purposes of analysis.

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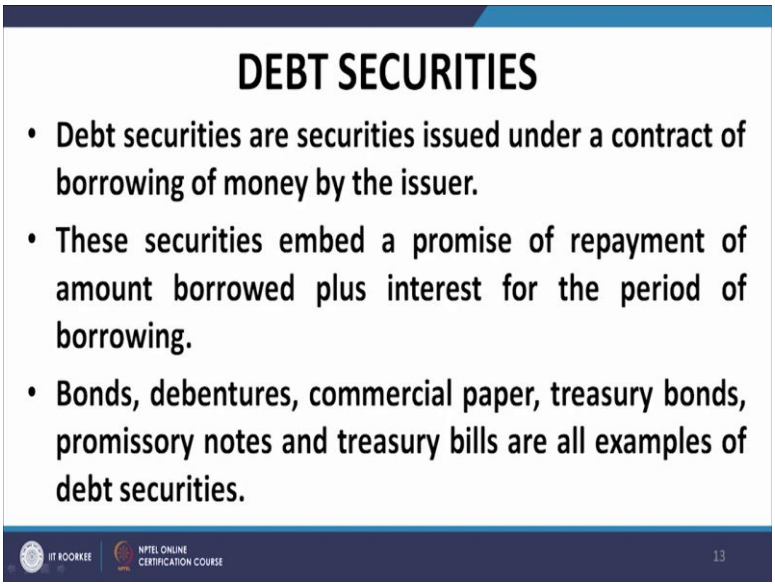

Debt securities are securities that are issued under a contract or borrowing of money by the issuer. These securities embed a promise of repayment of amount borrowed plus interest for

the period of borrowing bonds, debentures, commercial paper, treasury bonds, promissory notes and treasury bills, all examples of securities.

So, the basic characteristics of debt securities is that there is an underlying relationship of lender and borrower, which relates to the issue of these securities. There is an underlying relationship of lender and borrower which covers to the issue of these kinds of securities.

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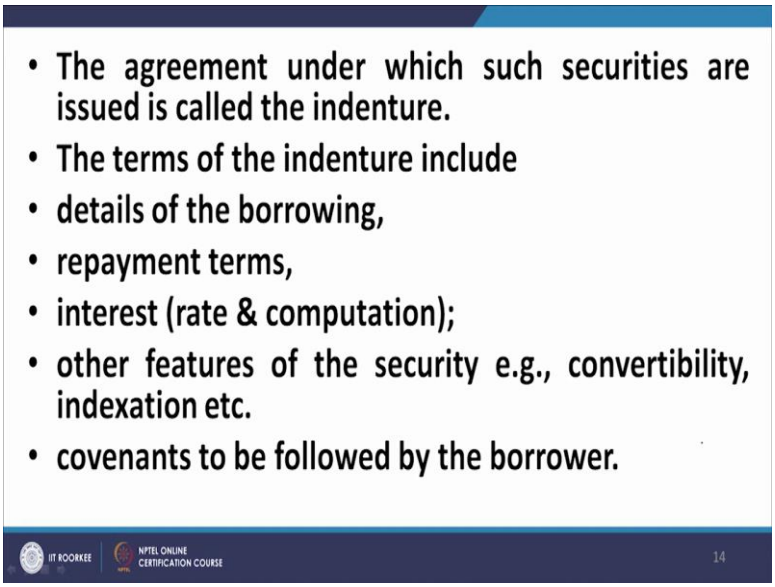

The agreement under which such securities are issued that is the lender borrower agreement is usually referred to as the indenture. The terms of the indenture include details of the borrowing, repayment terms, interest rate and competition, other features of the security that include convertibility, indexation, etc. Covenants that are to be followed by the borrower is also important.

Very often, when you borrow money from a lender, the lender imposes certain restrictions on the deployment of that money, as well as the management of operations like appointment of nominee directors, a payment of dividend, disposal of undertaking or part thereof. All these kinds of covenants are introduced in the loan agreements and the borrower has to obtain the permission of the lender before undertaking these kinds of activities. These are called covenants.

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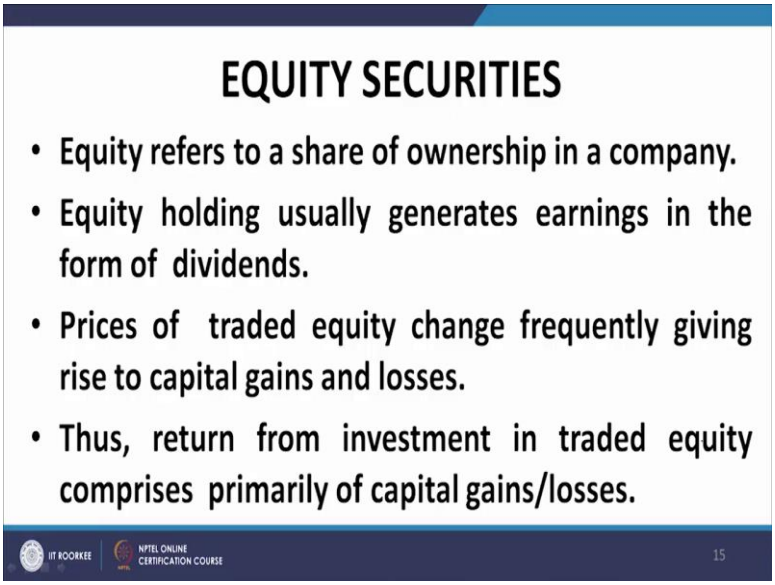

Then we talk about equity securities, equities refer to a share of ownership of the company. This is the fundamental difference between debt and equity securities. When we talk about debt securities, we are talking about a relationship of lender and borrower. The borrower is the issuer of the debt securities and the lender is the holder of the securities. Here, when you hold an equity share, you are a part owner of the company. For example, if you hold even one share of RIL, you are a part owner of RIL.

Equity holdings usually generates earnings in the form of dividends in contrast to the debt securities which generate earnings in the form of interest. The lender received interest from the borrower and at periodic intervals as per the terms of the contract of lending and here in the case of equity shares, the earnings are distributed to the shareholders and they are called dividends. Prices of traded equities change frequently.

The prices of debt securities, even if they are listed on the exchange, do not change so rapidly as the prices of equity shares can change very rapidly. In fact, in particular, the equity shares that form the for example, the BSE Sensex, S&P Sensex that change extremely rapidly changing in matter of seconds and change by significant magnitudes as well. So, prices of credit equity frequently changes giving rise to capital gains and losses.

And let me explain the term capital gains. The increase in price, increasing value of a particular asset gives rise to capital gains. For example, if you bought a share at 100 rupees to dispose it off at 120 in the market by selling it in the stock market, you get a profit of 20. That is called capital gains. Now, please note the fundamental difference between capital

gains and dividend. Dividend itself is part of the profits that are distributed by the company to all shareholders in proportion to the holdings usually.

However, as far as capital gains are concerned, they are generated by the market by the prices of the securities fluctuating in the market. If the price is increased and you dispose of the share, that is called capital gains, if you have earned a profit. And, if the price is decreased, you make a capital loss. So, capital gains are related to market transactions. Dividends or transaction interest between the company and the shareholder whereby the company distributes part or whole as the case may be of its profit to the shareholders.

The return from investment in traded equity comprises primarily of capital gains. This is empirical observation, that very often, the amount that you derive as returns from holding equity portfolios and equity shares is through capital gains, and only a minimal amount is derived through dividends. This is usually the case. Again, there may be situations where this principle is violated, and there may be situations where the capital gains is insignificant.

Shares are infrequently traded, companies incurring losses and there are very few takers of those shares, in which case liquidity of the shares would be low and even capital gains would be unlikely in that event. However, if the company decides to declare dividends of earlier corporate, for that matter, profits that have accumulated over the years, that could be part of the dividends.

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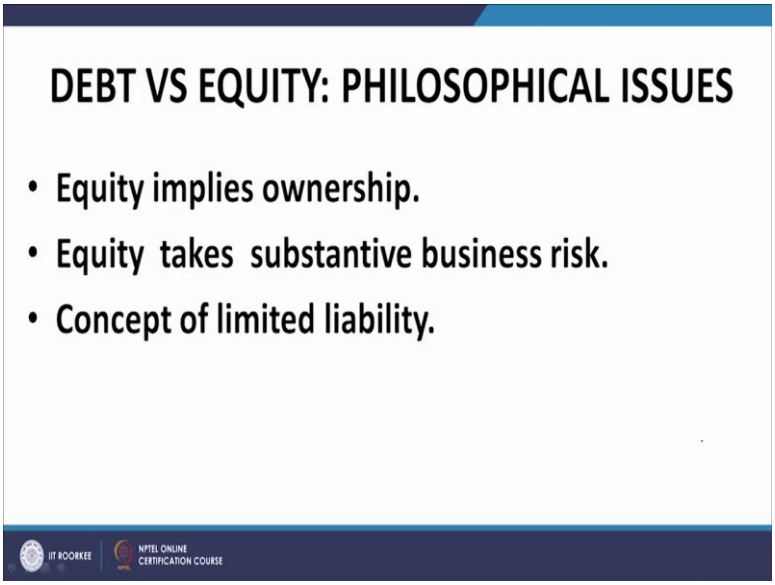

Debt versus equity: philosophical issues: So, what we infer from the discussion that we have been doing for the last few minutes, equity implies ownership. Equity takes substantive business risk. It is ultimately the owners of the company that take the business risk and equity representing the ownership stakes, they are responsible, or are attributed the business risk of the company. Now, we come to an important issue that is called limited liability or discuss it in brief.

The basic meaning of limited liability is that if you are holding equity shares in a company, and you are paid up the full amount that is due on those shares, for example, if it is a 10 rupee share, and you are paid up all 10 rupees to the company as the value of the shares to the company against application allotment and calls.

Once you have paid up the full amount on the shares, you cannot be asked by the company under any circumstances, to pay any more amount for example, the redemption of the liabilities, even if the company has significant liabilities and is not in a position to make payment to those liabilities of out of existing funds. It cannot approve the shareholders provided the shareholders have made full payment against the shares allotted to them. This is called limited liability.

The liability of the shareholders is limited to the extent that the shareholders are liable to pay on the shares once whatever their level they have paid. They cannot be asked to pay any more. For example, for the repayment of debts of the company.

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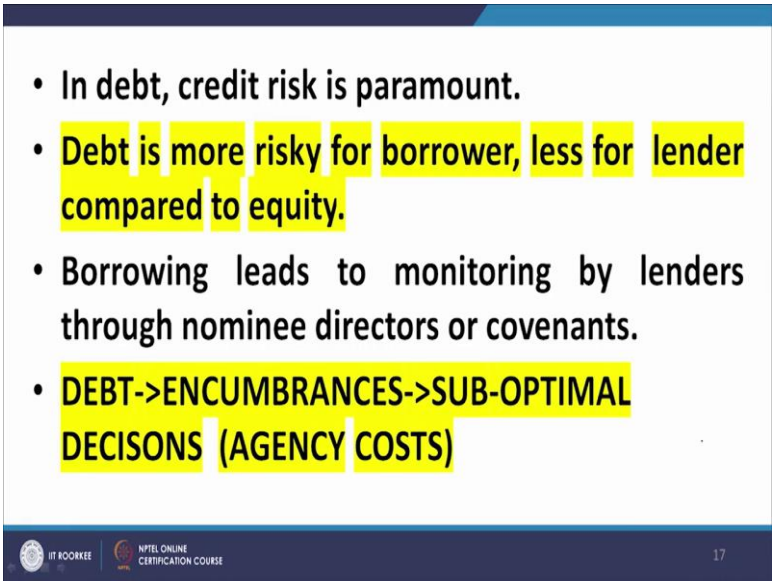

In debt, the credit risk is paramount. As I mentioned in the case of equity, the paramount risk, the cardinal risk, the business risk, the risk of the business doing well or risk of the entire business operations, including marketing of the product, including the operations, the finance and everything. Debt on the other end has the card credit risk as the cardinal risk. Debt is risky for the borrower and less risky for the lender compared to equity.

Now, this is an important statement. As far as the borrower is concerned, that debt is more risky than equity, because debt envisages a fixed charge by virtue of interest. However, in the case of equity, if the company has profits, it pays dividends. If the company does not have profits, payment of dividend is not mandatory by any means.

Borrowing leads to monitoring by lenders through nominee directors or covenants. So, if there could be situations where, for example, these directors who are nominee directors would be more worried about their stake, that is the stake of the lenders in the company. in contradistinction to the overall business environment of the company. In other words, what I am trying to bring to you is that there could be situations where the creditor stake as presented by the nominee directors would supersede the optimal business decisions or decisions based on the optimality of business environment.

And that gives rise to what is called agency costs. So, let me reiterate. There could be situations where the business could be asked to make sub optimal decisions to take account or take cognizance of the interests of the lenders, rather than the overall business interests or the interests of the shareholders. In other words, the interests of the lenders may supersede the interest of the shareholders. This would obviously result in suboptimal decisions. This could

result in agency costs. So, let me reiterate. Agency costs is a situation where the interests of the shareholders are compromised with, in order to benefit the interests of the lenders.

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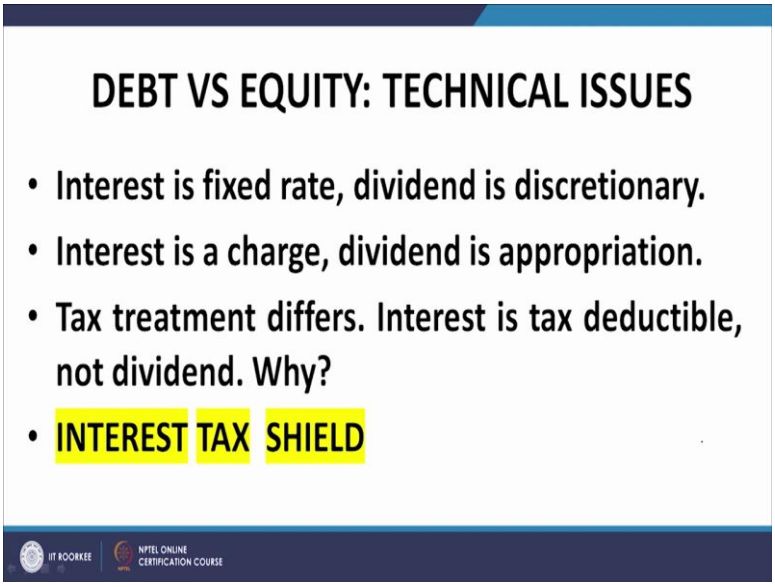

Debt versus equity: technical issues: The bondholders of the company are the persons to whom bonds have been allotted. The person to whom debt instruments have been allotted, get interest, because there is a subsisting underlying contract of lending and borrowing between the issuer of the bond (issuer of the debt instrument) and the holder of the debt instrument. The holder of the debt instruments has lend a certain amount of money to the issuer of the debt instrument and the issuer has to pay interest there on and of course, the repayment of principal.

So, the important thing here is that, this interest that the issuer of the bond instrument has to pay is a mandatory payment. In other words, it must necessarily be paid irrespective of the company making a profits or losses. And secondly, it is a fixed payment. Of course, we do have floating rate modes which will be discussed later. At this point, you may understand that, usually interest on debt instruments is a fixed payment and a fixed rate payment.

However, dividend is discretionary. As I mentioned, dividends are distributions of profits. So, if there is no profit, there is not likely to be any dividend. So, dividend is discretionary. In facts even if the company has made profits, it is not essential that the company distributes the entire profits by way of dividends. It may retain a part of the profits for future investments and operations or capex.

And it may, on the other end, it may also decide not to distribute any of the profits that it has incurred. The decision on the distribution of dividends is based on the recommendation by the shareholders and the board of directors during the general meeting.

Interest is fixed payment and it is a mandate repayment. Firstly, it is a fixed payment in general, and it is also a mandatory payment. You must pay interest, irrespective of whether you are making profits or losses. For dividends, the tax treatment differs.

When you pay interest, you can debit the interest to the profit and loss account or to the statement of total income, taxable income. It means that, when you pay interest, you debit that interest to the profit and loss account on the taxable income. Your taxable income will naturally decline. Suppose your taxable income is 1000 rupees and 100 rupees is interest. And your income after interest goes down to 900. And you will be taxed on 900, you will not be taxed on 1000.

This is the meaning of the fact that interest is tax deductible. Let me repeat, if you pay interest on a certain borrowing, that interest can be debited to the profit and loss account. As a result of which, when you pay interest, your taxable income declines. And because your taxable income declines, the tax that you pay also declines.

This fundamental is given a name. It is called the concept of interest tax shield. Whenever you pay interest, you debit interest to profit and loss account. Your taxable income declines and the tax that you pay also declines.

Now, contrast this with the dividend situation. In the case of dividends, you do not debit it to the profit and loss account and nor is it allowed nor is it explicitly allowed as a deduction when you calculate the taxable income of the company.

Dividend is not the entire debited to the profit and loss account nor is it explicitly allowed under the Income Tax Act, when you work out the taxable income of the company.

Let us consider the same example. If you have an income of 1000 rupees and you paid 100 rupees as dividend, you will have to pay tax on 1000 rupees and not on 900 rupees. This is the fundamental difference between the two. Dividends does not enjoy tax shield. The reason therefore, the reason for these contrasting procedures under the Income Tax Act is that interest is a charge against the profits and therefore it is treated at par with other expenses of

the company. The company does not have any discretion insofar as the payment of interest is concerned.

The result is that the income tax authorities recognized interest as a part of the expenses of the company, mandatory expenses of the company and therefore, they allow this to be debited to the profit and loss account. In the case of dividend, it is treated as an appropriation of profits, it is treated as a distribution of profit. Therefore, the income tax authorities do not recognize it as an expense, and it is a part of the calculation of taxable income.

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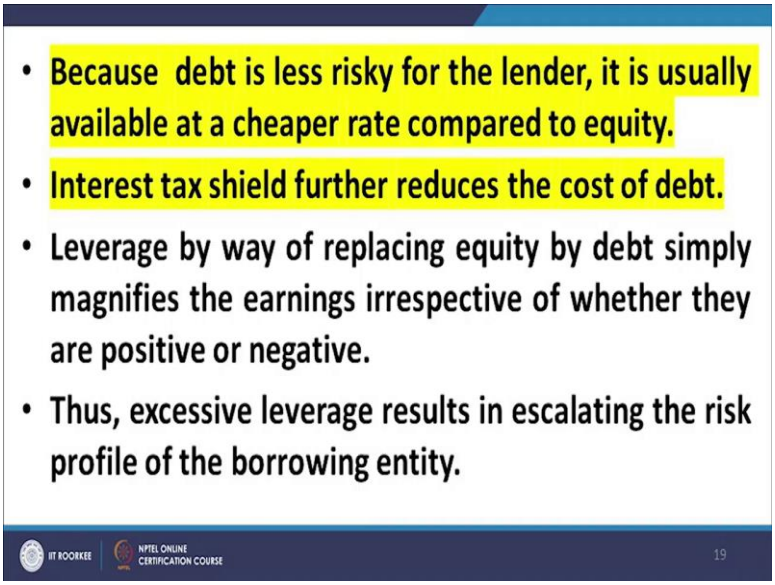

Because debt is less risky for the lender, the lender is able to part with the money to give up this money at a lower rate than actual interest. This further reduces the cost of debt. To explain that particular process, then leverage by way of replacing equity by debt, simply magnifies the earning irrespective of whether they are positive or negative.

If you replace equity by debt, that is you are incurring leverage, you are taking advantage of leverage, you are replacing equity. Let us consider a situation where you are replacing our discretionary cost by a mandatory interest payment. But that rate of interest payment is usually lower. Because it is less risky for the lender, the lender can part with this money at a lower rate.

And therefore, what happens is that the overall earnings, the net earnings of the company get magnified when you use leverage. But the important point here is that, the magnification is both with profit and loss. If your profit is higher, the profit will become even higher, if you take advantage of leverage. But in similarly in tandem with this, if the losses are there, then the losses will get magnified.

Because if you take advantage of leverage, or if you replace equity by debt, because equity is not a mandatory payment so it would not form part of the losses. However, interest is a mandatory payment irrespective of whether you are incurring profits or losses, and therefore, your losses will get magnified.

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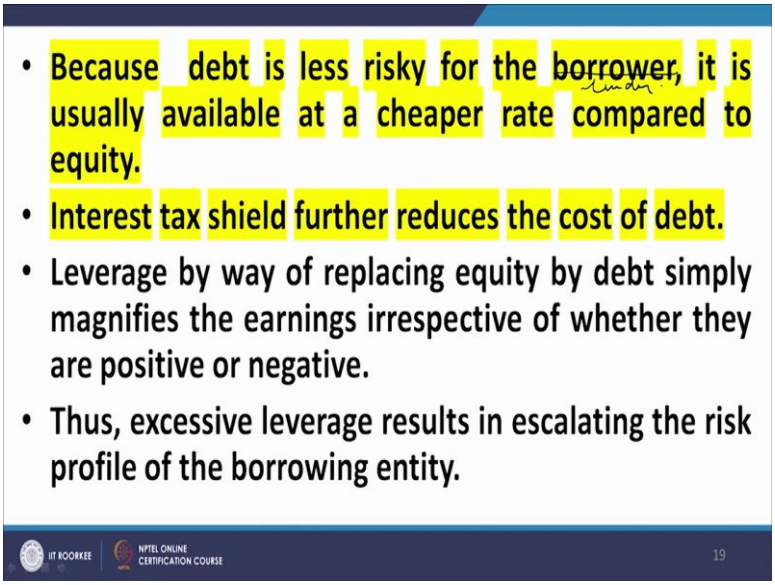

Does excessive leverage results in escalating the risk profile of the borrowing entity. Because if you are incurring losses, the losses will be magnified by if you undertake leverage. This is will be continued in the next Lecturer. Thank you.