Engineering Economic Analysis
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Lecture 1
Introduction to Engineering Economy, Physical & Economic Environment, Phases in Engg. process

Welcome to the online NPTEL course. Engineering economic analysis. I am Dr. Pradeep Kumar Jha, Associate Professor in Department of Mechanical and Industrial Engineering, IIT Roorkee. So we will deal with this course and this is the first lecture of the course and we will deal with introduction to engineering economy. So first of all let us see what is the meaning of engineering.

We all know that we have the resources available and we work on these resources and get ultimately something which is meaningful, something which is useful for the person. So basically, we have the materials, we have the resources on which we work. The work on the materials is using certain procedure, by certain laws, laws of science are applied and ultimately we get something, some end product which must be beneficial for mankind.

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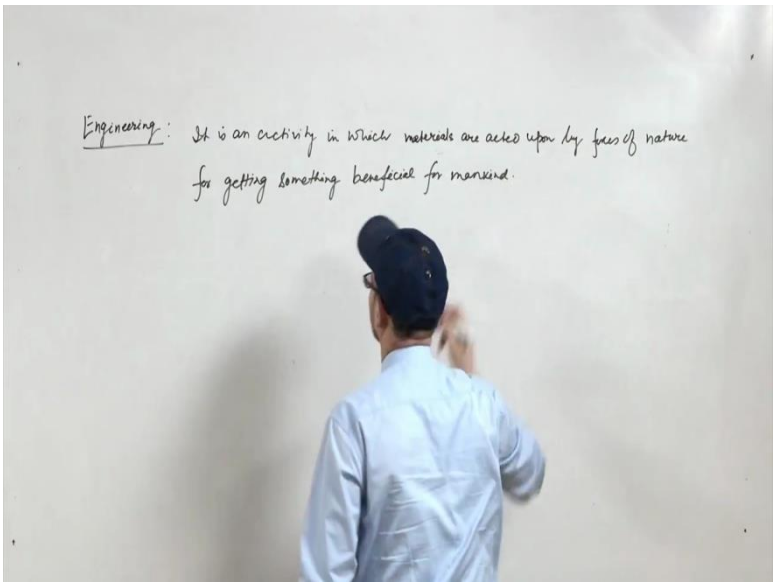

So basically, we can define engineering as it is an activity in which materials are acted upon by forces of nature for getting something beneficial for mankind. So this is the ultimate objective of engineering activity. We have the materials and resources, we have to transform it in different shapes and we have to get something which should be useful for mankind, which should be beneficial for mankind.

This main purpose is to get the satisfaction. Basically we have the resources or materials which have little value for the person like us. Like iron ore which is there, we do not have any value for it because it is just there and we do not need it. But then once this iron ore is used, it is extracted, it is further processed and we get iron or steel, we get utensils from it, it is useful.

So work is done on that, there are laws of science applied on this and we are giving a value to this. So we have materials and the force of nature is combined and then we get something which is useful for mankind and the purpose is to satisfy human wants.

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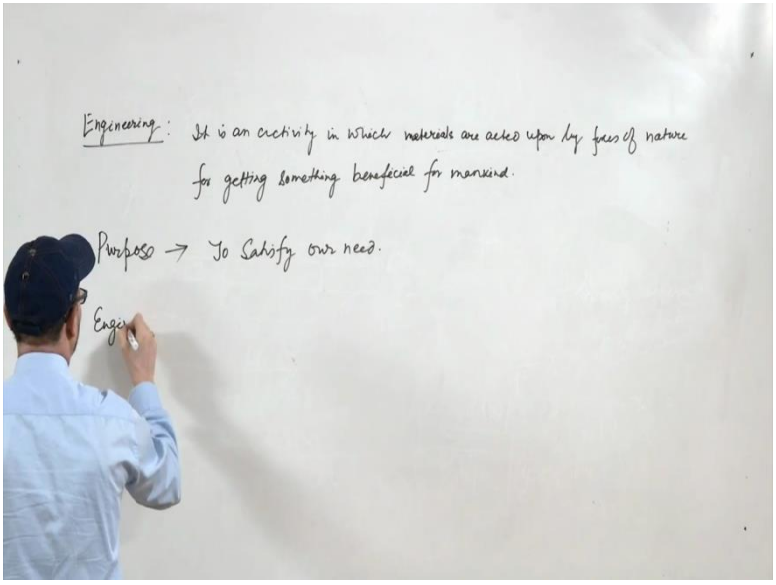

So purpose of engineering is satisfy our need. So we have the need in various aspects and by engineering activity, our need is satisfied. So we have the need in various aspects and by engineering activity our need is satisfied.

Now why economics is important? In earlier days when this engineering activity started the purpose was to get something new, to do something innovative. So the purpose was that do something which gives you some satisfaction, which gives a value to it. Later on as the resources were depleted, resource constraints came into picture and engineers had to think how to economise.

So basically in today's world when there is energy crisis all over the world, there is stiff competition in the market. Without keeping economics in mind, any engineering activity will be a failure from economic point of view because any activity which is started by any organization, has to sustain. So economics cannot be sidelined.

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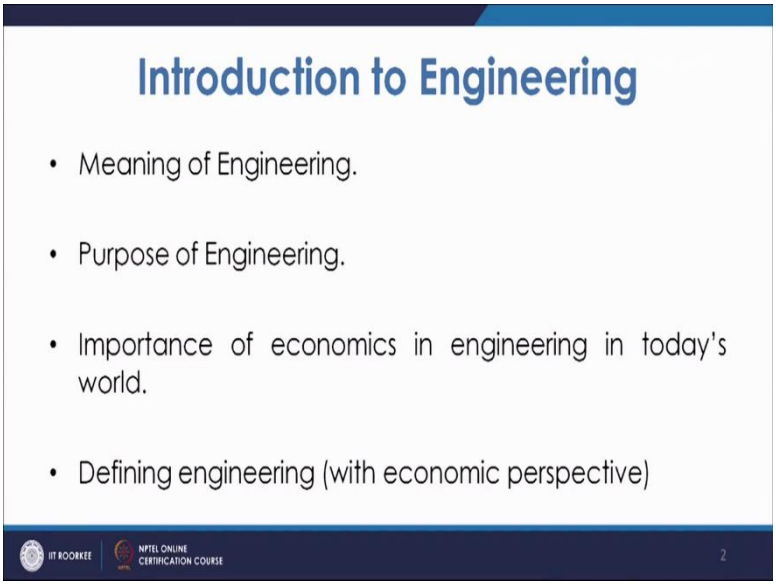

So importance of economics in engineering in today's world, it can be stemmed from the fact that you might be looking at a number of companies which come into the market, give product of similar kind but very few still remain in the market for longer times because economically they are not able to sustain themselves.

Although each of the company uses the engineering principles, the laws of science, the other principles and it gives also the products which is useful for the customer or the end users but the only one which keeps this economics in the mind which also keeps that what customer really wants and how they can economise the process, they can give the product at least cost, only those companies survive and they can flourish.

And also this is a continuing process. It has to think over this again and again. So importance of economics in engineering is quite high.

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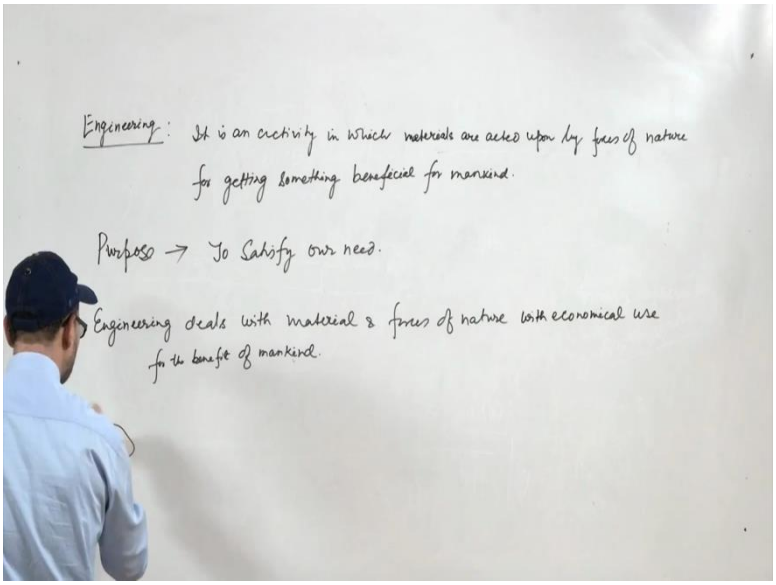

So ultimately if you keep economics in mind and try to define engineering, in that case you can further redefine that engineering deals with materials and forces of nature with economical use for the benefit of mankind.

So economics has to be kept in mind. Without economics, the engineering activity will be a failure. So basically there are a number of decision-making stages where you have to decide whether this activity is required, what are the decision-making principles so that economics is not undermined. Ultimately the objective is to earn profit for the company and giving good satisfaction to the customers, to the end users.

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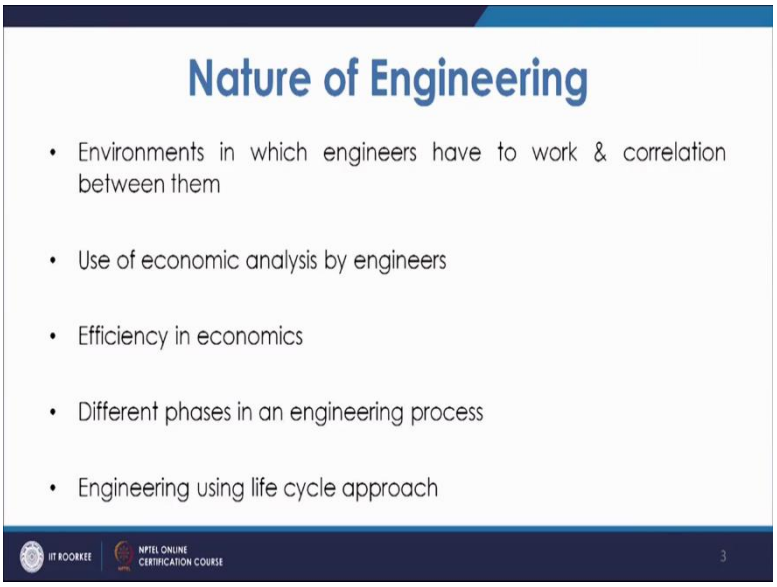

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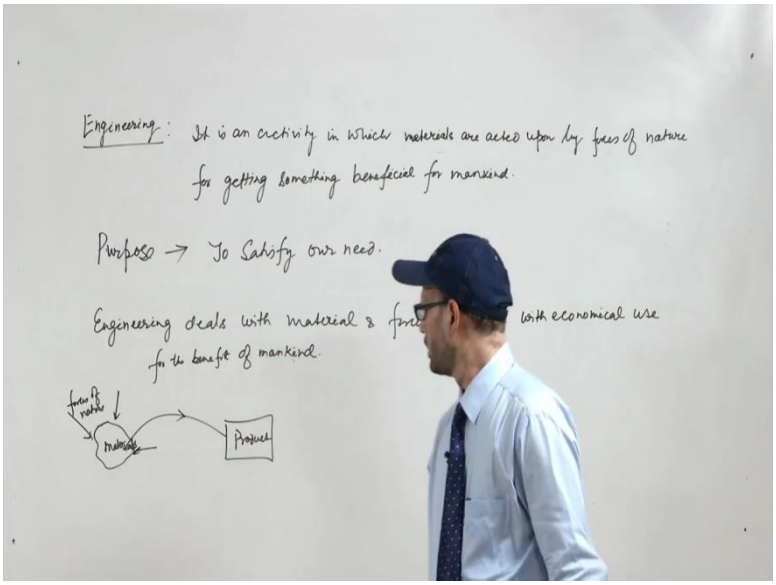

So this is how both the parties are satisfied and this the goes on. So basically what we see is that engineers have to work in two environments. What are those two environments? One is that you have materials and you use the forces of nature and then ultimately you get a product. So the material which is subjected to a number of operations using the laws of science, then after certain operations a product is found which is the realisation of the company.

The company had something in mind, it had the design so it worked upon this and it got this, then it goes into the market. So this product is basically satisfying the need of the customer.

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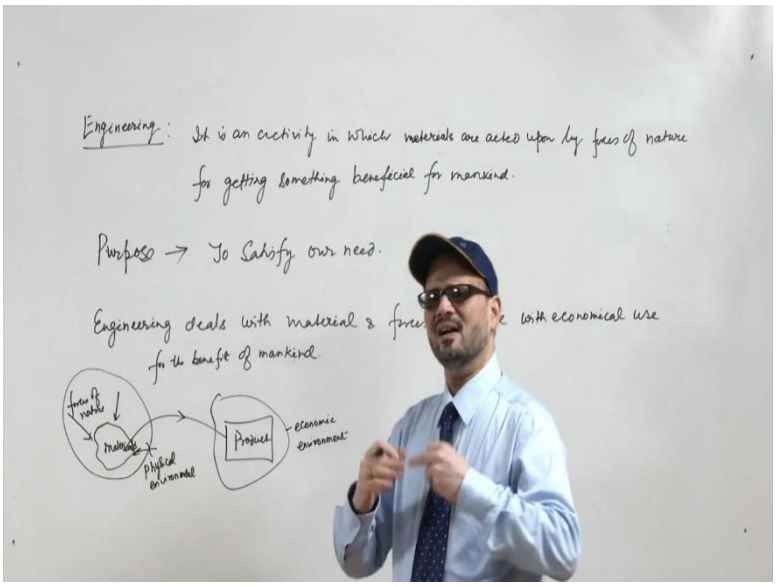

Now the two things which is to be kept in mind is, one is this where the physical laws are applied on the material and it is saved into a certain form. So this is a kind of environment that is known as physical environment. Engineers are typically concerned with this environment. Their main job is to see that how they can utilise the different laws and they can transform, they can alter the physical environment and they can give a product.

So this is the physical environment, once it comes into the market and it is used, it is used because it has some value. The value is added to it, the value is added because of the working on this. Because of the work or because of the alteration of the physical environment, its value and utility is basically increased and now there are any takers for this. So, it has the value, it has a utility and this is the environment which is nothing but an economic environment.

So what we discussed earlier, in earlier days, the engineers were confining their selves to this part. They were thinking that their main job is to work for altering the physical environment and this is not their job. This is the job of sales and marketing personals or the administration but then in today's world you have to be aware about this. In fact, this is to be kept in mind prior to this.

Engineers must know what they are going to produce, what is the overall economy, what is its life, who are their end-users, what they want and accordingly they have to alter the physical environment. So basically if you take the total environment, the total environment is consisting of two environments, physical environment and the economic environment.

Physical environment when you work on this expressed in terms of physical units. You apply certain forces, you use certain volumes so all these physical units are there to say how much physically you are changing the environment. The economic environment when you try to see what is its utility, basically that is expressed in terms of economic units, mostly in terms of medium of exchange such as money.

So if something is transformed into a manner that it has a good utility for certain section of the customers, they will pay more. So in that case you have created utility more for that segment of customers. So what we mean to say that, before this it has taken the precedence, working on the economic environment has taken precedence over working on the physical environment for the venture to be successful which we will discuss later.

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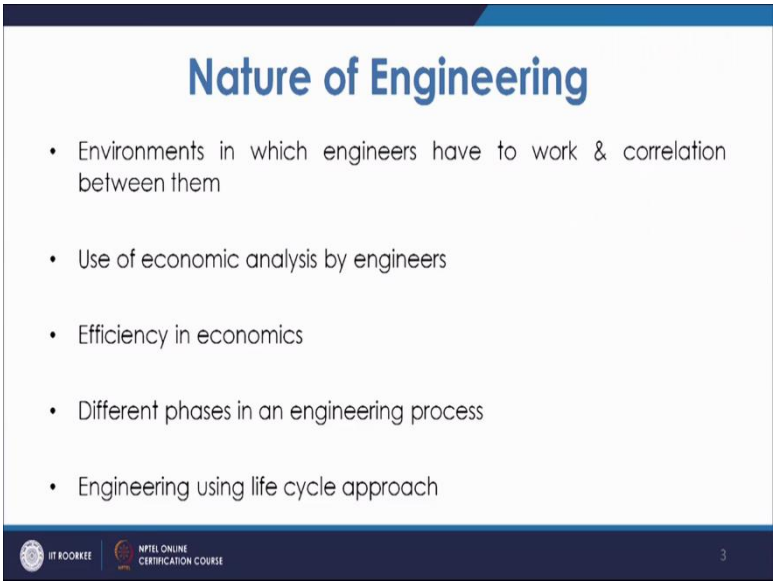

So use of economic analysis by engineers. So that's what I was telling, that engineers have to see that how you have to add the value, you have to add the utility value to any product by changing the physical environment, by altering the physical environment and the product is being accepted by the customers.

Now we talk about efficiency. When we talk about the efficiency, basically efficiency in economic analysis, you can take it as one is physical efficiency and another is economic efficiency.

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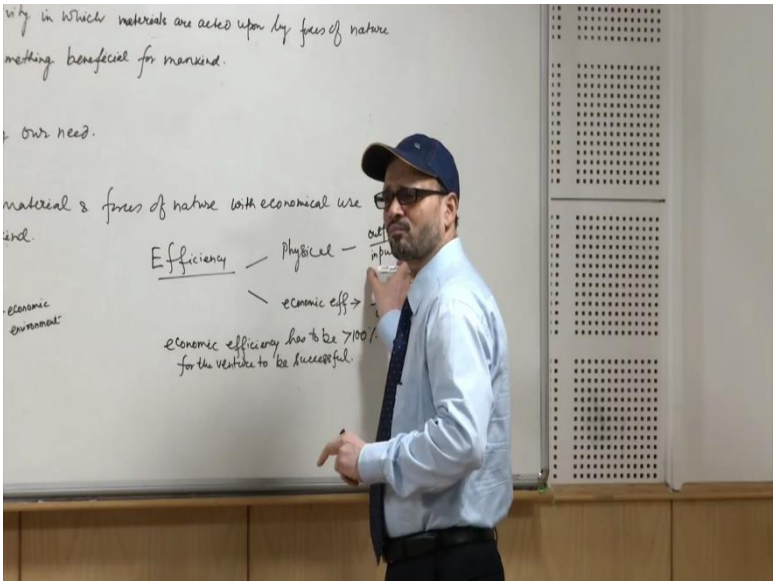

So if we talk about physical efficiency, physical efficiency will be expressed in physical units and this will be something defined by output by input. So basically we are dealing with altering the physical environment. Ultimately we have the outputs and inputs in terms of physical units, maybe in terms of watts, in terms of joules, in terms of velocity, there are many physical units in that.

So physical units once they are divided output by input, that is known as physical efficiency and it is less than one. So efficiency will be always less than 100 % here.

When we talk about economic efficiency, economic efficiency means you are getting the ratio worth to cost. What is the worth and how much it cost it to you? So in that case it has to be more than 100 % for the venture to be successful. So for any venture to self-sustain the economic efficiency has to be more than 100%. If the economic efficiency will be less then 100%, in that case, that economic venture cannot sustain.

So economic efficiency has to be more than 100% for the venture to be successful. We can have the example of any plant where if you would look at the physical efficiency, if we convert any raw material, if we burn the coal and try to get the steam, in that process, that efficiency which is measured in terms of the physical efficiency that is normally quite less than 100 %.

But if you talk overall, about and what price we had taken the coal and what is the ultimate output, maybe the steam or the electricity, in that case we will talk about the economic

efficiency and ultimately you will you must have the efficiency more than 100 % so that you can run your plant. So this is how you have the two efficiencies defined.

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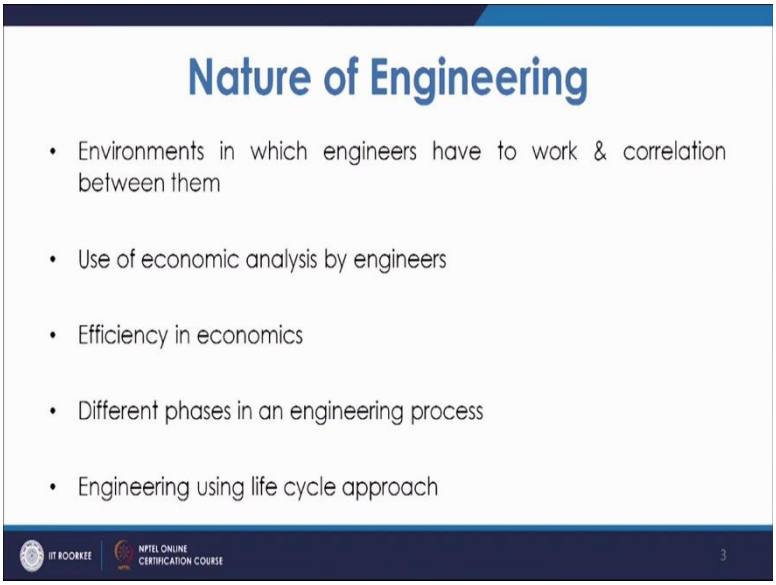

Now we will talk about different phases in engineering process. So the different phases in engineering process, what we mean by this is that when we have the materials, we have the forces of nature, they work on it and you get an end product which has the utility. What we also discussed is that this economic perspective should come first, you must know what you need.

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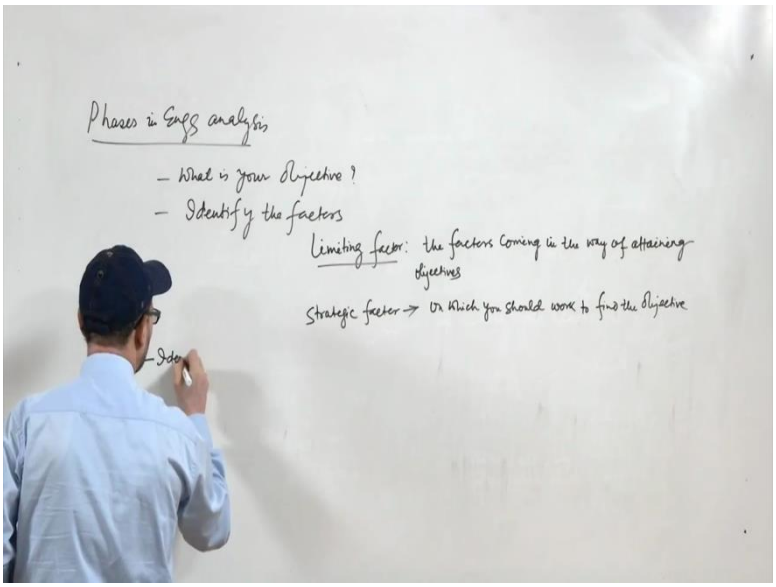

So basically in the economic terms or economic analysis terms, it is better. So first of all you should know what is your objective? So first of all you have the market service, you try to see what people need then only you can proceed. So suppose you need a pen which should be light, people may have the feeling that they need a pen which should be quite light and what is the number of users, how many people want that.

Similarly, use of automobiles, what kind of automobiles people prefer at this stage. So all these things, that is basically the requirement of the person. So first of all for that you have to have a proper process to know what is your objective.

You have to set your objective and for that you need to have an R&D section, a section which goes into the market, tries to find what are the emotions of people, what they need, what are the changes in their thought processes, how to use the material. So first of all you will see what is the objective then the thing is how you will attain this objective. So for that you have to identify the factors.

So what are these factors? Now once you have set the objectives, certainly the objective cannot be achieved easily. There will be some factors which are coming in the way of obtaining the objective, the objective. So there is an factor known as limiting factor. The limiting factor is the one which is coming in the way of attaining the objective. So the factors coming in the way of attaining objectives.

So you have to define what are the limiting factors? Once you have located the limiting factor then the factor on which you can work so that you can overcome this, that is known as strategic factor. So basically this factor can be altered, those factors which can be altered, so that you get the desired objective, they are known as strategic factors. Now once you have located the limiting factor and further the strategic factors.

So ultimately you came to a point where you know the factors, that is strategic factors on which you should work to find the objective. Now there are many ways by which the strategic factors can be worked upon. So these ways or these means are to be seen. So you have to identify the ways or means. So there are many ways by which you can work on these strategic factors and you can get the work done.

Now among them, there will be some ways or all the ways which basically are governed by the principles of engineering or they apply the laws of science, they are known as engineering

proposals. So basically they are nothing but they are proposals. So the way you are working on the strategic factors, you get different proposals.

Now the proposals which uses the engineering principles, they are the engineering proposals. So engineers have basically to see what are the kind of engineering proposals, in what way you can get the work done, you can get rid of the strategic factors, you can work on them and you can get the objective. So ultimately you get a large amount of proposals or engineering proposals.

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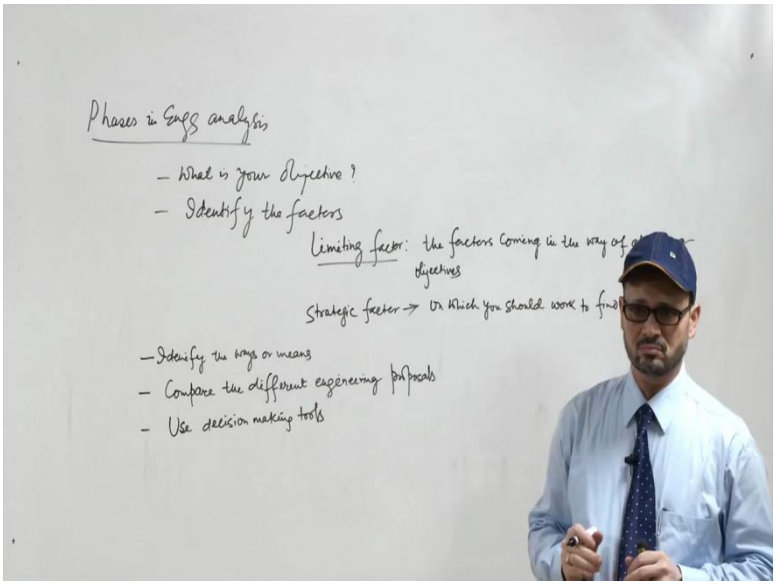

So you have to evaluate, so compare the different proposals. You have to evaluate, you have to compare the different engineering proposals which are coming here. Once you compare, the while comparing the main factor is to keep the cost in mind. That particular engineering prop engineering proposal will be called the best one where you attain the objective at the minimum cost.

So that will be basically your final engineering proposal which you should use. For that basically you have to use decision-making tools. Which are the engineering proposal you should go for? Which will give you the best result at least cost? That has to be decided by a expert in that particular area.

So there are different kinds of analysis tools by which you can analyse, you can predict about it and ultimately you can suggest that which of the engineering proposal is the best one. So that's how the different phases are there in the engineering process.

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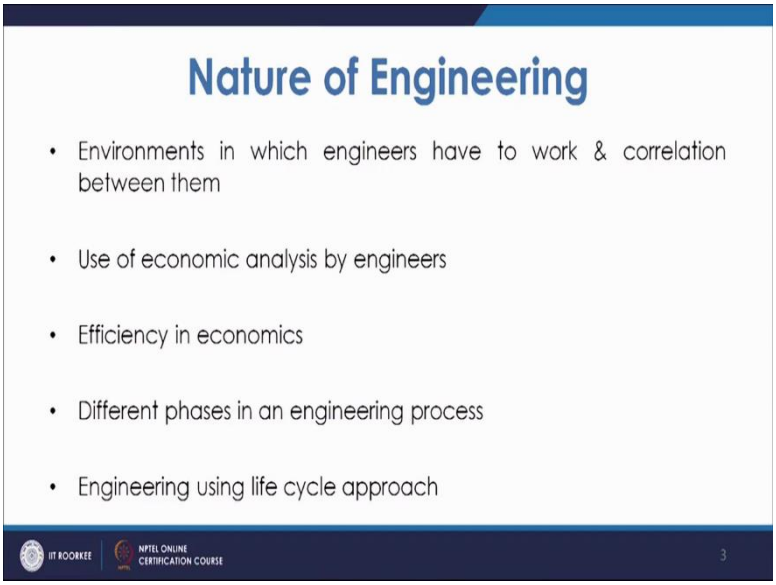

Next is engineering using life-cycle approach. The meaning to this is that, as we have seen that there is more and more competitiveness in the market, there has to be an approach which talks about the life cycle of the product. What does this mean? Basically, you do anything, you create something when there is a need. Once the need is realized, then basically you find a preliminary design, you develop a very basic design of it. How to get it?

Further, there will be experts in that particular area which will again discuss about the consequences and they will have a detailed design. Then there will be construction process, once you have detailed design ready, you will have construction of the product and then the product will be ready, it will go into the market for use.

Once it goes in the market for use, the feedback is taken back, how the product is performing, what would be the life expected for this product. There will be associated changes in the design if required or not so in this process goes. And in it between it also looks for its disposal when the company feels that okay it has done its work. The customer feels that they need further a change in the design then they further go for its disposal, a new design comes.

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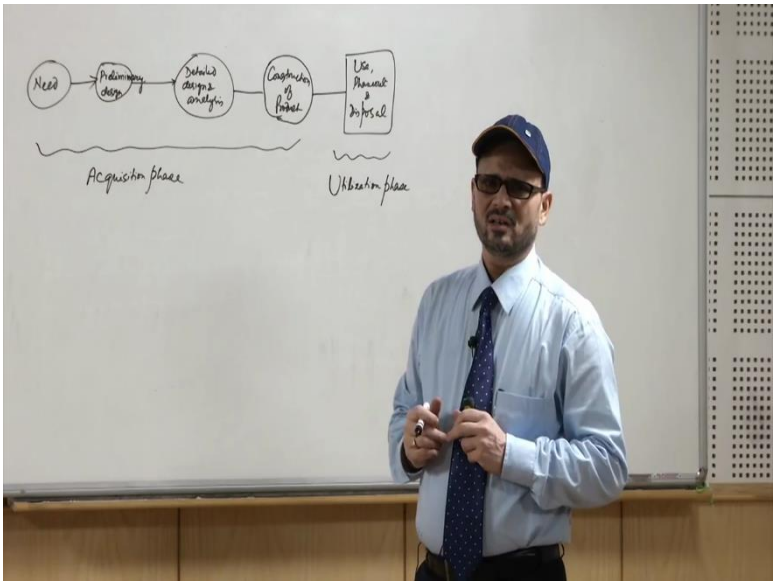

So basically it is a cycle, in cyclic way it goes on, so that is known as the life cycle, product life-cycle. So we can have some idea about this. Once we have the need which is felt by the customer, then you have a preliminary design further you make one detailed design and analysis then after that you go and construct the product, so construction of product. Now, product goes into the market for its use, phase out disposal.

Now you have to be aware about the cycle. When you feel that what will be basically the life of this product, when you need to see that this product now either needs a revision or it needs to be disposed, the company should see that this product should go away from the market. Means there is a life of certain product that is known as the product life-cycle approach. So in that case this phase is known as acquisition phase and this phase is known as utilisation phase.

So during this process, the product acquisition has taken place, product has come into the market, once it has gone into the market, it will be used, depending upon its market service, the feedback by the customers. Further a life is seen, such like you see, we have pen, we used to have the pen for years, now do not have want to have the pen for years. We take it and leave it in two months.

The thing is that it is based on the emotional need, people want a pen with some different design every time. So we have to see that what should be the changes, whether we should go more for its stubbornness or should go for its aesthetic appearance that basically defines what

should be the time of phase out and disposal. So if this aspect is kept in mind by the engineers, then that mentioned will be successful.

So we have understood about the concept of economy, the concept of the different stages of the engineering process, finally, how to see the engineers, the product life-cycle, all this things in our lecture. Thank you.