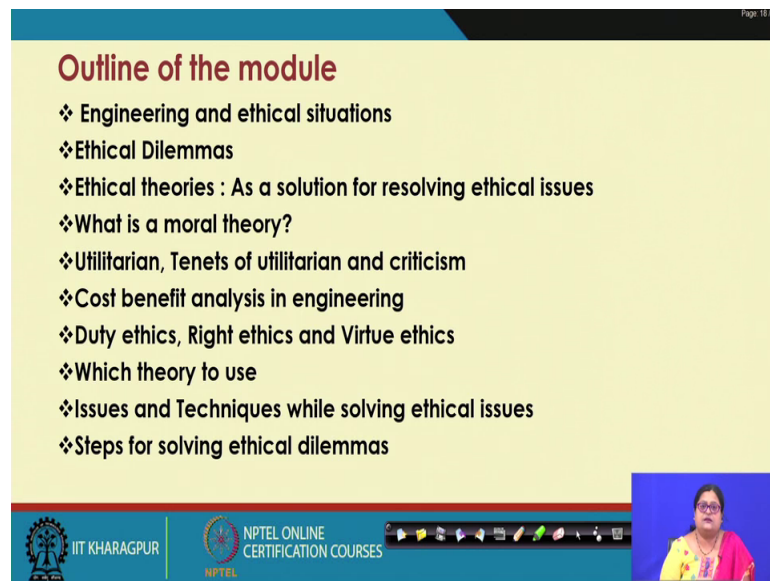


**Ethics in Engineering Practice**  
**Prof. Susmita Mukhopadhyay**  
**Vinod Gupta School of Management**  
**Indian Institute of Technology, Kharagpur**

**Lecture - 10**  
**Ethics as design doing justices to**  
**moral problems**

Welcome back, today we will discuss the Ethics as a design like how do we do justice to moral problems. So, in this discussion we will try to look into the; in this discussion we will try to look into the ethical issues, which are sometimes there in engineering in design also and we try to use the theories of ethics that you have already learned in how to solve this design problems. Also we will use some of the design decision making techniques that we have, to solve problems which are of ethical dilemma nature. So, it will be both ways let us see how we proceed about it.

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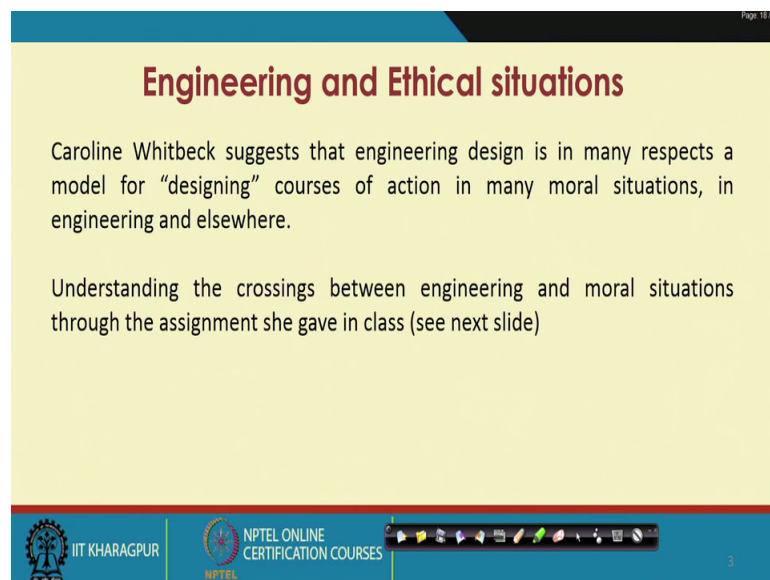
- Outline of the module**
- ❖ Engineering and ethical situations
- ❖ Ethical Dilemmas
- ❖ Ethical theories : As a solution for resolving ethical issues
- ❖ What is a moral theory?
- ❖ Utilitarian, Tenets of utilitarian and criticism
- ❖ Cost benefit analysis in engineering
- ❖ Duty ethics, Right ethics and Virtue ethics
- ❖ Which theory to use
- ❖ Issues and Techniques while solving ethical issues
- ❖ Steps for solving ethical dilemmas

The slide footer includes the IIT Kharagpur logo, NPTEL Online Certification Courses logo, and a small video inset of the professor.

So, the outline of the module will be engineering and ethical situations, ethical dilemmas, ethical theories as a solution for resolving ethical issues, we learn about what is a moral theory, and we learn about utilitarianism the tenets of utilitarianism and the criticism of it, we will learn about cost benefit analysis and how we apply at those things in engineering.

So, like problems we will learn about duty ethics right ethics and virtue ethics and apply them to problems and then we will try to come to a decision to which theory to use for the particular problem, which is there at hand and we will look into the issues and techniques while solving ethical issues and steps for solving ethical dilemmas and finally we will look into the code of ethics as a solution. So, this particular discussion of this lecture today will be mainly based on application first bit of recapitulation of the theory, because some of some parts of the theories we have already done and more about application of these theories to ethical problem solving and design issues and other engineering problems.

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## Engineering and Ethical situations

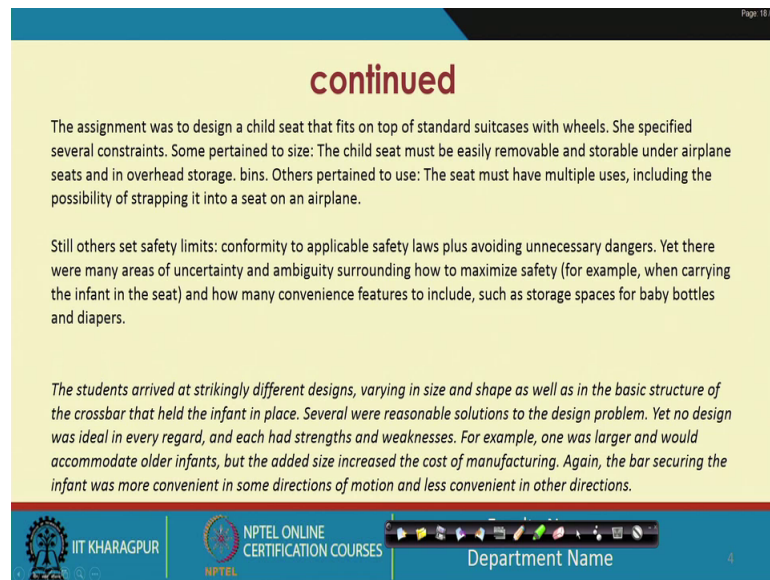
Caroline Whitbeck suggests that engineering design is in many respects a model for “designing” courses of action in many moral situations, in engineering and elsewhere.

Understanding the crossings between engineering and moral situations through the assignment she gave in class (see next slide)

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So, we will start with the like issues of designing and we will start with the suggestion given by Caroline whitbeck, it suggests that engineering design is in many respects a model for designing courses of action many moral situations in engineering and elsewhere. So, there is a crossing between engineering and moral situations and we will specifically in terms of while you are talking of designing and we will start with a small discussion that has been used by heard in the class.

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The assignment was to design a child seat that fits on top of standard suitcases with wheels. She specified several constraints. Some pertained to size: The child seat must be easily removable and storable under airplane seats and in overhead storage bins. Others pertained to use: The seat must have multiple uses, including the possibility of strapping it into a seat on an airplane.

Still others set safety limits: conformity to applicable safety laws plus avoiding unnecessary dangers. Yet there were many areas of uncertainty and ambiguity surrounding how to maximize safety (for example, when carrying the infant in the seat) and how many convenience features to include, such as storage spaces for baby bottles and diapers.

*The students arrived at strikingly different designs, varying in size and shape as well as in the basic structure of the crossbar that held the infant in place. Several were reasonable solutions to the design problem. Yet no design was ideal in every regard, and each had strengths and weaknesses. For example, one was larger and would accommodate older infants, but the added size increased the cost of manufacturing. Again, the bar securing the infant was more convenient in some directions of motion and less convenient in other directions.*

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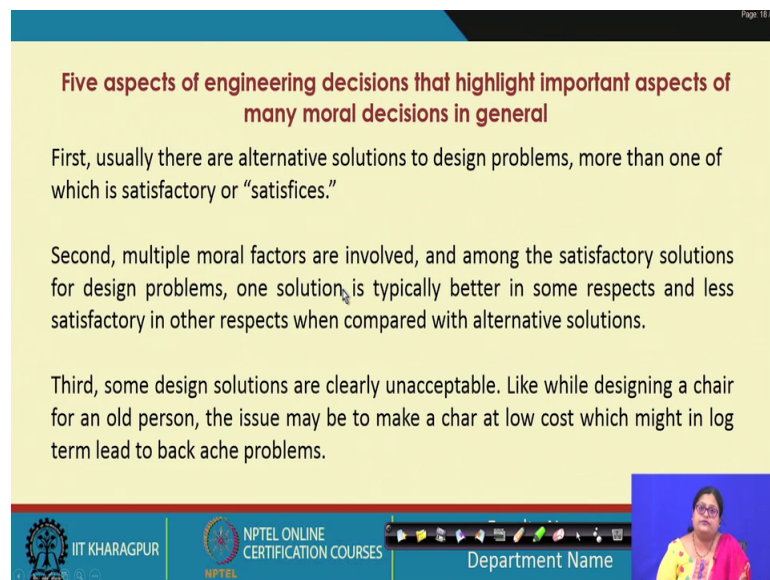
So, it was an assignment which was to design child seat that fits on top of a standard suitcase with wheels. She specified several constraints in it some were pertaining to size like the child seat must be easily removable and storable under an airplane seats and in overhead storage means others were pertaining to the use of it; whereas, like the seat must be view of multiple users including the possibility of strapping it in a seat on an airplane.

Still other constraints were about the safety limits like conformity to applicable safety laws plus avoiding uncertainty dangers, so if there were many areas of uncertainty and ambiguity surrounding how to maximize safety. For example like when carrying the infant on the seat and how many convenience features to include such as storage spaces or baby bottle set diapers.

So, here what we find in the problem given there are a number of constraints given, as per how to design their child seat in terms of the use in terms of the safety features that needs to be maintained in terms of like the size and the why designing the designers have to keep all these constraints into mine. What it arrived like the students arrived at strikingly different designs varying in shape and size as well as in the basic structure of the cross bar that held a infant in place. Several reasonable solutions to the design problem yet no design was ideal in every regard and each had strengths and weaknesses.

For example one was larger and would accommodate older infants but the added size increase the cost of manufacturing, again the bar securing the infant was more convenient in some directions of motion and less convenient in other directions of motion. So, if we consider these design situations.

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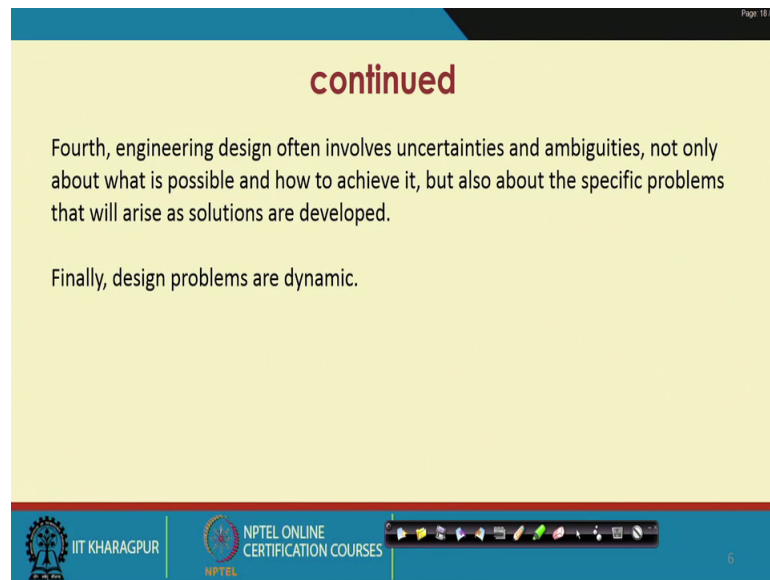


The slide is titled "Five aspects of engineering decisions that highlight important aspects of many moral decisions in general". It contains three paragraphs of text. The first paragraph states: "First, usually there are alternative solutions to design problems, more than one of which is satisfactory or 'satisfices.'" The second paragraph states: "Second, multiple moral factors are involved, and among the satisfactory solutions for design problems, one solution is typically better in some respects and less satisfactory in other respects when compared with alternative solutions." The third paragraph states: "Third, some design solutions are clearly unacceptable. Like while designing a chair for an old person, the issue may be to make a chair at low cost which might in long term lead to back ache problems." The slide footer includes the IIT KHARAGPUR logo, NPTEL ONLINE CERTIFICATION COURSES logo, a navigation bar with icons, and a video feed of a woman in a pink and yellow sari.

So, what we understand like there are always alternative solutions to design problems and more than one which is satisfactory or satisfies and we cannot like be satisfying or sometimes it happens all the constraints given to equal degree. So, there could be differences in that degrees also.

Second with multiple moral factors are involved and among the satisfactory solutions for design problems, one solution is typically better than the other in one or some respects and less satisfactory in other respects when compared with alternative solutions and in some cases some designs are there which are clearly unacceptable like while designing a chair for an old person. So, it may be the issue may be to design a chair, which may be at a low cost, but which in terms may lead to like backache problems. So, whether we will be going for it or not.

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continued

Fourth, engineering design often involves uncertainties and ambiguities, not only about what is possible and how to achieve it, but also about the specific problems that will arise as solutions are developed.

Finally, design problems are dynamic.

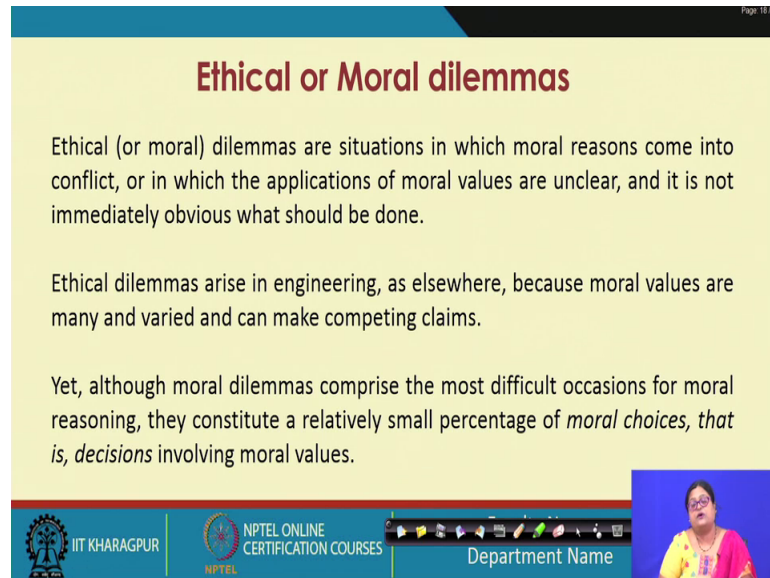
The slide features a blue header with the word "continued" in red. The main content is on a light yellow background. At the bottom, there is a blue footer containing the IIT Kharagpur logo, the text "IIT KHARAGPUR", the NPTEL logo, and "NPTEL ONLINE CERTIFICATION COURSES". A navigation bar with various icons is also present in the footer, along with the number "6".

So, should we take into this thing like whether low cost is more desirable or the person not having a backache is more desirable. So, here the degree of comfort is something which cannot be compromised while we are designing a chair for a old person. So, what we understand from the design problems is, there are like first there could be alternative solutions, there is no one single solution to a design given. The alternatives that we have one alternative is better than the other doing some respects it is not like with every respect one design is better than the other. Third there are some designs some which are clearly unacceptable because, it like we cannot compromise with some basic requirements for the user that we are doing the design.

Forth so in engineering design it often involves uncertainties and ambiguities, not only about what is possible, but how to do it how to achieve it; but also about the specific problems that will arise as solutions are developed. So, this point is very important with you this point is important as it shows like in engineering designs what happens offered, it is as the solutions as we work on the solutions more and more problems may come up as we are working on the solutions and then we have to design for a and then we have to design for it again or we have to make our choices of decision. Like which one to choose which is a better option to choose where to like maximize the pros and minimize the cons part as a ongoing process.

And it is finally that future design is a design problems are dynamic problems ok. So, it is that it goes on changing and newer problems may arise while we are like finding out solutions to older problems.

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**Ethical or Moral dilemmas**

Ethical (or moral) dilemmas are situations in which moral reasons come into conflict, or in which the applications of moral values are unclear, and it is not immediately obvious what should be done.

Ethical dilemmas arise in engineering, as elsewhere, because moral values are many and varied and can make competing claims.

Yet, although moral dilemmas comprise the most difficult occasions for moral reasoning, they constitute a relatively small percentage of *moral choices*, that is, *decisions* involving moral values.

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So, now we will discuss about like vision we write when you are discussing about moral dilemmas, we have discussed about the nature of designs. Now we will discuss about the ethical or moral dilemmas the ethical or moral dilemmas are situations, where in which moral reasons coming to conflict or in which the application of moral values are unclear and it is not immediately obvious that what should be done.

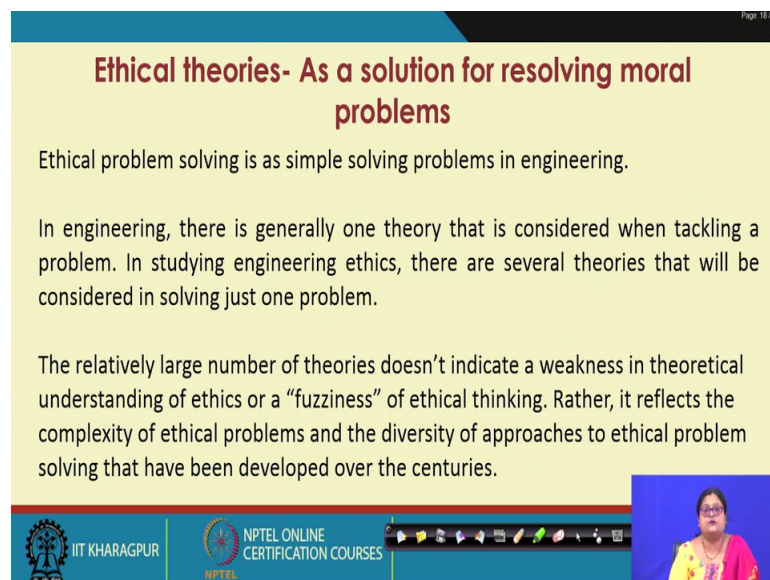
So, there could be 3 types like very fine directly the moral reasoning's are coming into conflict second, we are second type would be where it is application is unclear and like and it is not obvious that what should be done in this case and we are in a part of point to dilemma, because sometimes solutions which appears to be having short term gain benefit main the long run proof like it was not a correct choice to be take it. So, like elsewhere engineering, in engineering designs also ethical dilemmas arise because, moral values are many and varied and may take competing themes.

So, yet although moral dilemmas currents comprise the most difficult occasions for moral reasoning, they constitute a relatively small percentage of moral choices, that is decisions involving the moral values. So, what we find over here the this is a solving moral dilemma is a very difficult in part of the moral reasoning, because if we do not

understand the moral ethical pillars of decision making very clearly we are like what are the ways how to proceed for it, what are the you know criticism of each of the part and how one way of taking one part of decision making is like giving us a better solution over the other part of decision making.

Then solving this dilemma becomes a somewhat which your difficult because, we may not be able to see the all the shades of the moral dilemma that is happening. So, when we are about to take a moral decision, it is the moral dilemma is we called like it is a like most difficult part for the moral reasoning.

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The slide is titled "Ethical theories- As a solution for resolving moral problems" in red text. Below the title, it states: "Ethical problem solving is as simple solving problems in engineering." It then explains: "In engineering, there is generally one theory that is considered when tackling a problem. In studying engineering ethics, there are several theories that will be considered in solving just one problem." Finally, it notes: "The relatively large number of theories doesn't indicate a weakness in theoretical understanding of ethics or a 'fuzziness' of ethical thinking. Rather, it reflects the complexity of ethical problems and the diversity of approaches to ethical problem solving that have been developed over the centuries." The slide footer includes the IIT Kharagpur logo, NPTEL Online Certification Courses logo, and a small video inset of a woman in a pink and yellow sari.

So, when we were talking of these dilemmas, then the ethical theories that we have as a backup support or a solution for resolving of this moral problems but before we begin we need to understand like each of the theories have their benefits pros and each of them have their limitations also.

So, we will discuss here both the applica while we are talking for application like the till where it is helping us and what is the limitation and then given a particular case study will try to see given a problem, how each of the approach is trying to help us to solve the moral dilemma which is appearing over there. So, ethical problem solving is like again, so which is a problem solving which is done in engineering. So, here what in this discussion what we will try to do, we will try to draw a parallel will try to draw an

analogy between ethical problem solving and engineering problem solving. So, that it helps us in a better understand.

So, in engineering what happens there is generally one theory that is considered when tackling a problem. So, why you are studying engineering ethics what is happening there are several theories which will be considered while solving one particular problem. So, the relatively large number of theories does not indicate a weakness in theoretical understanding of ethics or fuzziness of ethical thinking, rather it reflects the complexity of the ethical problems and the diversity of the approaches to ethical problem solving that has been developed over centuries.

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### What Is a Moral Theory?

A moral theory defines terms in uniform ways and links ideas and problems together in consistent ways [Harris, Pritchard, and Rabins, 2000 ].

This is exactly how the scientific theories used in other engineering classes function. Scientific theories also organize ideas, define terms, and facilitate problem solving.

There are four ethical theories that will be considered here, each differing according to what is held to be the most important moral concept.

- Utilitarianism      - Duty ethics      - virtue ethics      -Rights ethics

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So, next we try to understand what is a moral theory; a moral theory defines terms in uniform ways and links idea and problems together in consistent ways. Thus it is exactly how the scientific theories are used in other engineering classes, scientific theories also organize ideas define terms and facilitate problem solving. So, what we understand there are 4 different ethical theories, utilitarianism, duty ethics, virtue ethics and rights ethics and they are focused on what is held to be the most important moral concept is different that is why we have these 4 different groups of theories.



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## Utilitarianism

**Utilitarianism** – Utilitarianism holds that those actions are good that serve to maximize human well-being. emphasis in utilitarianism is not on maximizing the well-being of the individual, but rather on maximizing the well-being of society as a whole, and as such it is somewhat of a collectivist approach.

An example of this theory that has been played out in this country many times over the past century is the building of dams.

Dams often lead to great benefit t to society by providing stable supplies of drinking water, flood control, and recreational opportunities. However, these benefits often come at the expense of people who live in areas that will be flooded by the dam and are required to find new homes, or lose the use of their land. Utilitarianism tries to balance the needs of society with the needs of the individual.

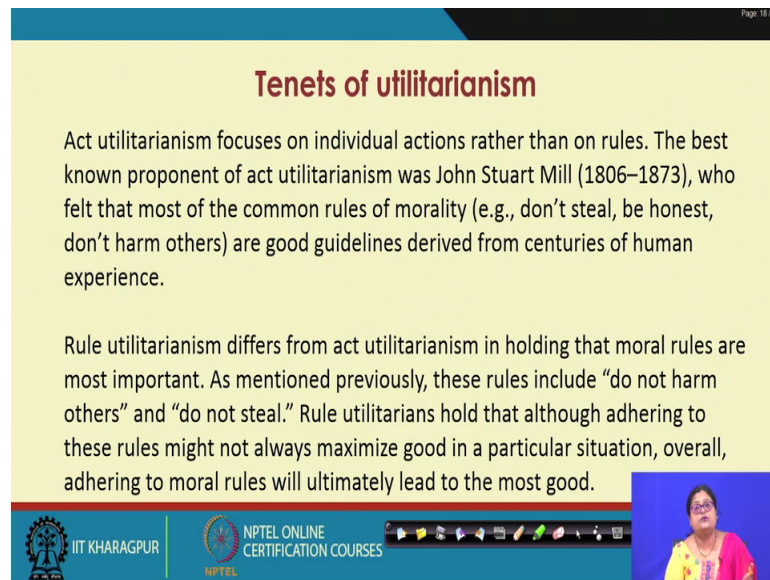
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The first we will start with the utilitarianism, utilitarianism holds that those actions are good that serve to maximize human wellbeing emphasized on utilitarianism is not on maximizing the well being of the individual, but rather on maximizing the well being of the society as a whole and it has got somewhat of a collectivist approach.

So, this theory has been used time and again while like in situations like building dams. So, what we find like dams often lead to great benefit to society by providing stable supplies of drinking water, flood control and recreational opportunities. But these benefits often come at the expense of people who live in areas that will be flooded by the dam and it required to find new homes or lose the use of the land, utilitarianism tries to balance the needs of the society with the needs of the individual.

So, utilitarianism we try to focus on the fact like the cost which these people are paying people who live in the areas of the dam which will get flooded or like they are they required to find their new homes or like they will be losing their land this is the cost that they are incurring. So, the benefits that we get is the is more than terms of the cost that is these people are paying and this benefit which is for the larger society it is the collectivist concept.

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**Tenets of utilitarianism**

Act utilitarianism focuses on individual actions rather than on rules. The best known proponent of act utilitarianism was John Stuart Mill (1806–1873), who felt that most of the common rules of morality (e.g., don't steal, be honest, don't harm others) are good guidelines derived from centuries of human experience.

Rule utilitarianism differs from act utilitarianism in holding that moral rules are most important. As mentioned previously, these rules include "do not harm others" and "do not steal." Rule utilitarians hold that although adhering to these rules might not always maximize good in a particular situation, overall, adhering to moral rules will ultimately lead to the most good.

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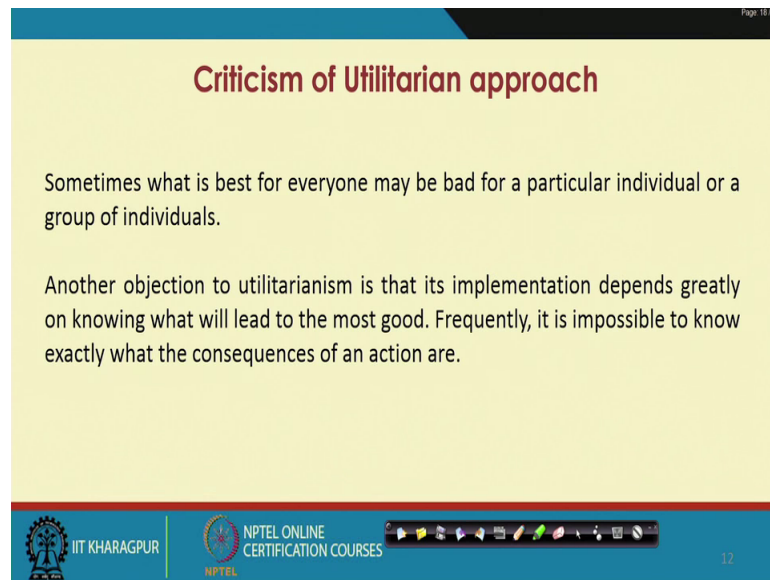
So, utilitarianism again have to like mains of looking at the problem one is called the act utilitarianism and the other is the rule utilitarianism. So, act utilitarianism focuses on individual actions rather than on rules, the best known proponent of act utilitarianism was John Stuart mill, who felt that the most common of the rules of morality like do not steal be honest, do not harm others are good guidelines derived from centuries of human experience. So, if you see these are all focusing on actions do not steal, be honest, do not harm others these are guidelines focused towards some actions of people which if they follow is going to be beneficial to the society at large.

Rule utilitarianism differs them act utilitarianism in holding that moral rules are more important most important, as mentioned previously these rules include do not harm others, do not steal. Rule utilitarianism holds that although adhering to these rules might not always maximize good in a particular situation, overall adhering to moral rules we ultimately lead to the most good. So, actually these are 2 linked with each other rule utilitarianism is the principle like which tells like it is like bad to steal it is bad to harm others and then do not harm others, but action is focus towards the action.

So, both rule utilitarianism and act utilitarianism is linked with each other. Rule tells like do not harm others and we if you are doing, so then it is an office do not steal this is the rule and if you are not doing, so then you are like violating the rule that is given. So, whether these rules are again bringing leading to the well being to the society at large at

all situations that cannot be claimed in one go, but if everybody follows that rules it is assume the everybody is following then ultimately it is leading to the good of most of the people.

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The slide is titled "Criticism of Utilitarian approach" in a bold, dark red font. It contains two paragraphs of text. The first paragraph states: "Sometimes what is best for everyone may be bad for a particular individual or a group of individuals." The second paragraph states: "Another objection to utilitarianism is that its implementation depends greatly on knowing what will lead to the most good. Frequently, it is impossible to know exactly what the consequences of an action are." The slide has a yellow background and a blue header and footer. The footer includes the IIT Kharagpur logo, the NPTEL logo, and the text "NPTEL ONLINE CERTIFICATION COURSES". The slide number "12" is visible in the bottom right corner.

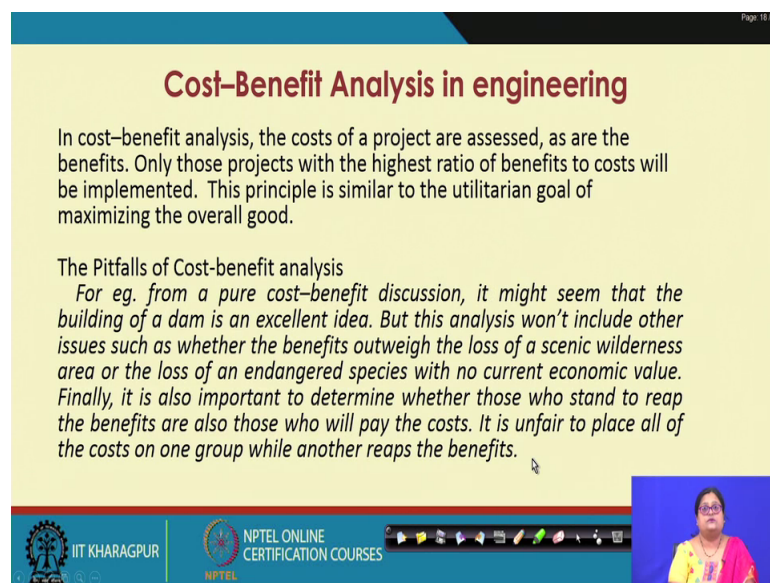
However what is most important we should mention over here like, even if utilitarianism is talking of the well being of larger people well being of the society at large. So, there is certain and it focuses more on collectivist approach and less on the individual aspect of the person individual, there is certain criticism of utilitarian approach. One of the criticism is that what is best for everyone may be bad for a particular individual or a group of individuals, so here like whenever we are talking on the example of the dam, we are thinking like it will bring in like recreational activities it will be helping in irrigation and other things. So, we are here thinking of the benefit of a set of people, but here we are not thinking of the sufferings of another set of people.

So, like who are whose homes are getting flooded or who have to find their new homes who have to who were losing their land. So, it may or may not be the case, the group of people who will get benefitted by the dam is more than the group of people who are suffering for the project and it sometimes may also be the case like what we are thinking like will be beneficial to a larger group of people, sometimes could be imagine the benefits also because we may or may not it may or may not be possible for us to take a rational count of all people who will get benefitted by the project.

So, in that maybe our assumptions also I think type of answer we think that it will help, but we may not have count of the total people who will truly get benefits by it and with comparison to the people who are suffering for it. So, this balance may not always be a very objective balance that we have, that is why it is stone like sometimes what is best for everyone may be bad for a particular individual or a group of individuals. Another objection to utilitarianism is that the implementation depends greatly on knowing what will need to most of the good. Generally it is impossible to know exactly what are the consequences of an action.

As we have discussed while we were discussing the design, if you remember like way we are providing a solution to a design problem more and more problem unfolds as we are finding out the solution and these problems have with newer problems with newer challenges. So, even if utilitarianism claims that it is implementation depends greatly on knowing what will lead to most of the good, ultimately it may be impossible to know exactly what are the consequences of these actions.

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### Cost-Benefit Analysis in engineering

In cost-benefit analysis, the costs of a project are assessed, as are the benefits. Only those projects with the highest ratio of benefits to costs will be implemented. This principle is similar to the utilitarian goal of maximizing the overall good.

The Pitfalls of Cost-benefit analysis  
*For eg. from a pure cost-benefit discussion, it might seem that the building of a dam is an excellent idea. But this analysis won't include other issues such as whether the benefits outweigh the loss of a scenic wilderness area or the loss of an endangered species with no current economic value. Finally, it is also important to determine whether those who stand to reap the benefits are also those who will pay the costs. It is unfair to place all of the costs on one group while another reaps the benefits.*

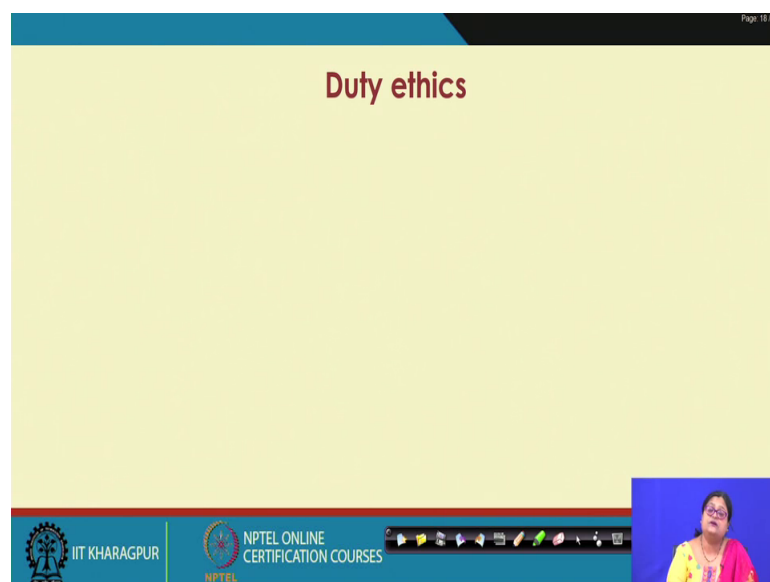
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Moving forward what we have is a cost benefit analysis in engineering so and cost benefit analysis which is the developed version over utilitarianism what we have is the cost of a projector assessed and so are it is benefits, only those projects with the highest ratio of benefit to cost will be implemented. The principle is similar to that of the utilitarian goals of maximizing the overall good.

However there are certain pitfalls of the cost benefit analysis, like from a pure cost benefit discussion it might seem that the building of a dam is an excellent idea. But the analysis would not include other issue whether the benefits will outweigh the loss of the scenic wilderness of the area or the loss of an endangered species with no current economic value because everything cannot be measured in terms of money. These are like something which is priceless and we have to understand the value of these things work of these things. Finally, it is also important to determine whether those who stand to reap the benefits are also those who will pay the costs, in many cases it is not. So, somebody will reap the benefits and other people pay the costs for it or suffer for it. So, it is very very unfair to place all of the costs on one group, but another group reaps the benefits of the project.

So, what we have to understand in a cost benefit analysis like for everything benefits or every losses there, it is very difficult to put the monetary value to each of this and we have to understand the worth of it and also we cannot ensure from these type of projects like those will reap the benefits are in the people who are paying the cost for it also. Generally, costs are borne by other people and benefits are taking for some other person and that is why these becomes unfair in nature.

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Next, in the next lecture we will move towards the duty ethics, right ethics, virtue ethics and hands for, so in utilitarianism ethics and cost benefit ethics analysis what we have

focused is on the outcome of the project. Whether it is on benefit to the society at large and whether that is a it is focused mainly on the society, the individuals well being is not the focus for the utilitarianism aspect which is which talks of a greater good.

But some it is it has criticism in this regard because sometimes the what we think to be a good for a larger group may be some bad for an individual or a another group of individual whom we do not may include see or we tend to ignore and in cost benefit analysis also your focus with the outcome and try to see what is the cost and benefit ratio benefits and cost with respect to the project and we choose the project which is more benefit.

But again this is with the point of caution to understand like for we cannot give a price monetary value for every type of things that are happening, the cost which is some something which may not have a present economic value, but it is may maybe having a very high a scattig value. So, it may be very important from the point of environmental synergy. So, these we have to like appreciate this we have to understand and we also have to see who is getting the benefit and who is paying the cost for it and these are all outcome based approach these are called consequential theories of ethics.

In our next discussions we will focus on the non consequential theories of ethics which are based on no not on the moving the outcome, but in the briefs the decisions and mean the process of decision making and how it solves the moral dilemma and after that we will take a case and we will try to see the application of all theories together. And try to find out if there is a moral dilemma, how the different what are the different lenses taken by each of the moral theories to answer that moral dilemma and rather weak data suitable answer to that dilemma or not.

Thank you.