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

Lecture - 01
Introduction to Ethical Reasoning and Engineering Ethics

Welcome to the session on ethics in engineering practice. Today we will discuss about the introduction to ethical reasoning and engineering ethics.

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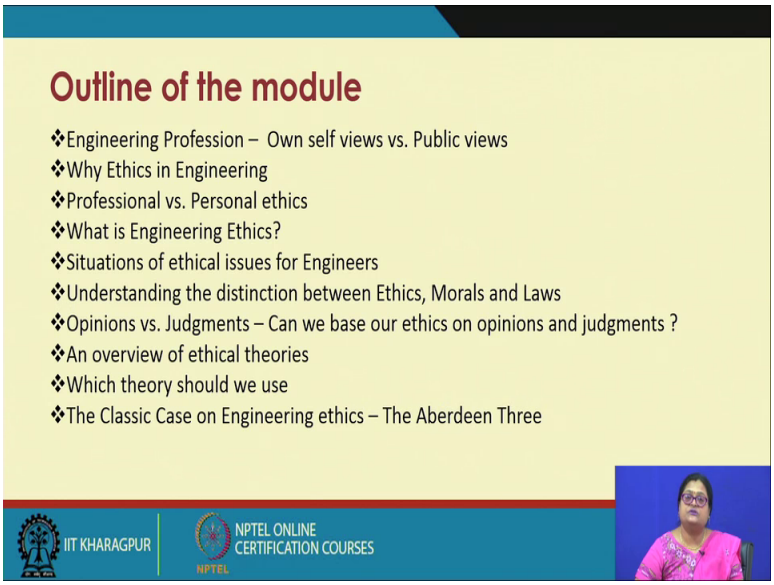

The outline of the module will be we will discuss engineering as a profession own self views versus public views, why ethics in engineering, professional versus personal ethics, what is engineering ethics? Situations of ethical issues for engineers, understanding the distinction between ethics morals and laws. Opinions versus judgments can we base our ethics and opinions and judgments, and overview of ethical theories. Which theory should we use? And the classic case on engineering ethics, the Aberdeen 3. So, this will be the whole coverage of the model which we will discuss through the lectures that are going to follow.

So, first we are going to discuss about the engineering as a profession.

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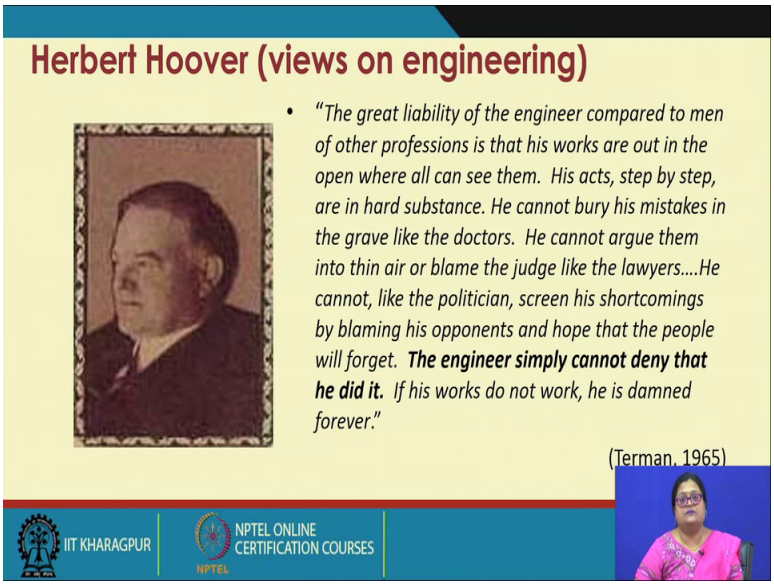

What we find like the Herbert Hoover way back in he gave importance of the engineering profession, where he told the great liability of the engineers compared to men of other professions is that his works are out in the open where all can see them. His acts step by step are in a hard substance. He cannot bury his mistakes in the grave like the doctors, he cannot argue into thin air or blame the judge like the lawyers. He cannot like the politicians, screen his shortcomings by blaming his opponents and hope that the people will forget. The engineer simply cannot deny that he did it if his words do not work he is damned forever.

So, to look into this important quotation without undermining the other professions and their importance also, what we can see because engineering profession is something where the outcomes are important for the it is a tangible product where everybody can see and use, and then have the it affects the life of people. Then it is very important to tone up the responsibility of the outcomes faced by the users of the product, and we cannot deny like we have not done it.

So, that is the important quote from there which talks of that the as you see from this quote like the engineer simply cannot say deny that he did it. With this we will move forward to the discussion of engineering as a profession.

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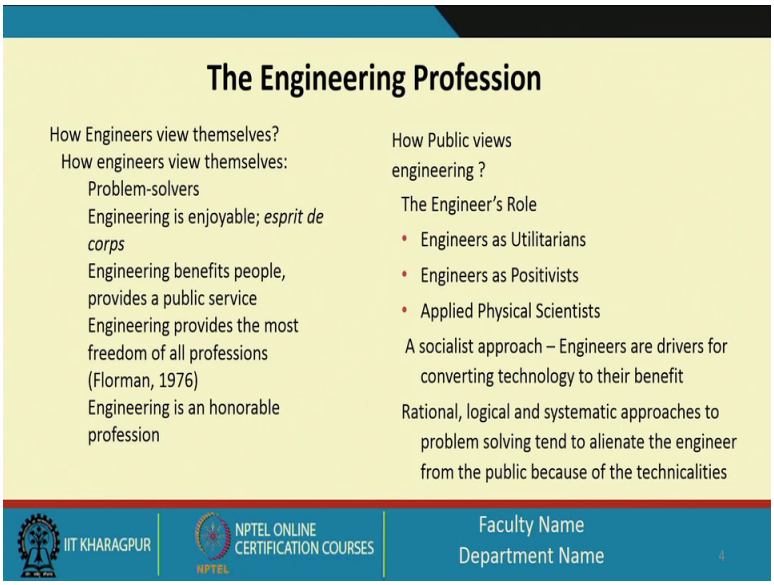

So, there could be 2 viewpoints. One is how engineers view themselves, and the others is how the public at large view this them. So, now we will see how engineers view themselves or problems they view themselves as problem solvers. Engineering is enjoyable, engineering benefits people provides a public service. Engineering provides the most freedom of all professions, and engineering is an honorable profession. How the public views engineering? We can see the engineers role is at utilitarians where there is a cost benefit analysis of whatever they are doing, engineers as positivist they have to have a positive orientation towards life, towards the safety and health or issues of the public at large.

They cannot say like solution is not possible, they need to have they should believe like every problem it must be having a solution, because they are taken to be as problem solvers.

Third what we see over here like they are taken to be like applied physical scientists, because they need to work on the design and find out like how it is working. They have a socialist approach engineers and drivers for converting technology to their benefit. And they have to take a rational, logical and systematic approaches to problem solving; which tend to alienate engineer from the public because of the technicalities.

So, sometimes what happens the general public at large may not understand the in depth technical issues involved in it. But it is a great responsibility and challenge for the

engineers to translate that technology into something which is usable and which is in the benefit for the public at large. So, these are 2 viewpoints which the engineers have about themselves and what the public at large have about the engineers.

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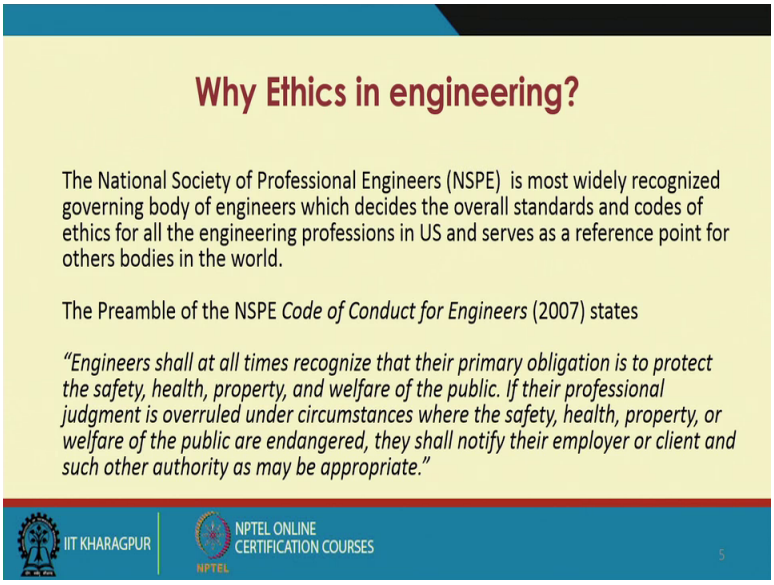

Next we are going to discuss like why we discussed about ethics in engineering. So, what we see over here the national society of professional engineers is most widely recognized governing body of engineers, which decides the overall standards and code of ethics for all engineering professions in US, and serves as a reference point for other bodies in the world.

So, we will discuss the n NSPE code of conduct for engineers which states. Engineers shall at all times recognize that the primary obligation is to protect the safety, health property and welfare of the public; safety, health, property and welfare of the public. If the professional judgment is overruled under circumstances, where the safety health and property or welfare of the public are endangered, they shall notify their employer or client and such other authority as may be appropriate.

So, this is an important; like, code of conduct where they have always because it is a very noble profession, and it is an important profession they have to go by their professional judgment, and where do you see like if they feel like their professional judgment about the safety health and welfare and prosperity of the and public to take care of them these issues are overruled. Then they must immediately go for reporting it

to their like appropriate bodies who can hear to these concerns and take remedial measures for it, which is giving a hint towards the right for engineers for whistle blowing if necessary, which we will discuss in the subsequent lectures in the module upcoming modules.

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Next, what we are going to discuss? Like, engineering it is a blend of technology social science and business. So, engineering is done by the people and it is done for the people. Engineers decisions have a major impact on all the 3 areas in the confluence.

Like, how they use the technology what up gradation do they make in the technology, and how it is affecting the society at large, is it taking into concern is it delivering certain products and services? Where there is a demand from the society which to fulfill certain of the needs of the society, and how they are like, how it is affecting the business of the organization also like in which maybe they are employed.

So, engineers' decisions have an impact in all 3 areas in the confluence. The public nature of the engineers work ensure that ethics will always play a role, because there are different stakeholders involved and when the society at large is involved, then what happens this ethical issues in the decision making processes are very important, because the ultimate beneficiaries of their outputs are the general public at large.

Thus it becomes important for engineers to make sure that the interest of the groups to be affected prevails over their own interest of profit. This is very important like when we discuss in the next chapters next modules we will be discussing about conflicts of interest that may happen in the engineering as a profession, and how to take remedial measures of it.

So, we have to keep into concern, you have to give primary responsibility towards the safety, health, property and welfare of the public and it is a part of the responsibility of the engineers to protect these things. And if these comes in and this is the responsibility to protect these 4 pillars for the public is over and above thinking of owns personal profit. And if in any case some conflict of interest happens then how to solve it also we will discuss in the upcoming modules.

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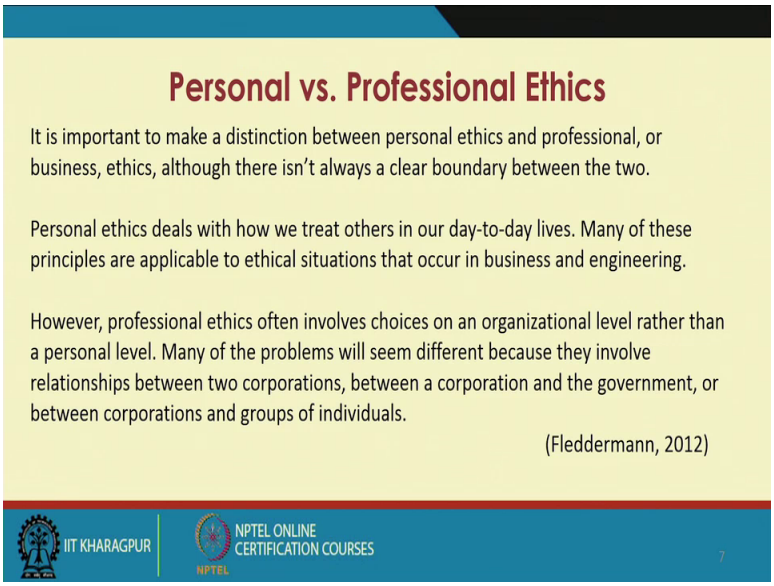

So, here we are going to discuss again what is personal and professional ethics because engineering is a profession, and we are discussing about ethical ethics with respect to it and there is personal ethics also.

So, it is important to distinguish between a personal ethics and professional ethics or business ethics, although there isn't always a clear boundary between the 2 because at the end of the day it is the person who is making the decision. And it is the virtue the value of the person his or her worldview judgment which makes him or her to take a decision about the any business problem also.

So, personal ethics deals with how we treat others in our day to day lives, many of these principles are applicable to ethical situations that occur in business and engineering also. However, professional ethics often involves choices of an organizational level, rather than at a personal level many of the problems will seem different because they involve a relationship between 2 corporations, between a corporation and the government and between corporation and groups of individuals.

So, it is a blend of like personal like there are so many stakeholders involved, and because this professional ethics this interest of the corporation then the interest of the public at large. Interest of the government and the interest of the corporation, the interest of the corporation and the groups of individuals and may be one's own self-interest, all these are like intertwined with each other maybe sometimes there will be conflicts of interest also. And it is deals personal ethics own value system virtue which will help us to find an answer towards how to solve this professional ethics issues dilemmas and to arrive at the solution which is a balanced solution.

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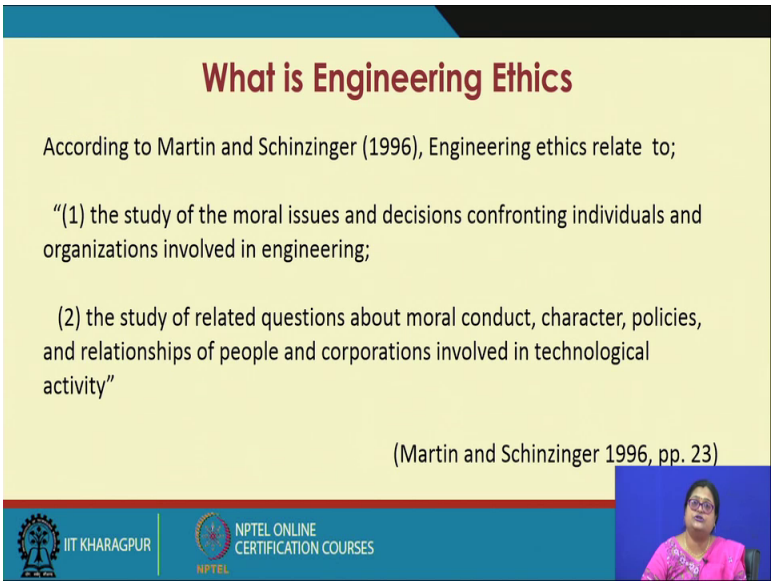

So, what is engineering ethics? According to Martin At El, engineering ethics relates to the study of the moral issues and decisions confronting individuals and organizations involved in engineering. The study of related questions about moral conduct, character policies and relationships of people and corporations involved in technological activity.

So, it is the there are 2 points. The study of moral issues and decisions confronting individuals and organizations. So, here may be you it is a blend of again a personal ethics and professional ethics, the study of related questions about moral conduct, character policies. So, how to behave in a particular situation if there are any guiding principles given by the organization or the professional body, which will guide the engineers to behave in a certain way in a given situation, all these things are important when we are studying like what is engineering ethics. It is a study of related questions about the moral conduct, characters policies and relationships of people and corporations involved in technological activity.

So, again the professional ethics were maybe cooperation and government to corporations at the public at large, cooperation in the groups of individuals cooperation and the individual, always there is an intersection of 2 parties and there may be mutual interests are involved.

And how to respond to this may be sometimes conflicting interest of each others, and dilemma involved out of this to which there may be no yes and no type of answer there is a certain gray area which is the moving backward and forward you need to decide should I go this way if I go this way maybe I am not answering the demands of the party b. If I go take a decision which is concerning party b, maybe I am not looking into the interest of the party a, then how do I decide. So, based on and these are to be in the framework of the technological activities. So, that concerns about engineering ethics.

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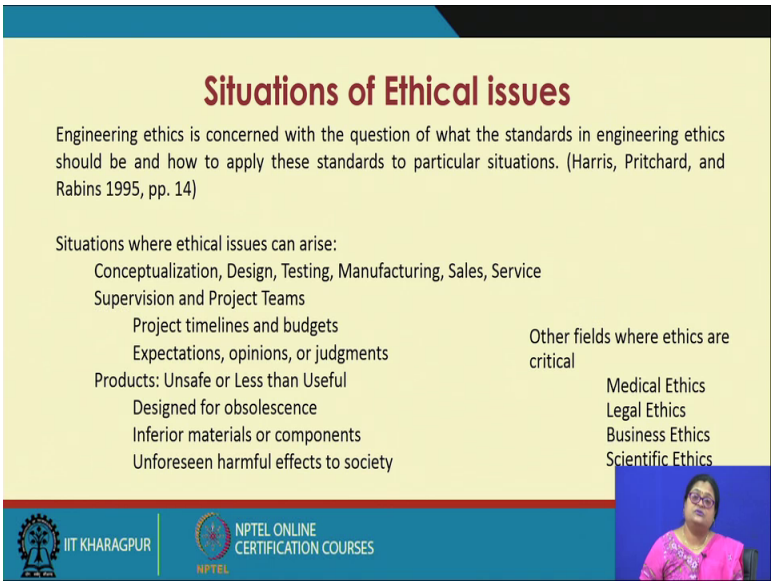

So, we were discussing mainly about the situations of ethical issues. So, here we will just focus on some of those situations. So, engineering ethics is concerned with the question of what the standards in engineering ethics should be, and how to apply these standards to particular situations.

Now, what could be the situations in where this dilemma may arise are; conceptualization, design, testing, manufacturing, cells, surveys. Then supervision and project teams, project timelines and budgets, expectations, opinions and judgments of the team members in terms of products, whether it is unsafe for less than useful. Designed for whether it is designed for obsolescence, inferior materials or components, unforeseen harmful effects to the society or not are some of the areas situations where ethical issues may arise because there will be conflict of interest of various parties involved in this whole process.

Other fields which are also ethics are important and critical are of course, medical ethics, legal ethics, business ethics scientific ethics. And along with that what we see in for engineering ethics at every step from the procurement of the material to the final delivery and after cells may be at every step ethics becomes very, very important. Because ultimate beneficiary is the society at large and it is the safety and welfare health conditions of the and the property of the public at large which are the major to protect these things at the major responsibilities of the engineers.

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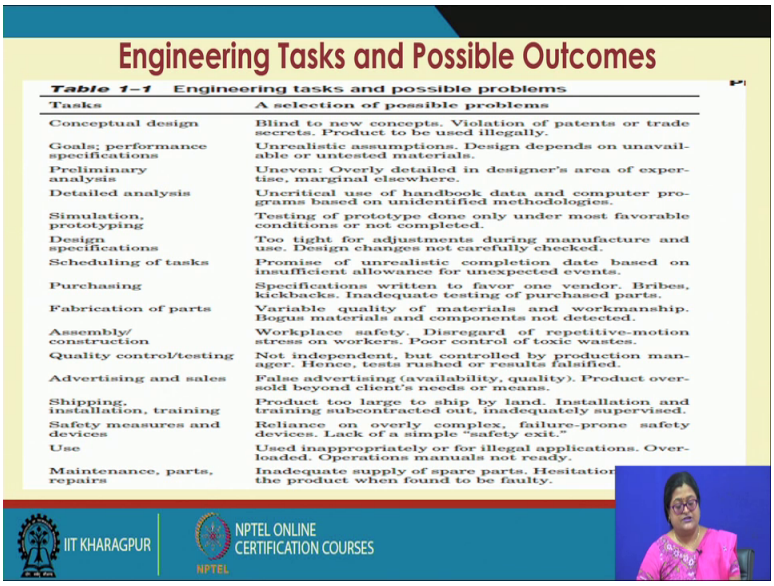

So, like what are the possible engineering tasks and their possible problems are like conceptual design. In that stage if people are blind to new concepts violation of patents or trademarks secrets products to be used is illegal. Goals performance specifications and realistic assumptions design depends on unavailable or untested materials, preliminary analysis stage uneven overly detailed or design in designer's area of expertise marginal elsewhere.

Detailed analysis, uncritical use of handbook data and computer programs, based on unidentified methodologies, simulation prototyping testing of prototype done only under most favorable conditions are not completed. Design specifications, too tight for adjustments during manufacture and use design changes not carefully checked.

Scheduling of tasks promise of unrealistic completion date based on insufficient allowance for unexpected events. Purchasing, specifications written to favor one vendor bribes kickbacks inadequate testing or purchased parts, fabrication of parts, variable quality of materials and workmanship, bogus materials and components not detected.

Assembly constructions, workplace safety, disregard of repetitive motion stress on workers, poor control of toxic wastes, quality control testing not independent, but controlled by productions manager. Hence, tests rushed or results falsified advertising and sells, false advertising, availability quality, product over sold beyond client's needs

or means, shipping installation training product too large to ship by land installations and training subcontracted out in a inadequately supervised.

Safety measures and devices reliance and overly complex failure prone safety devices lack of a simple safety exit use used inappropriately or for illegal applications overloaded operations manuals not ready. Maintenance parts repairs, inadequate supply of spares parts, hesitation to recall the product men found to be faulty.

So, what we find these are the engineering tasks and if you see this is a whole list of task from the start of conceptual design then goals, and then preliminary analysis, detailed analysis, simulations and prototyping design specifications, scheduling of task purchasing fabrication of parts, assembly constructions quality control or testing advertising shipping, safety measures and devices use, maintenance of parts and repairs at each and every stages of the task engineering task involved.

There could be ethical issues and dilemmas coming up, because n number of parties are involved in it and as an engineer based on the professional judgment that the professional conscience the engineer has to take a decision; which is in the best interest for the safety and security of the public at large.

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Because, why this is why we are repeating about it to understand, because engineers ethical decision has a far reaching impact on the products and services in terms of safety

and utility. The company and it is stockholders, the public and the society they benefits to the people environment the earth and beyond the profession how the public views it the law how legislation affects the profession and industry personal position like the job and the internal moral conflict of the person.

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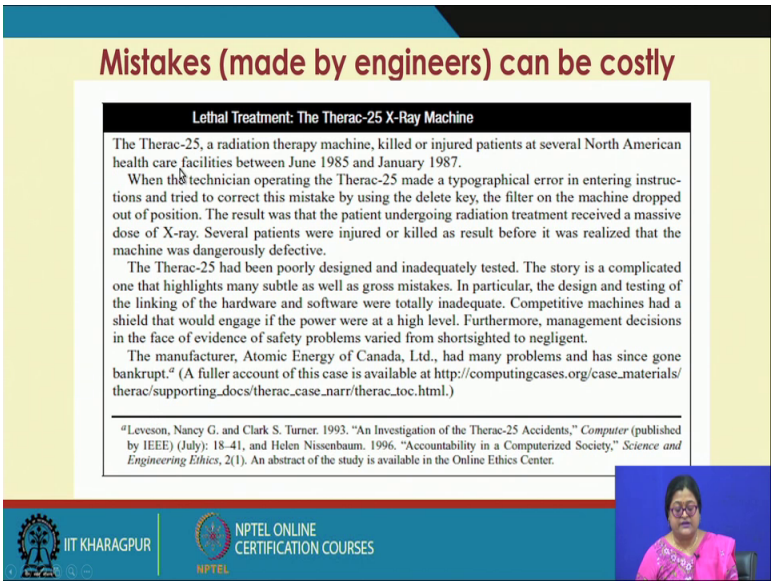

So, and of course, the mistakes made by the engineers can be costly. So, what we will focus over here is a case which talks of the lethal treatment, the Therac 25 X ray machine. The Therac 25 a radiation therapy machine killed or injured patients at several north American health care facilities between June 1985 in January 87.

When the technician operating the Therac 25 made a typographical error in entering instructions and tried to correct this mistake by using the delete key. The filter on the machine dropped out of position. The result was that the patient undergoing radiation treatment received a massive dose of X ray. Several patients were injured or killed as a result, before it was realized that the machine was dangerously defective.

The Therac 25 had been poorly designed and inadequately tested. The story is a complicated one that highlights many subtle as well as gross mistakes in particular the design and testing of the linking of the hardware and software. In particular, the design and testing of the linking of the hardware and the software were totally inadequate.

Competitive machines had a shield that would engage with the power were at high level. Furthermore, management decisions in the face of evidence of safety problems varied from short sighted to negligent. The manufacturer atomic energy of Canada limited had many problems and has since gone bankrupt. So, this is a beautiful case, where we see n number of parties are involved so, first we are talking of the tech and here is a major question is who is responsible if you are going to answer these question. Actually what we see like and who is guilty or who cannot be whole held responsible for these type of injuries to the patient.

So, what we see is the technician who is operating this may have made in a particular error. So, we are not telling like this person is not responsible, but who if you are talking of who is majorly responsible, and if you want to go and track back the major responsibility, what we find is that it was the design of the machine itself. Whether it has been tested properly, whether it has been designed properly, and whether the long term consequences of the proper use or misuse of the this machine was thought of; and proactive measures were taken to arrest for these type of accidents and harms were taken or not becomes a point of focus in this type of case.

Whether it was a short sightedness of the company to not to think of the possible harms that could be there from the maybe misuse or accidental use of this product, and how the design itself at the design stage can arrest for these type of happenings so that accidents can be prevented at large. Whether these were thought of or it was a very short sighted design, negligence on the part of the manufacturer, these needs to be taken care of when we are discussing these type of cases.

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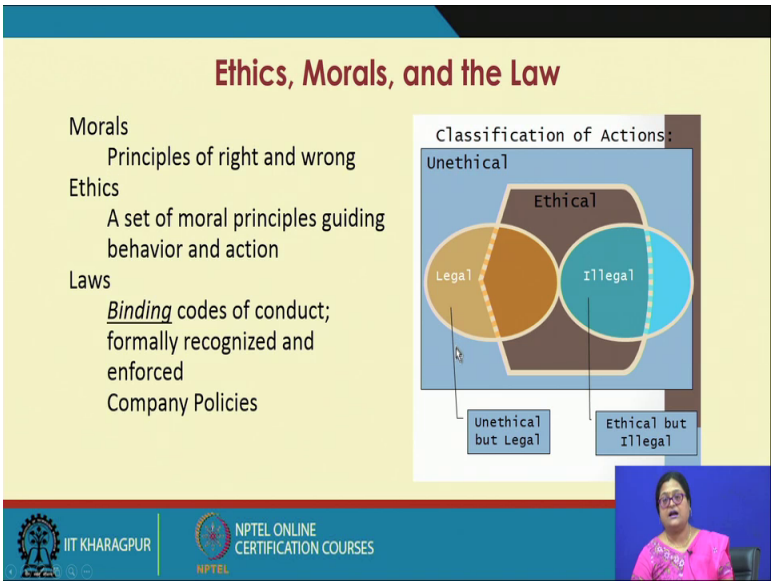

So, we have been discussing these 3 terms, ethics, morals and law because these comes hand in hand. And here we need to focus on the differences between these 3 terms, or the internet intersection of these 3 terms when we talk of morals we talk of principles of right and wrong. When you talk of ethics it is a set of moral principles guiding behavior in action, and when we talk of law it is a binding codes of conduct formally recognized and enforced company policies.

So, if you see this picture what we find this is a legal framework, this is an ethical framework and this is an illegal framework. Like, if you see these part is unethical, but legal law may support it, but your conscience may not support it. Because there comes the question of whether it is right and wrong from the perspective of the stakeholders involved. This is may be ethical, but may not be legal in the sense, it has not yet been transformed into law, but this is ethical and the domain whole outside is unethical.

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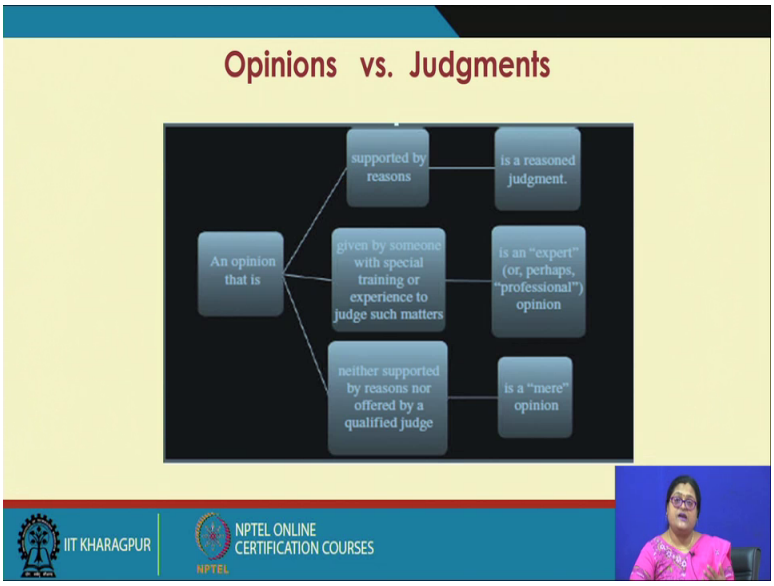

So, we will continue this discussion with again another thing which is open, because we will we have been repeating these words about what is judgment. So, we will see what is opinion and what is judgment. So, an opinion that is supported by reasons is a reasoned judgment. An opinion that is given by someone with special training or experience to judge such matters, it is an expert or perhaps professional opinion; which is neither supported by reason nor offered by a qualified judge is a mere opinion.

So, where we are talking of professional judgment of the engineers. We are talking of this, like, we it is the judgment it is a reasoned solution, reasoned opinion that is given by a person who is having some special training in depth knowledge capability and experience to judge such matters. And engineering as a profession teaches you prepares you to give this judgment. And when you are talking of the ethical issues, these judgment gets a widened like platform of thinking the judgment that you are giving whether it is right or wrong, with respect to the different stakeholders that are involved in the decision.

And the primary stakeholder that we are responsible to is to the public at large and whether the things that professional judgment, and that we are giving and with situations which are there at hand, and it has to be in the best interest of the safety, security, health prosperity and welfare of the public at large.

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So, we will continue with our discussion with the ethical theories that are a matter of concern. Because when you are talking about the professional judgment on how to take a ethical decision based on the professional judgment about certain situations which are present at each of the task level that we have already seen starting from conceptualization of the design to it is preliminary and then testing and then final testing and then delivery and then maybe use and repair at all these start stages different situations could be involved where conflict of interest ethical dilemma would be there.

Then what are the guiding principles? Are there any guiding principles which will help us to take a proper ethical decision, which show our view how to take a proper ethical decision? These are called the ethical theories which are involved, that are used in making ethical decisions which we are going to focus on in our next lecture.

Thank you.