Plant Design and Economics
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Lecture No -19
Income Tax and Depreciation

Welcome to lecture 19 of plant design and economics. In this lecture, we will talk about income tax and depreciation. Now as a design engineer, we do not have to be a tax specialist because specialized knowledge is required for that. However as an engineer or design engineer, we must have some basic understanding about income tax. Different countries have different tax laws and they generally change almost every year, so the tax laws may be very complicated.

That is why you do not have to be a tax specialist as design engineers. But we must have some basic understanding about the tax laws as well as the tax allowances, so that we can make economic evaluations of various proposals or various business ventures. Depreciation is an important tax allowance, so today we will start our discussion on income tax and depreciation.

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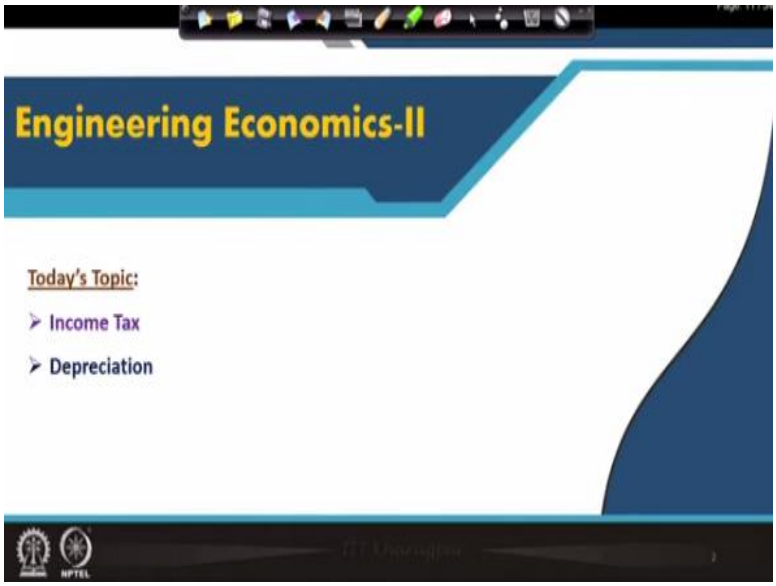

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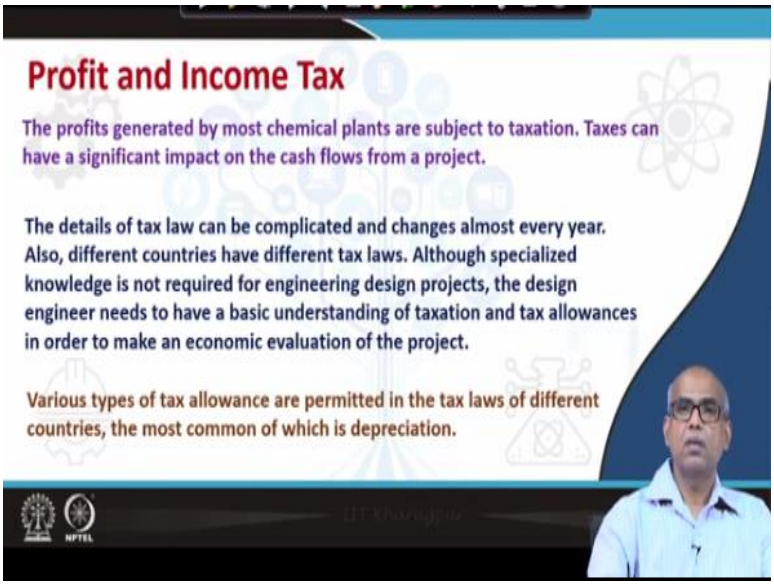

The profits generated by most chemical plants are subject to taxation, so both individuals and companies must pay income tax. Taxes can have a significant impact on the cash flows from a project. The details of tax laws can be complicated and change almost every year, as we just said. Also, different countries have different tax laws. Although specialized knowledge is not required for engineering design projects.

The design engineer needs to have a basic understanding of taxation and tax allowances in order to make an economic evaluation of the project. Various types of tax allowances are permitted in the tax laws of different countries, the most common of which is depreciation. We have briefly talked about depreciation earlier we define it as the decrease in value of an asset with time. We will learn more about depreciation soon for the time being.

Let us define depreciation as the decrease in value of an asset or facility with time. This may be due to wear and tear this may be due to advances in technology, so my asset has now become obsolete so on and so forth.

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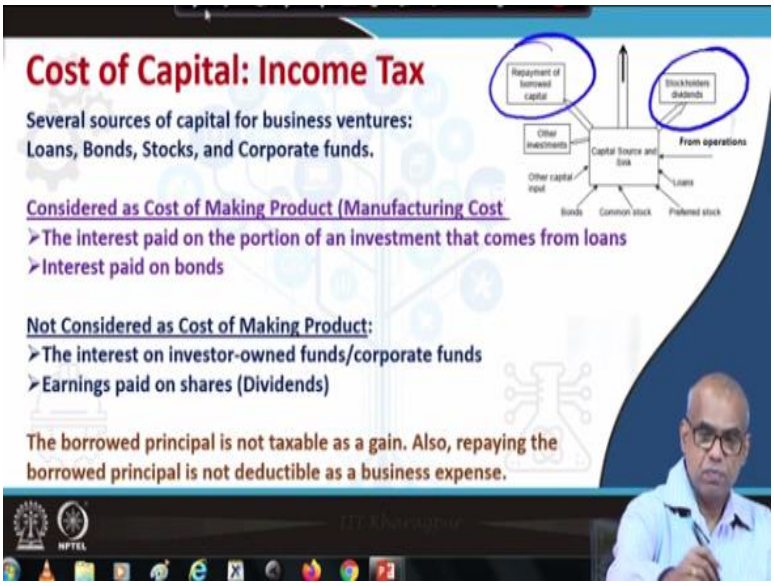

Now, look at this diagram, you have seen this diagram when you talked about cash flow tree diagram, when you just started talking about engineering economics part 1. You see that there are several inflows to the capital source and also there are several outflows. So the several sources of capital for business ventures are loans, bonds, common stock, preferred stock, corporate funds etc. Now not all costs are considered as the cost of making a product or manufacturing cost.

For example, the interest paid on the portion of an investment that comes from a loan, that means interest paid on loans. And the interest paid on bonds is considered as part of manufacturing cost, so they are considered as cost of making products. But, the interest on investor-owned funds or corporate funds, earnings paid on shares and dividends are not considered as the cost of making a product. If you look at this diagram again, you see that there are outros from the capital source indicated as shareholders dividends.

So earnings paid on shares or dividends cannot be considered as the cost of making a product. And we must know what are the costs that are considered for making the products and what are the costs that are not considered as manufacturing costs or cost of making the product. So that we can compute our tax or income tax on the profit that the companies make. The borrowed principle is not taxable as a gain, so any borrowed money, it is not considered as gain and it is not considered and not taxable.

Also repaying the borrowed principle is not deductible as a business expense. So the way the borrower principle is not taxable as again, it is not considered as gain, so it is not taxable. Similarly repaying the borrowed principle is not deductible as a business expense, so these are outflows, but not deductible as business expenses.

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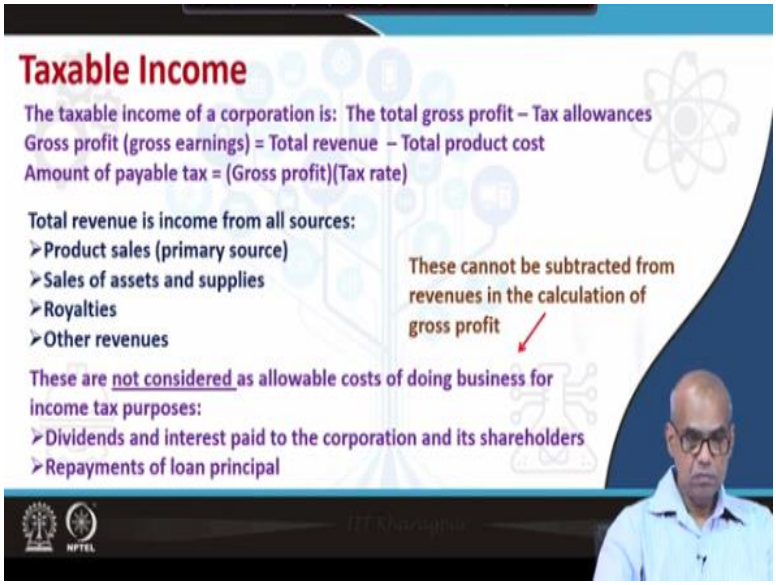

So what is taxable income? The taxable income of a company is the total gross profit - tax allowances. There are several tax allowances different countries give different incentives for doing business. So different countries give different tax allowances, depreciation is one of the important tax allowances. So the taxable income of a company is the total gross profit minus tax allowance. So what is total gross profit? Total gross profit is also known as gross earning.

So gross profit or gross earning is, total revenue minus total product cost. Now the amount of payable taxes gross profit multiplied by tax rate. So tax rates may be 20% or 30% depending on place or depending on different countries or different tax rates. Now total revenue is income from all sources, although the primary source is the sale of products, but apart from product is other sources of revenue or cells of assets and supplies, royalties or any other revenues.

However, as we just discussed in previous slides, the dividends and interest paid to the corporation and its shareholders. Repayment of loan principles are not considered as an

allowable cost for doing business for income tax purposes. So such cost cannot be subtracted from the revenues when you compute your gross profit for the company.

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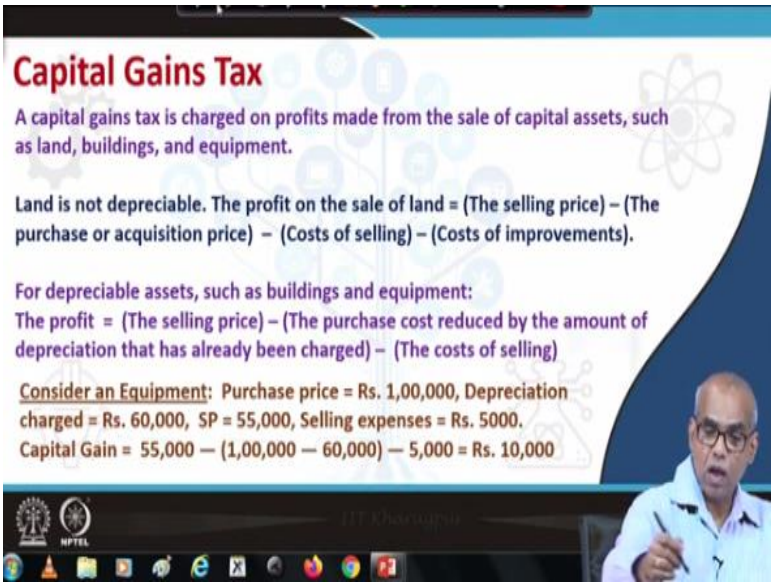

Capital gains tax is charged on profits made from the sale of capital assets, such as land, buildings and equipment. Land is not depreciable, that means you do not get depreciation charge for land. The profit on the sale of land will be equal to the selling price - the purchase or acquisition price of the land - cost of selling - cost of improvements of the land. So the profit on the sale of land is the selling price minus purchase price minus cost of selling minus cost of improvement of the land.

But buildings and equipment are depreciable assets that mean you get depreciation charge for assets such as buildings and equipment. For depreciable assets the profit will be the selling price - the purchase cost reduced by the amount of depreciation that has already been charged - the cost of selling. So this is important, the purchase cost is reduced by the amount of depreciation that has already been charged, because that money you have already got back.

So if you take a simple example, it will be clear, consider an equipment that is a depreciable asset, the purchase price of the equipment was rupees say 100000. Now the depreciation charge so far is 60000 selling price of the equipment is 55000 and the selling expenses is rupees 5000. So this is the expenditure that you incur when you go and sell the equipment. What will be the

capital gain?

First compute this quantity, the purchase cost is reduced by the amount of depreciation that has already been charged, how much the depreciation has been charged? Rupees 6000, so this quantity is 100000 minus 60000, this gives 40000. So you have to subtract this quantity 40000 also 5000, so 45000 from the selling price 55000 so that capital gain is 10%. So this is how the depreciation charge will influence the capital gain for the assets which are depreciable.

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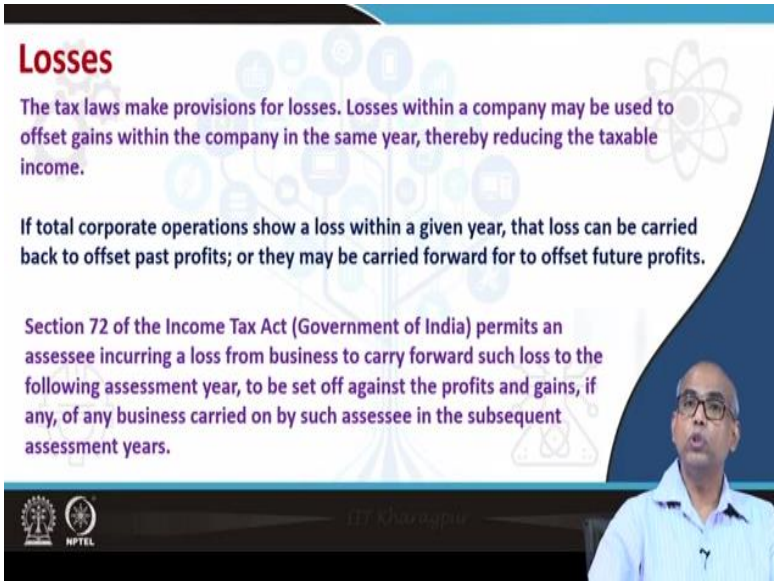

Now your company may not always make profit, your company can incur losses as well. Income tax laws make provisions for losses. Losses within a company may be used to offset gains within the company in the same year, thereby reducing the taxable income. It means suppose your company makes various products, various units, in one section you make profit, in another section you make losses.

So the losses within a company may be used to offset gains within the company in the same year, thereby reducing the total taxable income. If total corporate operations show a loss within a given year, that loss can be carried back to offset past profits or they may also be carried forward to offset future profit. Section 72 of the Income Tax Act Government of India permits an assessee incurring a loss from business to carry forward.

Such loss to the following assessment year, to be set off against the profits and gains, if any, of any business carried on by such assessee in the subsequent assessment years. So generally, every country allows companies to carry forward the losses to offset future profits.

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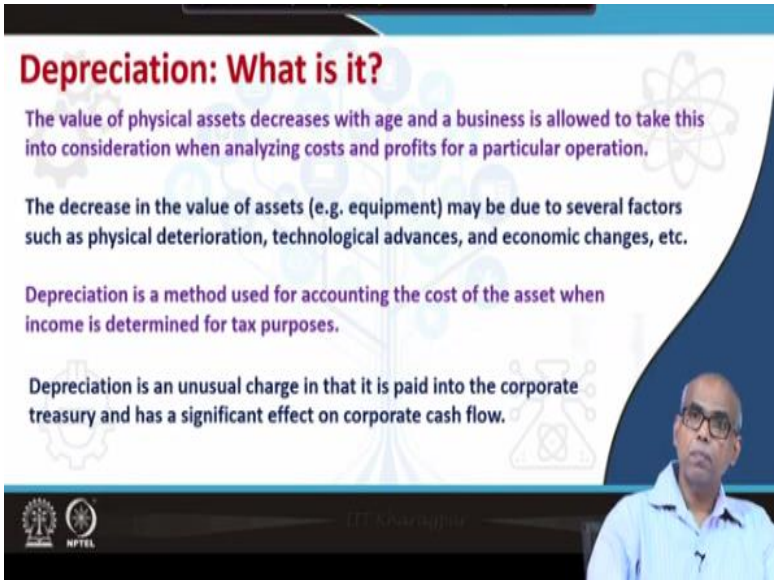

Now, we will talk about depreciation, so first let us try to understand what depreciation is, we have already defined it as a decrease in value with time, decrease in value of an asset or facility with time due to use wear and tear and obsolete. The value of physical assets decreases with age and a business is allowed to take this into consideration when analyzing cost and profits for a particular operation.

The decrease in the value of assets, for example equipment may be due to several factors such as physical deterioration, technological advances and economic changes. Depreciation is a method used for accounting the cost of the asset when income is determined for tax purposes. So, it is a tax benefit, a tax allowance. Depreciation is an unusual charge in that it is paid into the corporate treasury and has a significant effect on corporate cash flow.

We will see later how this depreciation affects the income tax? We have already seen this when we talked about the cash flow tree diagram, but again we will review this diagram today and see how the depreciation affects the income tax or the net cash flow to the treasury from the project operations.

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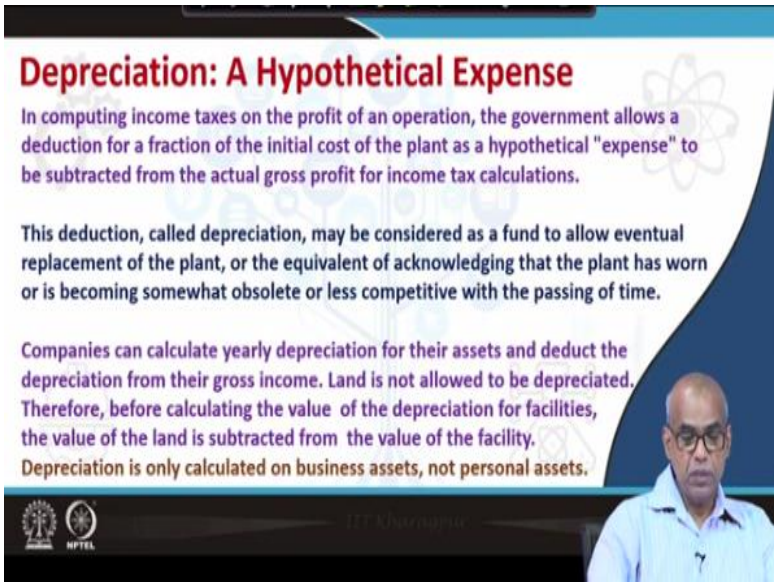

You can also define depreciation as a hypothetical expense. In computing income taxes on the profit of an operation, the government allows a deduction for a fraction of the initial cost of the plant as a hypothetical expense to be subtracted from the actual gross profit for income tax calculations. So it is a hypothetical expense that you are allowed to subtract from the actual gross profit for income tax calculations.

So income tax will be computed on an amount which is gross profit minus this hypothetical expense, which is known as depreciation. This deduction, called depreciation, may be considered as a fund to allow eventual replacement of the plant, or the equivalent of acknowledging that the plant has worn or is becoming somewhat obsolete or less competitive with the passing of time. So it is basically a way of repaying the initial investment made.

Companies can calculate yearly depreciation for their assets and deduct the depreciation from their gross income. Land is not allowed to be depreciated. Therefore, before calculating the value of the depreciation for facilities, the value of the land is subtracted from the value of the facility. The facility may be depreciable but the land is not, so the value of the land must be subtracted from the value of the facility. Depreciation is only calculated on business assets, not personal assets.

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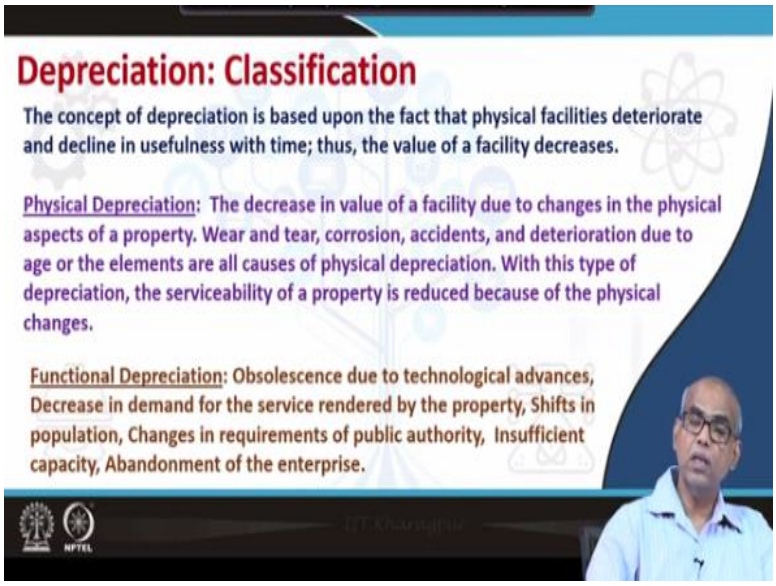

The concept of depreciation is based upon the fact that physical facilities deteriorate and decline in usefulness with time; thus, the value of a facility decreases with time and age. We can classify depreciation in two ways, physical depreciation and functional depreciation. Physical depreciation is the decrease in value of a facility due to changes in the physical aspects of a property. Wear and tear, corrosion, accidents and deterioration due to the age or the elements are all causes of physical depreciation.

With this type of depreciation, the serviceability of a property is reduced because of the physical changes of the facility. Functional depreciation; here obsolescence due to technological advances, decrease in demand for the service rendered by the property, shifts in population, changes in requirements of public authority, insufficient capacity, abandonment of the enterprise. So, these are the factors responsible for functional depreciation.

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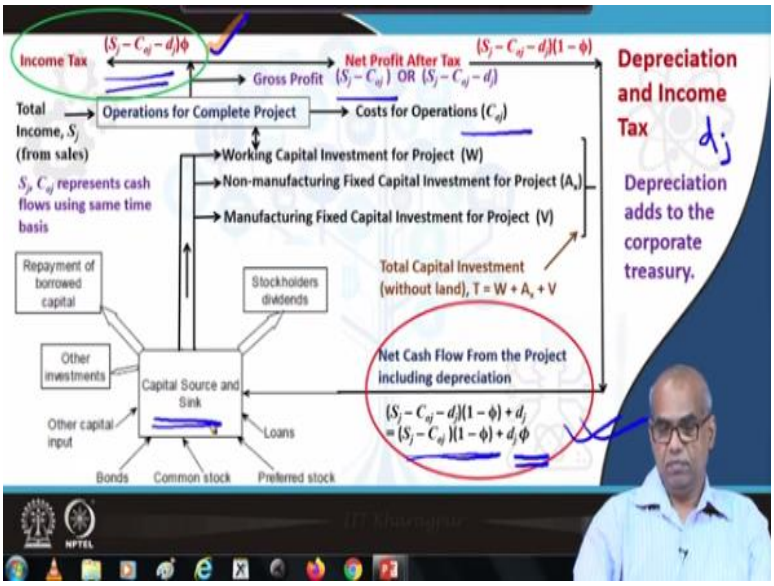

Now, this is the cash flow tree diagram that we have already discussed in the previous module. Now, you look at this block, here S j represents the total revenue from cells in the jth year. And C o j represents the cost of operations in the jth year, so the gross profit is S j minus C o j. Consider that income tax is phi, so if it is 30 percent phi equal to 0.3. Now, when you compute income tax, see I am reducing the gross profit by the depreciation in jth year, which is d j.

So, d j is the depreciation in the year j, so the income tax is being computed as S j - C o j - d j into phi. So basically, your gross profit is being reduced by d j. Now if you look at this block, if there was no d j, there was no depreciation, you would have paid back, S j - C o j times phi. So, this was the quantity that you would have retained. S j - C o j into phi would have been income tax, so S j - C o j times 1 minus phi would have been your net profit after tax.

But because of depreciation you add a positive quantity d j into phi. So this recovery of depreciation adds to your made cash flow from the project and goes to the corporate treasury or the capital source. So this recovery of the depreciation increases the net cash flow and also leads to the recovery of the initial investment that has been made.

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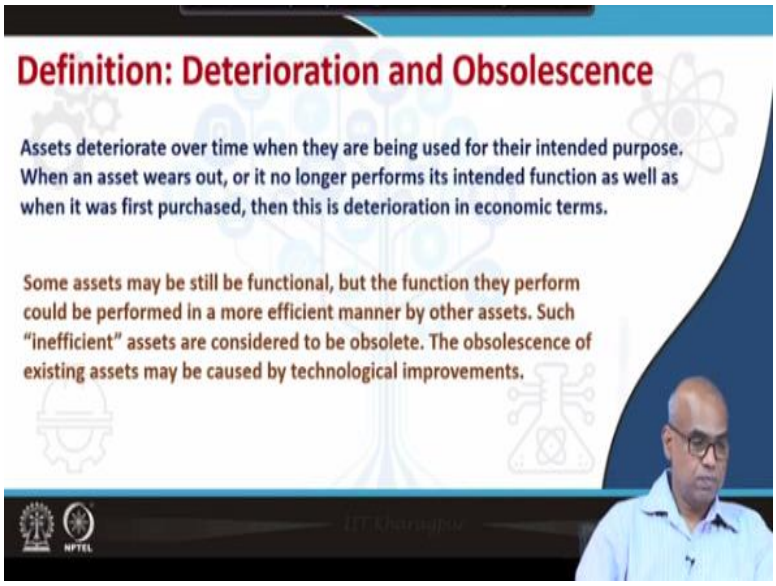

Now, let us define certain terms, deterioration and obsolescence. Assets deteriorate over time when they are being used for their intended purpose. When an asset wears out, or it no longer performs its intended function as well as when it was first purchased, then this is deterioration in economic terms. What is obsolescence? Some assets may still be functional, they have not stopped working, they are still functional, but the function they perform could be performed in a more efficient manner by other assets.

In other words, although some assets are functional they have become inefficient. Such inefficient assets are considered to be obsolete. The obsolescence of existing assets may be caused by technological advancements.

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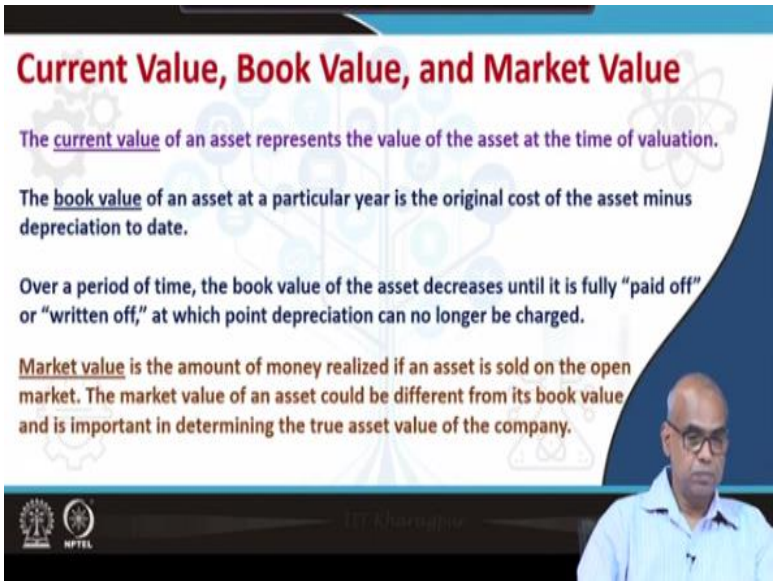

Now, we will define three terms; current value, book value and market value. You will frequently encounter these terms when you talk about cash flows or economic evaluations of different projects. The current value of an asset represents the value of the asset at the time of valuation. The book value of an asset at a particular year is the original cost of the asset minus the depreciation that has been charged up to that point of time.

Over a period of time, the book value of the asset decreases until it is fully paid off or written off, at which point depreciation can no longer be charged. Market value is the amount of money realized if an asset is sold on the open market. The market value of an asset could be different from its book value, because on the open market, your asset may be sold at a higher price or lower price than the book value. Market value is important in determining the true asset value of the company.

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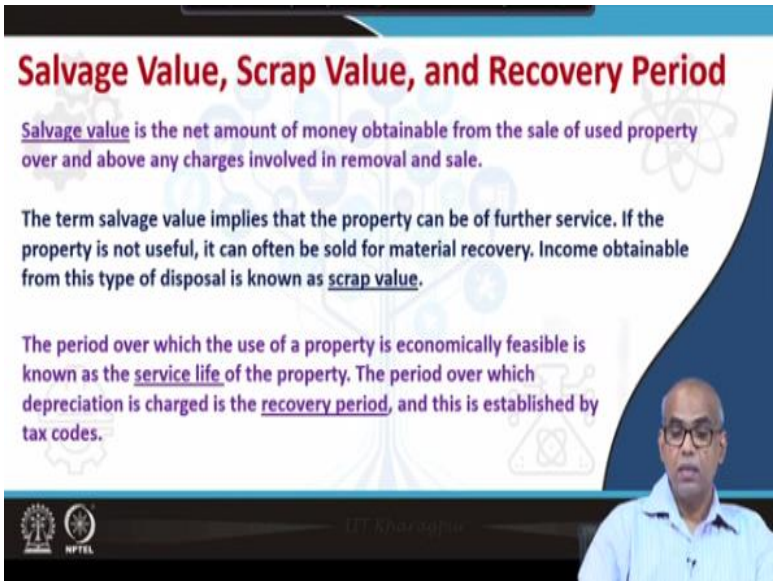

We will define three mode terms; salvage value, scrap value and recovery period. Salvage value is the net amount of money obtainable from the sale of used property over and above any charges involved in removal and sale. The term salvage value implies that the property can be of further service, that the property is still functional, if the asset is still functional. If the property is not functional, not useful, it can often be sold for material recovery. Income obtainable from this type of disposal is known as scrap value.

The period over which the use of a property is economically feasible is known as the service life of the property. The period over which depreciation is charged is the recovery period and this is established by tax codes of different countries. So the period over which the use of that property is economically feasible is known as the service life of the property. The period over which depreciation is charged is known as the recovery period. And the recovery period is established by tax laws of different countries.

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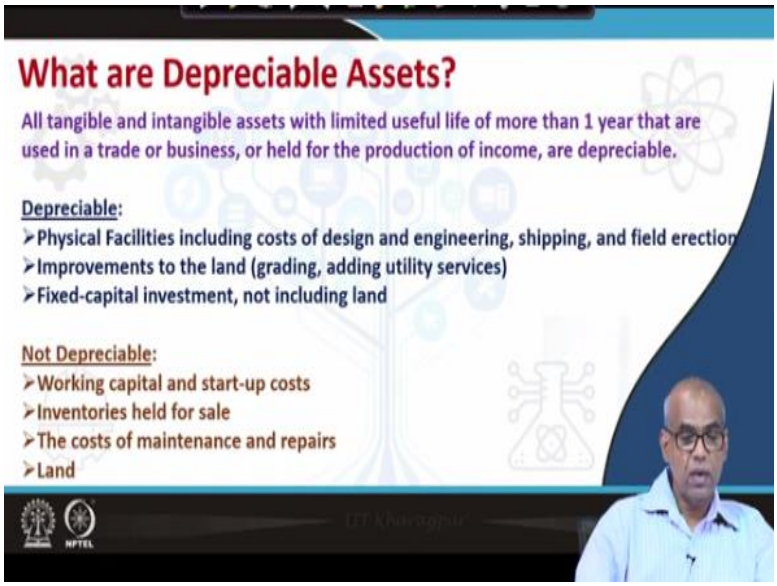

So what are the assets that are depreciable? We have already talked about the land is not depreciable, but buildings and equipment are depreciable. So let us try to see what are the assets which are depreciable and what are the assets which are not depreciable. All tangible and intangible assets with limited useful life or more than one year that are used in a trade or business or held for the production of income are depreciable.

For example, physical facilities including cost of design and engineering, shipping and field erection is depreciable. Improvements to the land such as grading, adding utilities services, etc are depreciable. But land itself is not depreciable but improvements made to the land are depreciable. Fixed-capital investment, not including land is depreciable. What is not depreciable? Working capital and start-up costs are not depreciable, inventories held for sale are not depreciable, the cost of maintenance and repairs are not depreciable and land is not depreciable.

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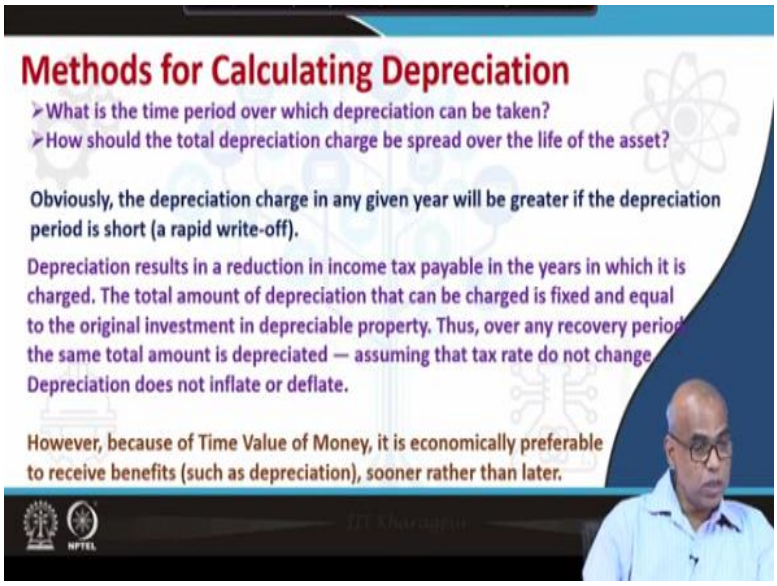

Now how to compute depreciation? Two basic questions are important about depreciation. One; what is the time period over which depreciation can be taken? We are talking about the recovery period here. Second; how should the total depreciation charge be spread over the life of the asset? Obviously, the depreciation charge in any given year will be greater if the depreciation period is short.

If the depreciation period is short, then in any given year the depreciation charge will be higher. Because the total amount of depreciation that can be charged is fixed, that is basically the original cost of the asset. So you can only recover that much over the recovery period. The question is, how should the depreciation charge be spread over the life of the asset? Depreciation results in a reduction in income tax payable in the years in which it is charged.

We have seen that when income tax is computed you subtract the depreciation from the gross profit. The total amount of depreciation that can be charged is fixed and equal to the original investment in depreciable property. Thus, over any recovery period, the same total amount is depreciated assuming that income tax rates do not change over the period of recovery. Remember depreciation does not inflate or deflate.

Now, although the same amount of charge, the same amount of money can be charged as depreciation over a recovery period, because of the time value of money, it will be economically

preferable to receive depreciation sooner rather than later. Because money has time value, it is always economically preferable to receive benefits, sooner rather than later. So, that is why you want to push the expenses in future and bring the revenue as soon as possible. So for a company, it is economically preferable to charge depreciation as soon as possible.

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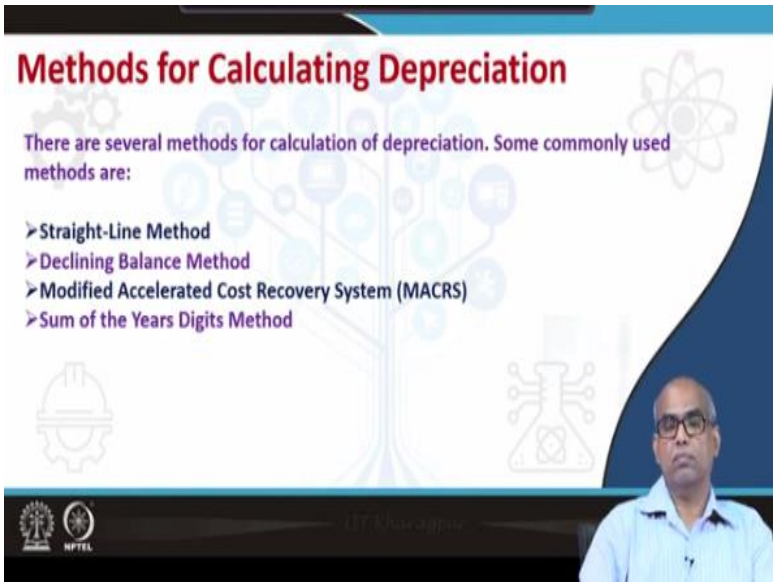

There are several methods for calculation of depreciation. We will consider some of the commonly used methods and will consider methods such as, straight-line method, declining balance method, modified accelerated cost recovery system and sum of the years digits method.

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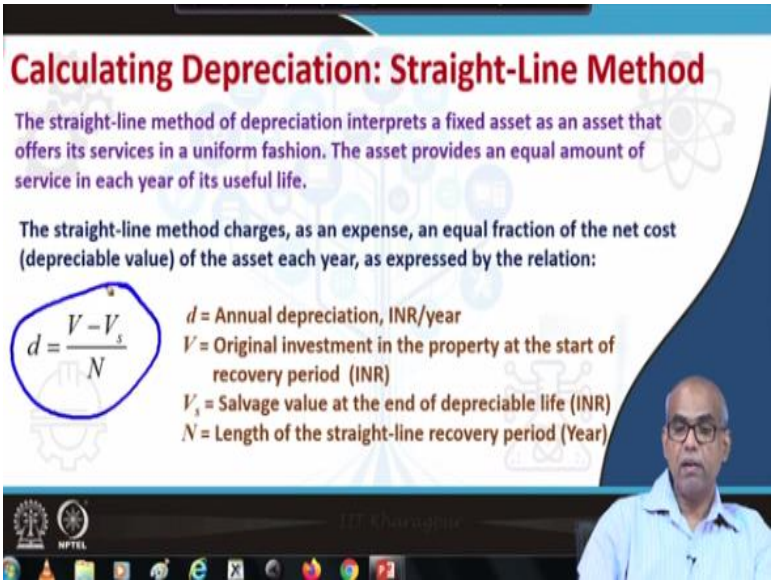

So let us first look at the straight line method for calculation of depreciation. The straight-line

method of depreciation interprets a fixed asset as an asset that offers its services in a uniform fashion. The asset provides an equal amount of service in each year of its useful life. The straight-line method charges, as an expense, an equal fraction of the net cost, that is depreciable value of the asset each year, as expressed by the relation: d = V - V s by N.

Where d is the annual depreciation such as rupees per year, V is the original investment in the property at the start of the recovery period in rupees, V s equal to salvage value at the end of depreciable life in rupees and N is the length of straight-line recovery period, it is a unit of time, so year. So according to the straight-line method the depreciation annual depreciation d is V - V s by N.

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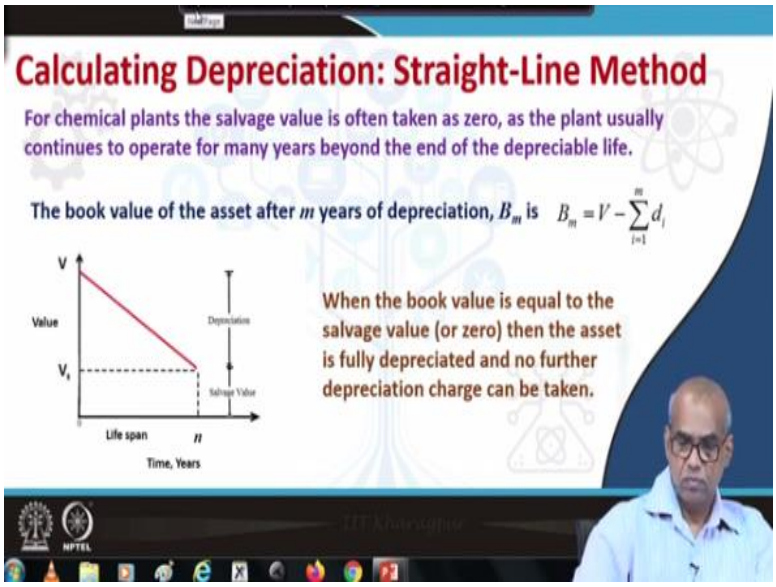

So pictorially it will look like this. So the value decreases with time and if N is the useful lifespan, at the n you have the salvage value for the asset, which is V s. If the salvage value is 0 then the V s will be 0, or it will come down to 0. So anyhow you have a salvage value, the depreciation that you get is this much. For chemical plants the salvage value is often taken as 0, as the plant usually continues to operate for many years beyond the end of the depreciable life.

So after the depreciable life, after the recovery of the depreciation, the plant continues to operate, it is still economically feasible to operate the plant. So that is why the salvage value will be considered as 0. The book value of the asset after a 'm' year of depreciation will be the original

cost or original investment minus the total amount of depreciation that has been charged up to mth year. When the book value is equal to the salvage value or 0, then the asset is fully depreciated and no further depreciation charge can be taken. It is then completely written off or paid off.

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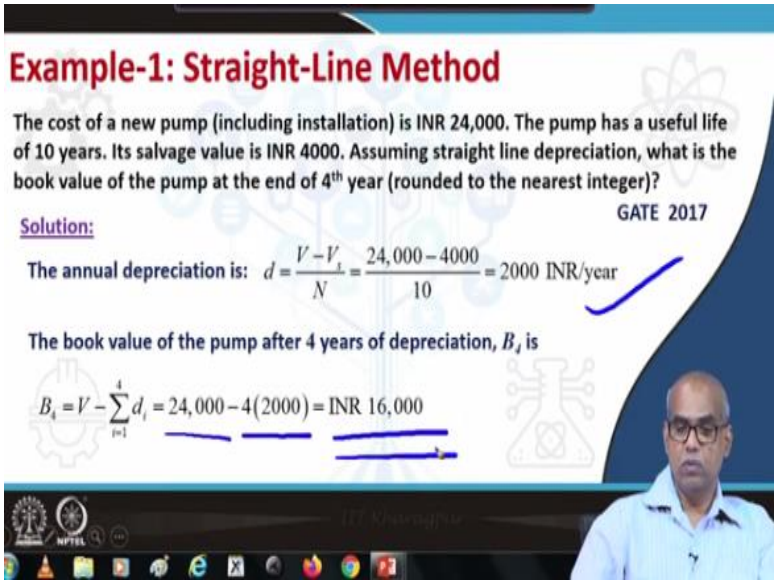

So now let us take one example. The cost of a new pump including installation is rupees 24,000. The pump has a useful life of 10 years. Its salvage value is rupees 4000. Assuming straight line depreciation, what is the book value of the pump at the end of fourth year rounded to the nearest integer. So let us first find out the annual depreciation, d = V - V s by N. So, what is V? V is 24000, the original cost of the new pump including installation.

V is the salvage value is 4000, so 24000 - 4000 by 10, which is useful life for the pump is 10 years. So this gives me rupees 2000 per year as annual depreciation. Now the book value of the pump after 4 years of depreciation will be the original value 24,000 minus the depreciation that you have charged after the fourth year, you have been charging 2000 rupees per year, so 4 into 2000, means 8000 here you have been already charged.

So 24000 minus 8000 is rupees 16000, so that is the book value at the end of the fourth year. So this is how the straight-line method can be used for computation of depreciation. With this we stop our discussion on lecture 19 here and in the next lecture we will continue with other

methods of depreciation, thanks for watching.