Engineering Graphics and Design
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Lecture No. 01
Introduction

Welcome to the course, Engineering Graphics and Design. This course is being jointly taught by me, Sunil Kale and my colleague, Naresh Datla. In this lecture I will present this course. What is the objective? the plan and the expected outcomes.

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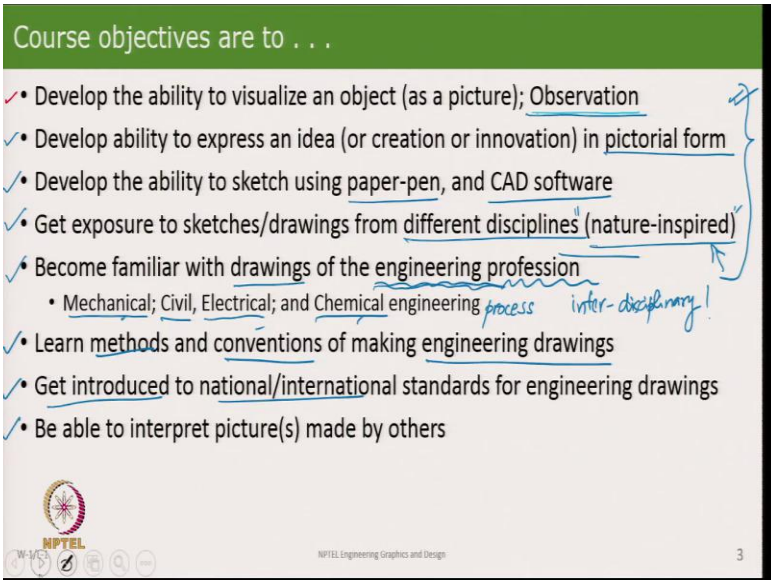

So, the objectives of this course are as follows. First develop the ability to visualize an object or make a picture and also to see things around you and express them as a picture. It could be nature, it could be any object, it could be anything. But the idea of observation here is that we see things around us we think about it and one of the things we can do with it is make a sketch.

The second objective is to develop the ability to express an idea in pictorial form. So, we get that idea in our mind either completely as fresh idea or by observing other things and then we want to communicate it with someone else for any purpose or just for record sake. So, we put it in pictorial form. The next objective is that, we put this object in pictorial form in many mediums, one is paper and pen and the other is various types of software packages including CAD packages.

This course is not just restricted to one discipline like mechanical, but it will introduce to you how drawings and sketches are relevant to a set of different disciplines including nature inspired. What we mean here is that if you see increasingly, if someone is trying to make a micro UAV they are getting motivation by looking at flies at birds at insects. That is an example of what I mean by nature inspired. So, we are trying to understand how things happen in nature.

Nature is the most sophisticated manifestation of various aspects, then we learn from there and see what next closest we can do. So, the idea is to get exposure to variety of applications, bear sketches and drawings become relevant. The next objective is a subset of the previous one where we are looking at drawings of the engineering profession.

So, until this point, what we did here there is no restriction on where sketch and pictures and drawings can be used. Practically every discipline that we have in education, we can always make a drawing. In this course, we make, come to a subset of that, which is the engineering profession. And we will look in particular, largely at drawings that are, or may called mechanical engineering drawings. But this is the way you express an object before you make it, at least in one style of making.

We can also express a drawing to make not just an object but say a building or a road or something like that, that is civil engineering drawing. And then there is electrical drawings where you expect to show wires, connections, switches, bulbs, circuits like that. And the fourth thing we will briefly look at is also chemical engineering drawings. How do I show things flowing from one place to another place and which may even call this as process engineering.

And we will also give you a flavor of how in an application more than one of these disciplines actually manifest themselves. So, that is what we will look at the interdisciplinary nature of drawings. Then, regarding engineering drawings, we will learn the methods and conventions by which engineering drawings are made. So, in the first part, when you are sketching something, we are completely at liberty to make it any which way we want.

But when we come to making engineering drawings, a lot of that flexibility is gone especially when we want to communicate with others, there are very specific set of standards national and international, which we must follow, we don’t have a choice.

And that is where we come to the next point that will get introduced to various national and international standards, which dominate the world of engineering drawing. And our objective also finally is that should have the ability, we want to develop the ability to interpret pictures and drawings made by other people. So, those are the objectives of this course.

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Now, an overview of how we will do this course. This is, as you know, a 12 week course. In this, we have activities which are split on a week wise basis. Each week has a theme. Within that theme, we will look at various applications. The week activities will include some lectures. But that is to introduce the concept and the, get the big picture about what that particular topic is all about.

How we actually go about doing it will be done through demonstrations, we will have some video demonstrations, you can see that whether it is freehand, whether it is a CAD package that will come here. Then, there are some weeks, where we will focus on familiarity with some CAD packages. We may use a particular package, but the basic features are pretty much same across CAD packages that are widely used in industry.

Each profession further has its own sets of CAD packages, we may not look into all of them, but we will learn the basics of at least a few of them. Every week, we will have assignments that you have to submit. While you are at your place, we will also engage in some activities that we call reverse engineering where you take an object, take it apart, make sketches and express the object as a picture.

On some weeks, we will have self assessment quizzes, which will help you see how well you have understood the subjects. At the end, we will have a design project. And we will see how in a connected world, how different people come together to make a design happen. This happens on a large scale in industry, where design teams are spread across many offices in the world. And they come together to make something. At the end of the course, we will have a course examination. So, those are the main elements of this course.

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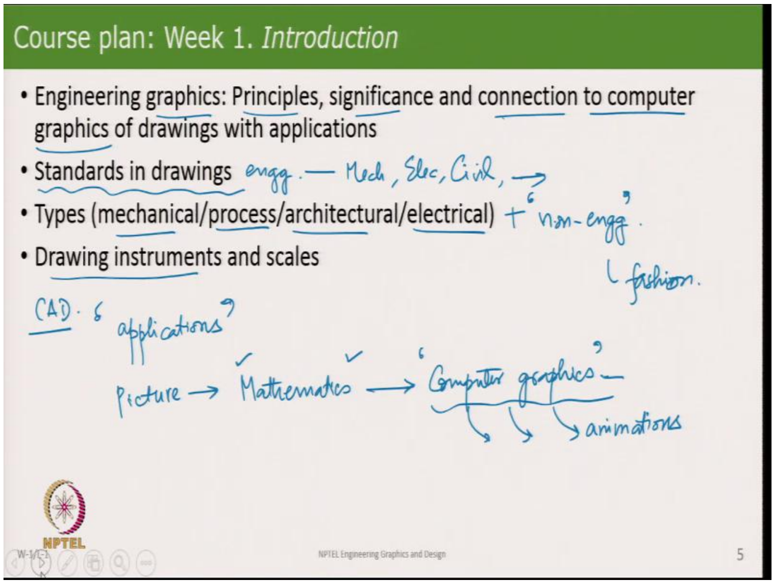

Now let’s see what we will do from week 1 to week 12. The first week is on introduction, where we will introduce engineering graphics, principles, significance and its connection to computer graphics of drawings. So, here we will see a variety of applications first, from all types of disciplines and see how drawing is an integral part to that profession. This we will see in the next two lectures.

We will also introduce here what we have put as computer graphics. So, we will see that what we are making as a picture, it could be on paper pen or on a software. What is the mathematics behind this and how this manifests in computer graphics. And so, this is applicable to a large variety of applications that we will see in this part. Which means that we are taking pictures, making it into a software file, which is basically a lot of mathematical operations and then play with it to create the effects that we want.

So, this is a very powerful technique these days and one of the applications is animations. And this cuts across many fields. And right now, as we are talking, we have pictures coming in from the surface of Mars. And it is using computer graphics, they are putting that thing to see what the surface of Mars looks like, then, of course do many more things on it tend to figure out how to interpret that picture. That’s an excellent example of this course, which is visualization.

We will broadly introduce the type of standards that are used, especially in engineering drawings, there are a set of standard used for mechanical drawings, and the set of standards for electrical drawings, civil drawings. So, these are largely 3 broad categories of these drawings. Within that then you have subsets which are related to aircraft, shipbuilding, things like that.

So, that is what we will be getting a flavor for this types of drawings plus of course, as I said earlier, even non engineering related drawings, but this is only a relative term, because today engineering techniques are used in so many places. For example, in fashion design, in clothing design, what used to earlier be a purely an art and a skill is today, visualization followed by CAD packages, and then making of things. So, the principles that we learn in this course get applied there also.

We will also introduce various drawing instruments, the techniques by which we do things, and we will also give a brief on the relevance of CAD packages and how we are going to approach them. So, this gives us a broad framework of what is it that this course does.

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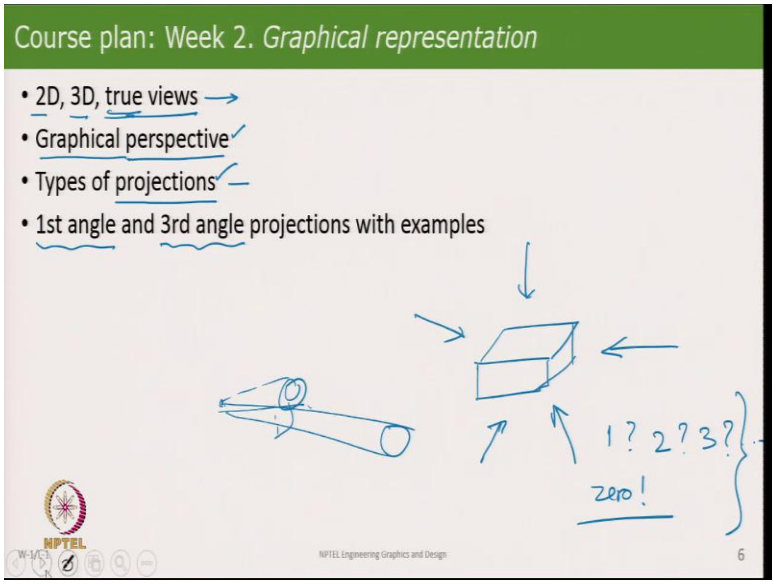

We then get into the various aspects of graphical representation, beginning with 2 dimensional and 3 dimensional, true views. True view means the way the object actually is, this could be a machine part, it could be a building, it could be an electrical circuit, it could be anything. And it differs because the true view is not something that you and I will see, our eye does not see the true view. It sees a perspective. So, we will introduce that in the second week, as graphical perspective.

Very simply, when you are looking from some point, an object nearer looks bigger, whereas the same size object at a distance looks smaller. That's perspective. Then we will look at the concept of projections. When we asked the fundamental question, how many views or how many pictures of an object do I need to make to fully convey every aspect of that object? That is what we will say, as projections, where I can look at the object from different viewpoints.

Very simply, if I just make an object like that, I could look at it from here. I could look at it from here, I can look at it from there, there, there anywhere. And then looking from that side, I could either look at it as a natural way of looking at it which would be perspective or I could make it a true view, which is what we put in projections.

So, the question here is how do we show these projections, and second, how many projections are adequate for fully representing an object? Do I need 1 view, 2, 3, more, or something more, or in some cases, even the zero projection, which is that can I communicate an idea of a picture without any drawing. So, this is what we have in this part. And then we will look at what engineers do, which is look at in particular 1st angle and 3rd angle projections with examples. So, that is week 2.

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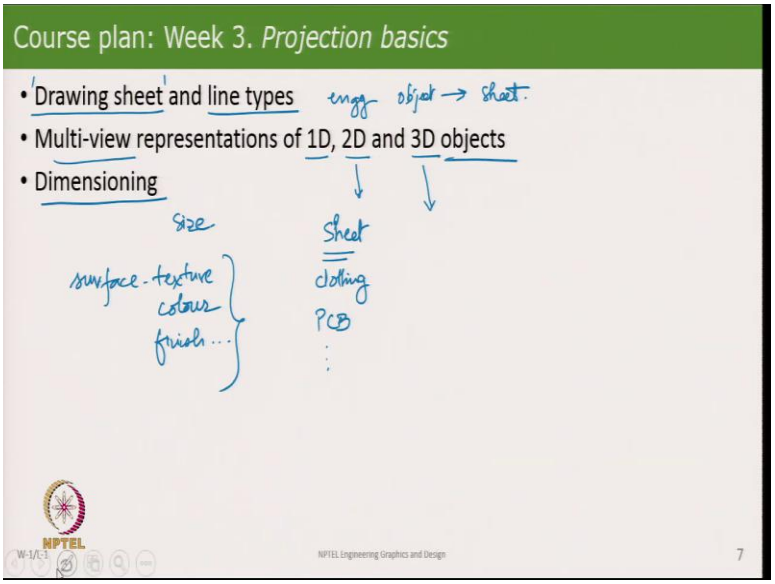

In the third week, we will look at the basics of projection of how do we put drawing on hard, paper pencil type of thing or in a computer drawing. So, we look at the idea of what is a drawing sheet. Historically, before the advent of computer drawing, everything was on a sheet of different sizes and everybody was associated with the drawing would read that sheet and interpret it. On that sheet, various things are drawn with certain lines and each line has a particular convention.

So, we will see how in engineering we use different types of lines to represent different concepts and how we put that to make an object and how we place the object on a sheet. We will look at that aspect. Then, we will look at multi view representations in 1 dimensional, 2 dimensional and 3 dimensional, but this is with respect to objects. A 2 dimensional object would be something where the thickness is very small, for example, a sheet.

If we have to just show how a cardboard box is made by cutting and bending it, the thickness is everywhere the same that becomes a non issue, it becomes a 2D object. Most other objects will be 3 dimensional and we will have to show various features of that. We encounter all these in many places, including say clothing. A cloth is basically a 2D object, then you can look at a printed circuit board and many more things.

The next thing is after having made a drawing, we want to convey some information about it to make it complete and the most fundamental law in amongst that are the dimensions of the object, dimensions means the size. How do we represent the size of an object that is what comes here. In design, we would do many more things, which we don't do in engineering drawing. For example, how do I show a surface texture, a color or say finish and every finished object has that you look at a car, it has a color, shade, all of that.

You look at various objects that you have their finish is different, something is very shiny, something is very dull, something has got deliberate particular types of features on it, could be a leather or a PVC sheet with different features on the surface itself. So those things are important. We will very briefly just touch upon that. But in most engineering drawings, we do not look at these aspects, but it is good to know that there is more to learn after this course.

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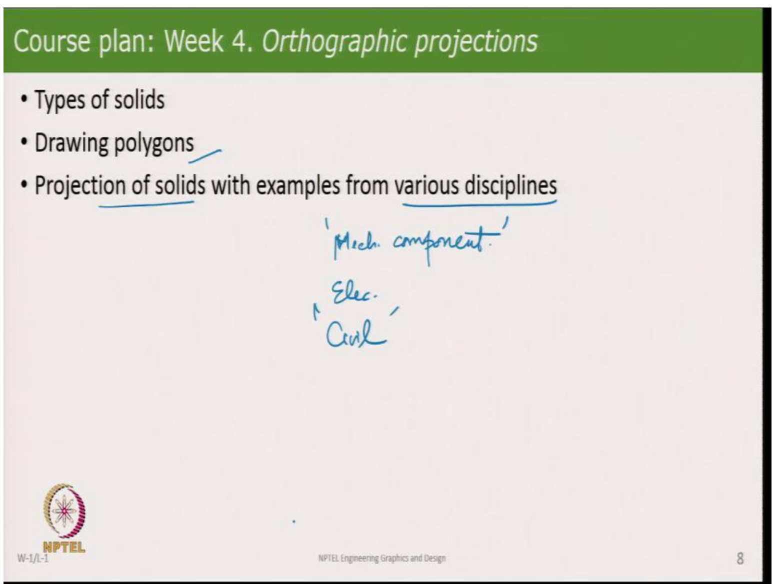

In the fourth week, we will go to orthographic projections. We look at types of solids, we will get drawing polygons and we look at projection of solids in different views from various disciplines. So, we will look at a sort of mechanical component.

And when I say mechanical component, it could be anything. It could be our domestic pressure cooker, it could be our LPG stove, it could even be the shoes or the slippers that you are wearing. In some way they are all mechanical components, we represent them by that broad category.

Then we look at electrical systems and most probably, most importantly, civil engineering projections. How do I show the projection of a building, of a house or a plan of road like that.

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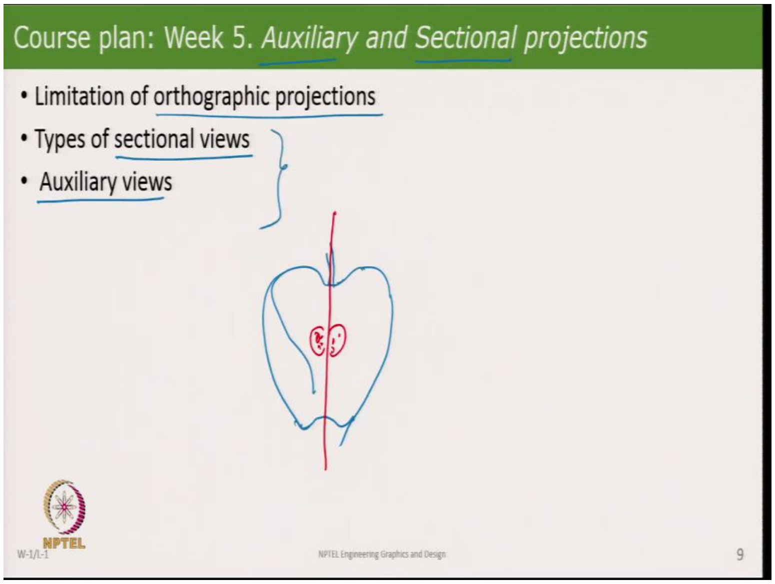

That will then take us to another set of topics, which are known as auxiliary projections and sectional projections. And this need arises, because some objects, which are, a lot of features, and a very complex looking, just by showing three pictures from different sides or even more from different sides may not be adequate. We need to look at it from various other directions to show some certain feature of that particular thing.

And then it could have internal features, which just by looking at the object, it will not tell us what is inside it. That takes us into the realm of a sectional view. That means you are hypothetically cutting that object and asking, what do I see. And in many cases, when you cut that way, you see a lot more things in it. A good example is, say an apple, you can draw this picture of an apple.

But you want to show the seeds inside this, it becomes very complicated. So, what one does it say that, well, if I cut this object like this, which in the real world would mean take a knife and just slice it, and then you open it. And then you see what is that cut surface looking like, then you begin to see that there are seeds and there are many other things inside this. So that’s an example of a sectional view. And these arise because as I said earlier, that the orthographic projections have certain limitations, which we overcome with these things.

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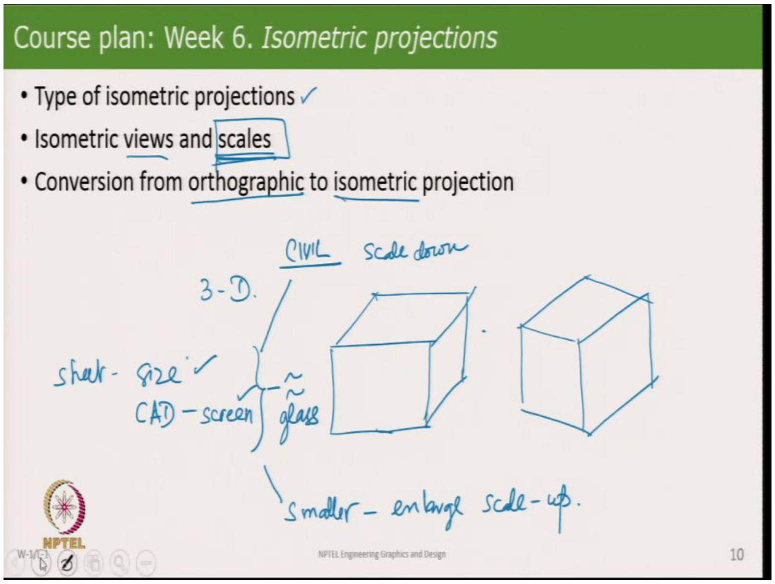

We then move on to what is called isometric projections. Which means that we are trying to present the object as a 3D object. For example, a box, when I make like this, is an example of one type of an isometric projection. We could even make an object like that. That is another type of an isometric projection.

So, these are techniques by which we will show, that is what we learn in this week. What are the views, scales that are used, that means by scales what we mean is, in our drawing world, our sheet has a certain limitation, the sheet size is limited. Same thing when you make a CAD package, or you view it on your screen. There is a size limitation.

So, this is what we interact with as somebody who makes a drawing, but objects need not always be in that same size range. You could have very large ranges, which is what you would see in a civil engineering drawing, say a building. Maybe 4 storey building, 40 meters wide, we cannot, how do I fit it into a paper or show it on a screen. On top of that, I want to show more details that if I have a beam and a column, what is inside it?. So, I need to scale down.

And then there could be some objects which are about the same size as the sheet. And say for example, a glass or a tumbler or a spoon, I can show that exactly nicely on a drawing sheet. Then, I am, I need not have to change the scale on which I am showing it and then there could be object which could be much smaller. So, if you see your cell phone, there would be very small screws in it.

If you have to make it exactly the way it looks, you may not be able to see its features. So, then you have to enlarge it and this is what we call scale up. So, standards tell us what are the scales that we can use in making drawings. And then we will also see that we will have to interconversion of a drawing expressed as an orthographic view, which is a flat, set of flat drawings to isometric, which looks like this. And vice versa, from here, going to those things, both in a paper pencil mode, as well as in a CAD environment.

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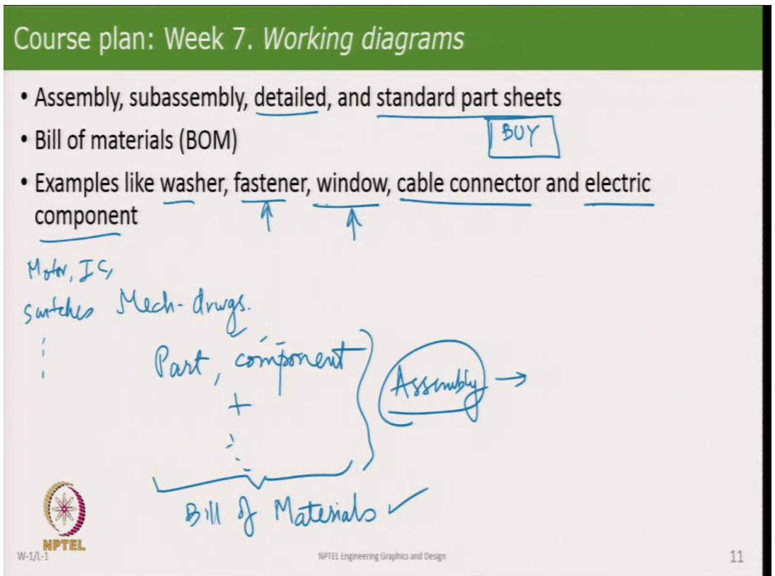

In week seven, we will look at working drawings, particularly focusing on what one may call mechanical type of drawings. We will look at how different parts come together. Assembly, sub assembly, details of that some parts that we don't make but we buy.

For example, we make an object where we have to make some parts, and then we buy a certain part from somebody else, which is a standard part for that manufacturer, we just use it in our design. So, we need the drawing of that in order to complete our own design, the assembling. So, how do I integrate that, with what I am making. And from there, we realize that an object has many parts, we call each one of them individual part, which is a standalone thing that is called an individual part, or a component.

And then we put all of these things together in numbers to get what is our assembly. And all this list of all these things that went into it, this is called a bill of materials. We need each and every one of these to make this. It could be an electrical circuit, it could be the building, it could be a piece of furniture, it could be a clothing part, it could be anything like say your pressure cooker all of that has many individual components, which come together to make that final product.

So, we will look at some standard parts like washers, fasteners like nuts and bolts, that is what we mean by fasteners. Even in these days in civil engineering, windows come in standard sizes, you just buy the window and put it in your building, cable connectors and various electric components including motors, motors, ICs, switches and so on.

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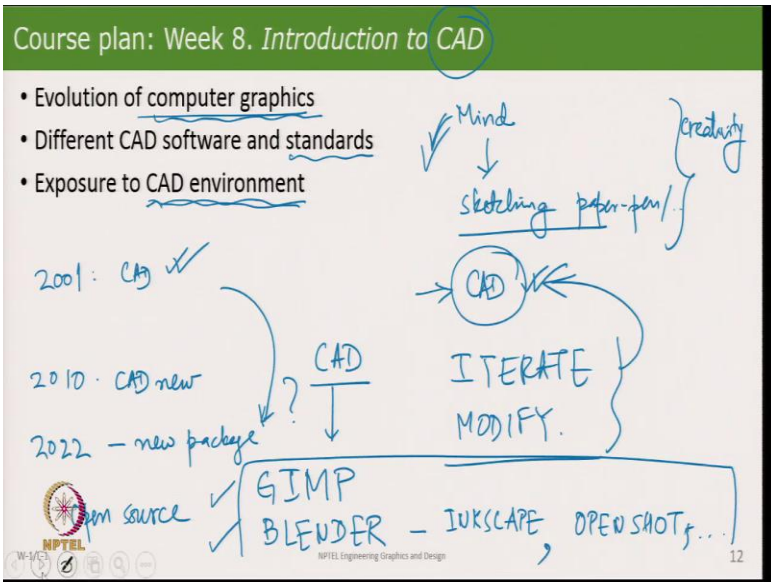

Then we will spend the next three weeks on getting familiarized with certain CAD techniques. So, although Computer Aided Design, which is what CAD stands for, has become very common and almost like a standard thing. But don't ever forget that creating something in our mind, sketching it, paper-pen, pencil whatever, this is the most powerful thing when it comes to creativity.

When we do something manually, our mind thinks about many more aspects of that drawing. How do I make it, will it break, how will it fit with others, all of this thing will keep on happening through our mind. But when we make the same thing in computer using some computer graphics package or CAD package, we may not be able to, fully able to think about all those aspects.

So, this thing comes first and CAD could partly help it, but it helps us to refine what we are doing. And where this really comes in handy is that after we have made a design, it is never final on the first go, we always have to iterate. We have to modify. Doing it manually is very tedious. That is where CAD really helps us, that you go to the computer, change a few things and immediately begin to see things. It will also tell you that if you change one part in an assembly, how does it affect all the other parts.

So, we will look at first, what is the evolution of the science or the mathematics of computer graphics? It is here that mathematics comes in a big way, particularly matrix operations or what you learn in linear algebra. Then there are different standards for CAD packages. So, although there are, you make drawings in one package, the issue is can I use and read the drawing in another package?

Or as you see in the next part, the CAD environment that if you made the drawing with the CAD package used in say the year 2001 and the same drawing is now coming up in 2010, chances are that this CAD package that you had in 2001 has been upgraded or maybe it is gone and new features have come and you have a new CAD package. Can I use this package to read this? And maybe in 2022, we could have entirely new package coming up.

But your original drawing was done in 2001 CAD. Well, how do I use it? So, what we will do is we will introduce you to certain basic features of every CAD environment, we will use certain package for illustration and practice purposes. But it is not that is the only thing to be used. There are many CAD packages to which most features are quite same or similar.

There are also other packages, which we will give a very like introduction to that, which are used by many designers these days. Objects like if you have a Photoshop, the open source part of it is GIMP. You can make drawings, you can manipulate drawings, you can make sketches, and you can do many more things than what a classical engineering CAD package does. This is GNU Image Manipulation Program, which an open source version of photoshop.

Then if you want to make movies one of the most powerful software's and this is open source, is called Blender. You can make a lot of exciting things with it. In fact, many of the things you see around you they have been made with this package. It is open source, then there are other drawing packages like Inkscape. And if you want to edit videos, put features into it, then we have OpenShot and many other softwares. And all of these that I have listed here, these are open source.

All these are freely downloadable, there are a lot of online tutorials. And they are still developing, so if you are keen on adding more features, making it more user friendly, the open source community you can join that and add value to this. So, these are more techniques for visualization. But we don't use that in engineering drawing. In the end when you make a product, when you want to show emotion, when you want to make it real life appearance, you will have to go to one of these packages.

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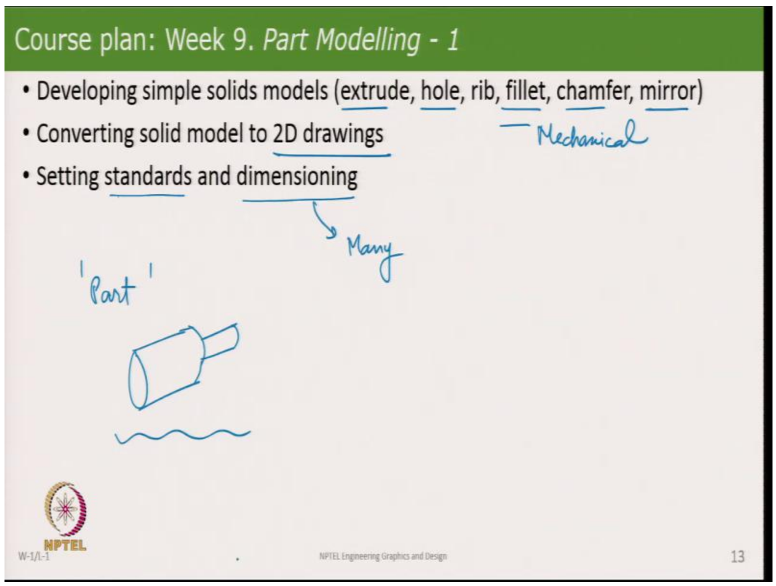

Weeks 9 and 10, we will look at Part modeling and various features by which we make parts. This would be largely for mechanical parts. We will come across various terms that are used, like that are there in these packages and see how using this I can make a package, a part. The thing here is that if I have to make a certain part, say, a cylindrical part here, with a smaller cylinder part there.

There are many ways in which I can make it within a CAD package. And each one of them on depending on the different package has different aspects and you will learn some of these in this week. Then we will also come across how to convert a solid model which would be say like this into 2D drawings, orthographic projections. And then we will see how we use standards for dimensioning. Again, they have many ways in which you can dimension a part which is the most appropriate way and maybe which is the most, which is the correct way, this is what we will see in this.

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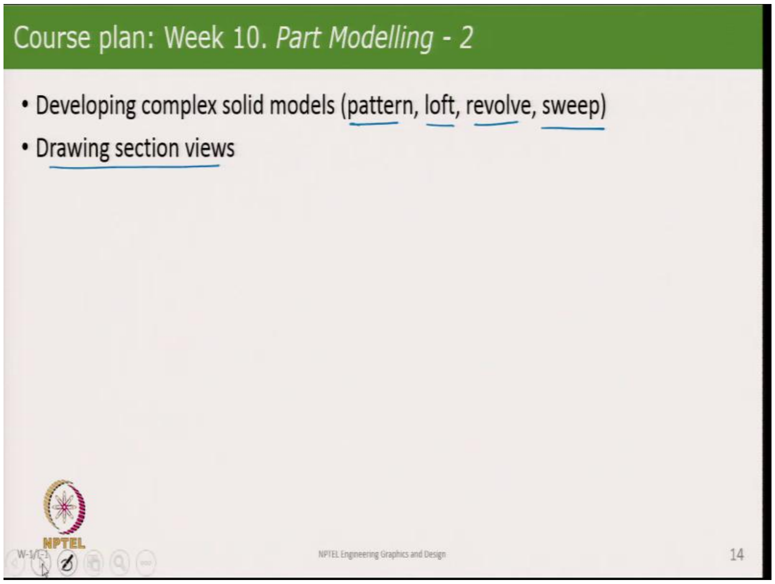

In the next week, we will look at some more complex features, like pattern, loft, revolve and sweep and also learn about how to make sectional views from a solid model.

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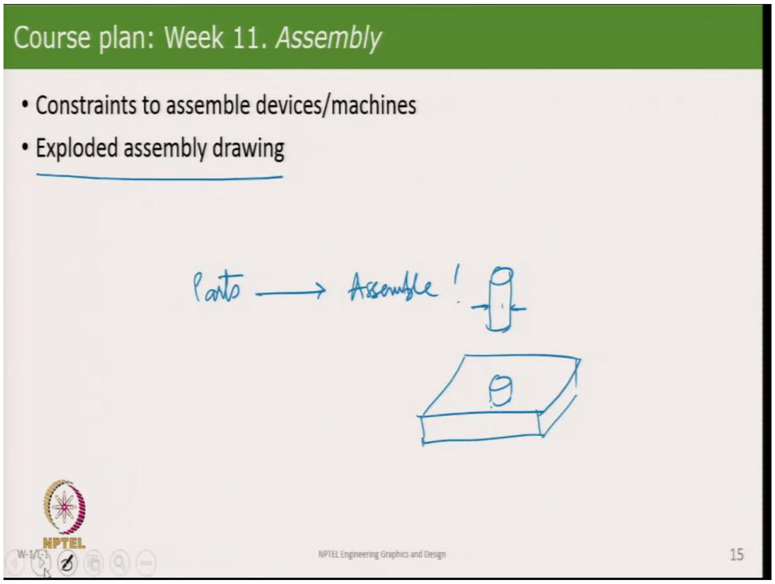

In the next week, we will be in a position that we have made lots of parts. And now we assemble them, how do I put them together? Now, this is only the drawing part of it. There are more advanced features in the packages which tell you that if you have made a plate and there is a through hole in it, through and through hole, and if you want to put a cylindrical object through this, it would also be able to check the size and various features of this and tell whether it will go into it or not.

All those features come in later advanced features of drawings. And then we learn an important thing, which is to, what is called exploded assembly drawing, that once you have assembled something if I were to disassemble it, how do I show it and in that disassemble drawing, I can see everything that is going into it and how it fits.

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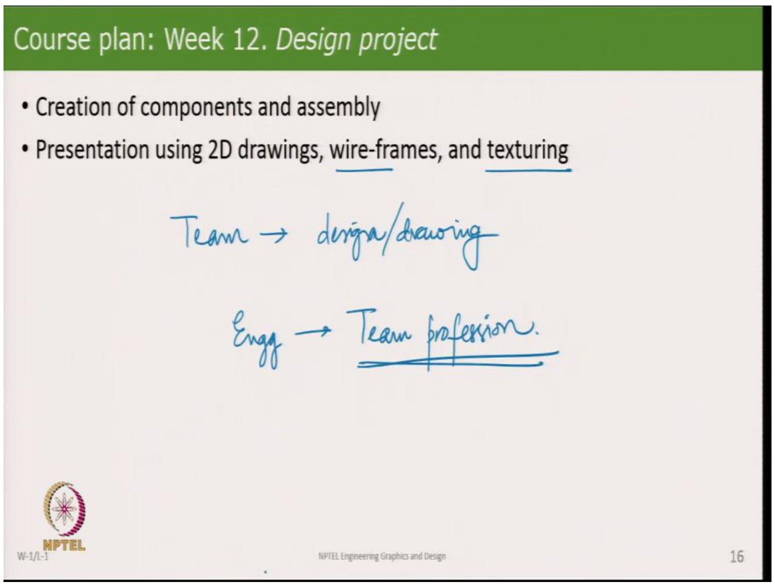

The final week is on creation of components and assembly putting 2D drawings, wireframes, texturing and working with a small team to make a design possible. You need to appreciate that engineering is a team profession. Lots of people work together to make something happen and each one has to do their part and somebody who is experienced or who is the leader, they get everybody to work together and put it all together in a nice harmonious way.

So, that is the week wise plan, all on the way we will give examples from various applications. But this is last four weeks of CAD, we will predominantly be looking at Mechanical CAD.

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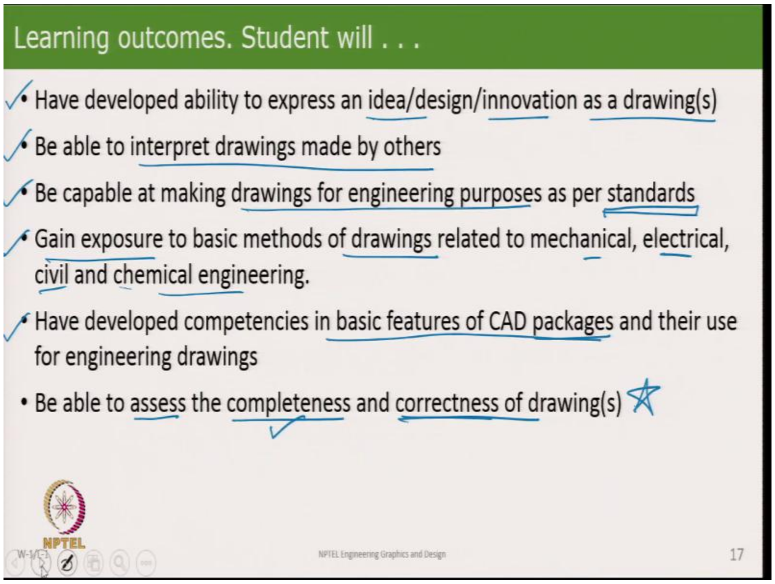

So, if you do the course, do all the assignments then what will you learn? So, the outcomes of this 12 week course are, that having done the course you will have developed the ability to express an idea or design or innovation as a drawing. That when you want to make something you can not make it say, but you want somebody else to make it for you, how do you make a sketch and communicate to them what they want.

And it is not a one way process that just happens with one drawing. Once you make a drawing the other person will ask you some queries, you modify it, you add more details to it, you may not have been able to express it fully you add something more to it and it is through a discussion process that the final object gets finalized. So, that the first objective, the outcome that we expect. The second outcome is that after doing the course, you will be able to interpret drawings made by others.

This is the basic feature of engineering. Even here, if you buy something, you open up the product catalog, there will be some drawings there which tell you how to do it. So, for instance you have a printer, you need to change the cartridge, there will be a set of drawings telling you how to change the cartridge. So, that drawing was made by somebody else, but you are using it. So, this is what we are, that is another outcome of this course.

Then you will also be able to make drawings for engineering purposes, as per standards. And standards are important because everybody in the world follow the same standard. And it is not that drawing made in one country may not be used in other country, it is now very common that there is engineering happening across continents. Then you will also gain exposure to basic methods of drawings related to mechanical, electrical, civil and chemical engineering.

So, you will get a feel for what type of drawings do these different disciplines have and what are the important salient features of these. So, you will at least have a working knowledge, at least to begin with, to be able to interact in a team, multidisciplinary team of different engineers, when it comes to making something happen. One of the outcomes is that you would have developed competencies in basic features of CAD packages and their use for engineering drawings.

So, you have not become an expert. But you have got the first, you have crossed the first hurdle of how to make a simple drawing and how to use features of a CAD. It is not necessary that you will learn everything here only. Indeed, a lot of learning happens by just hacking a software, see what works, what does not work.

And yet, one more outcome is that after doing the course, you will be able to see a drawing, whether you made it or somebody else made it and assess whether it is complete or not. And whether it is correct or not. For this is very important in that, in engineering you don’t make anything until you have a drawing, which is both complete and correct in every aspect. So those are the learning outcomes of this course.

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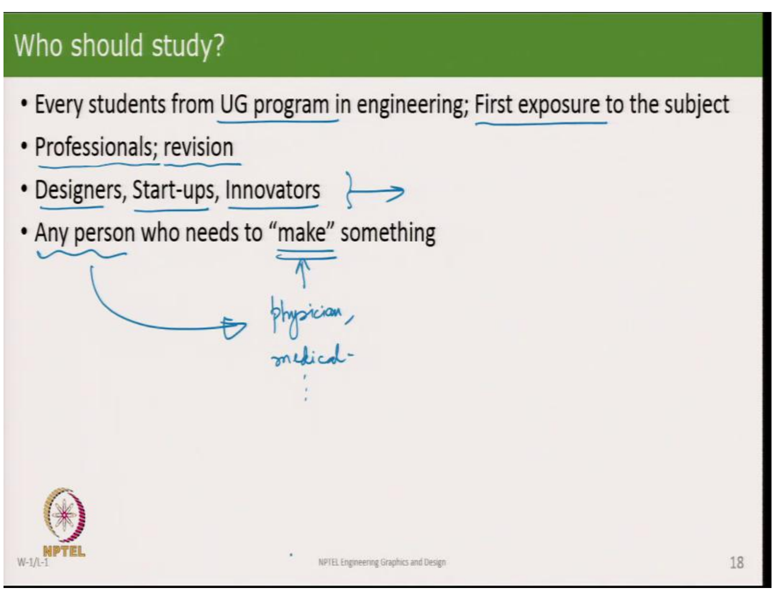

And now, who should study this course? Typically, such a course is a first year first semester or a first year, second semester course in engineering programs. That need not be the case, anybody who, that is one of the target audience that if you are studying basic engineering graphics, you could use modules of this course as part of your learning.

So, this is what I would call a first exposure to the subject. After this, you would have discipline specific drawing coming up. If you are a professional who has hack to use drawings, you could use this course, as a way to revise and re visit some of the things that you were taught when you were a student. It could help you better appreciate what you are doing.

If you are a designer, who is making things, you would have to make a drawing for it. So, if you have an idea, and you need not be an engineer, if to make something anybody could have an idea, but if they want to express it, someone who has done this course will be more readily be able to express the idea to someone else who can then make it into a product. See it could be a designer, especially good for startups, if you want to make something even as simple thing as it will box in which a certain circuit board has been kept with a few switches on it.

You still have to make a drawing, only then somebody else will be able to make it for you. And innovators, that if you have an idea you have want to express something and make something the way people expect you to express yourself is to make a drawing. And remember all of this is important if you want to get funding, if you want somebody to give you money to do it, if you want somebody to make it and market it for you all of that is essential, drawing is an essential part of it.

So, in general, anyone who wants to make something would be benefiting from a course like this. This, when I say this, it is not just this it could also mean somebody who is say physician or someone who is making some medical device. So, when I say any person, we are looking at almost everybody, irrespective of their field of expertise.

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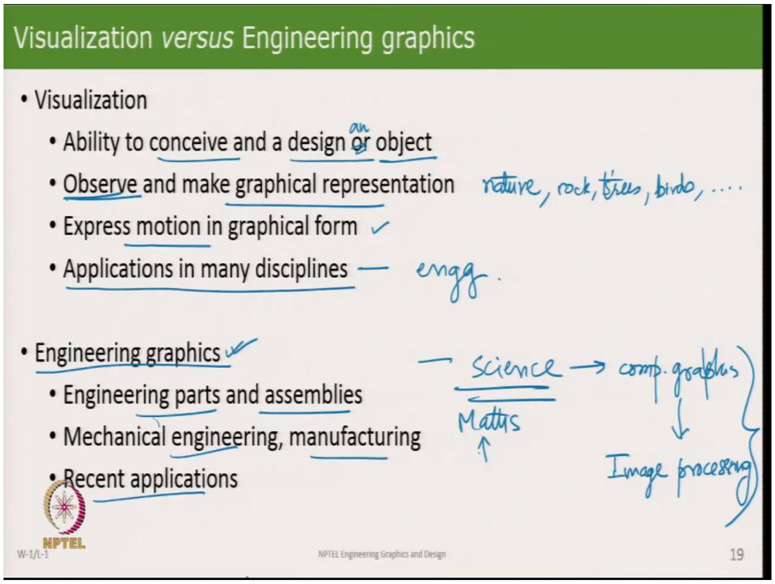

Now in few minutes we will contrast what we mean here by visualization. And how it is different from a typical course called engineering graphics. Visualization is a very broad active field of activities, beginning with ability to conceive and design an object, an idea, or anything, or even observe, in nature and make a graphical representation.

And this has got absolutely no limits on it. It could be observing nature, it could be observing the clouds, it could see rock formations, it could see trees, forests, birds, anything and human beings as well. In visualization, we look at the whole idea as being able to express things in a picture. It could also mean a series of pictures, which can express motion.

For instance, if you want to convey to somebody how a four-legged animal walks, say a dog was walking on the road, a video will of course show what it is. But when you want to make a computer graphic out of it, or you want to make sketches out of it, you will say that look, I look at the dog at different instants of time express it as a series of pictures, then I will know what happens.

The idea is very old. 70, 80 years back, cartoons were made that way, that you made lots of pictures. And each picture differed from the other very slightly, you had about 15 pictures that you zipped past per second and you end up making a video motion. So, that was visualization. It is still used today, but you now have many more tools in the electronic world. And visualizing has applications to many fields, absolutely no restriction.

And this has become important now, where you realize that virtually anything that you do has some sort of an engineering connection to it. So, visualization is a broad field which develops your ability to conceptualize, to make a picture in your mind or a movie in your mind or a device in your mind.

And then also be able to express it in a form paper pencil or on a computer and have someone else be able to unambiguously interpret it. Engineering graphics on the other hand is a very restricted subset of that. But it also touches on the basics from which we start doing computer graphics. So, in engineering graphics, we largely end up looking at engineering parts and assemblies. In mechanical engineering, manufacturing, and some more recent applications which are there.

But graphics also tells you, thus gives you an look into the science of it, which we do not learn in this engineering graphics course. But this becomes the basis of computer graphics. And which later on can give many more courses like image processing. And these again, are no longer restricted to any one discipline or, or the other. The most classic examples these days is in the COVID times when your lungs are damaged, the picture of the lung is taken by a scan.

And then using that image we interpret the extent of the disease and how the treatment should progress. All of that is this and it started off with the science which I call the mathematics of it, which it gives you an interpretation into in that particular example, about the biological aspect of it. The techniques used, the mathematics used their basics lie in engineering graphics.

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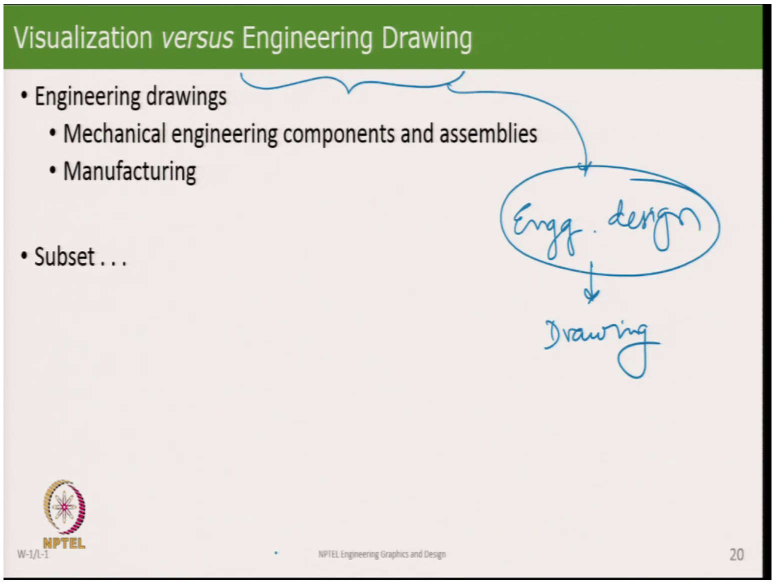

How is visualization or graphics different from engineering drawing? In most curricular engineering drawing would be a course that follows a graphics course. So, basic course like the one we are having here, it is a prerequisite to then go into an engineering drawing course or rather even if it is not engineering drawing course, you are doing engineering design in any discipline, electrical, civil, mechanical, marine, aeronautical, chemical does not matter.

When you learn the principles of design there, ultimately you have to express it as drawing. And that drawing is somewhat specific to that discipline, which is what that course or that set of courses will tell you. So, there is no such thing as drawing being an end of itself, drawing is an integral part of design.

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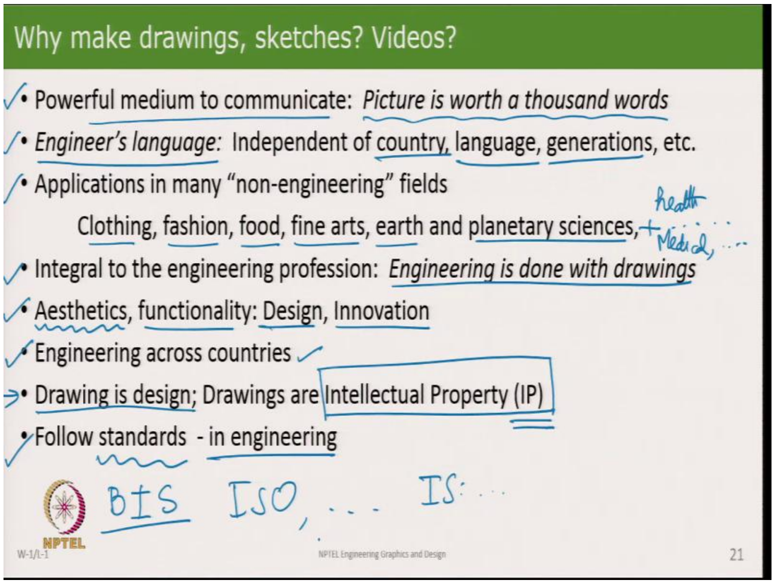

So, having talked too much about drawing and sketches, they asked a very fundamental question, why should I even be bothered about making a drawing? Why should I make a sketch? Why do I need to make a video and there are many good reasons why we, an ability to make a drawing or a sketch or a video is very, very useful in life.

First, an old saying that "picture is worth a thousand words". For something that you would like to talk and talk and talk, it is much easier if you just make a sketch. So, it is a very powerful medium to communicate. And it is used not just in engineering, but also to communicate how people use space or how people interact with one another. Even there, you can make a drawing and visualize it.

For the engineer, a drawing is very basic, it is the engineer's language, that is how engineering is done. Design, drawing, manufacture, assembly, construction, whatever it may be, it is a drawing, which is the language used to communicate. And this language is very powerful, because it is independent of the country where that person is, it is independent of the language that the person speaks. And it also cuts across generations of people.

So, this is a common thread which makes engineering what it actually is. And in today's world, this language is also percolated into many non engineering fields, what you may call non engineering here, like clothing, I mentioned garment design, weaving design, fashion, food, fine arts, earth and planetary sciences. And you can add virtually anything to this list.

You may call it health related, medical whatever. As I mentioned earlier, drawing is integral to the engineering profession. And engineering is done with drawings and drawings only. You can’t make a drawing don’t call yourself an engineer. Then there are certain aspects which engineering drawing doesn’t have but drawing in general has to do with design and innovation, where issues like functionality, of course have to be met.

But and also what is about the aesthetics, it should look nice. It should appeal to people, it should be safe. All of that comes in over here. Then as I mentioned, engineering across countries is facilitated by drawings. And one of the most important things here is the next item here, the drawing is design, drawing is expression of innovation. And so, drawings are intellectual property, whether it is a patent, whether it is a design, whether it is an innovation.

A drawing is a very, very valuable source and anybody who has made the drawing and made products out of it, that is something they will never disclose to anybody else. It is their intellectual property. And, one of the reasons that is there, why make drawings because we need to follow standards, especially in engineering, we don’t have a choice to make anything, any which way we want.

You can make it, no issue, but when you give it to somebody else, they will say no, this is not something what I will read, I want to make it this way. So, in engineering, we need to learn drawings to follow various standards. In India, our main standards making body is the Bureau of Indian standards, they have a whole variety of drawings which are harmonized with various national and international standards, biggest one being ISO, and then there are many other ones.

So, when you make a drawing as per that particular BIS standard, an IS standard, we know that we are following something which anybody in the world can understand, within the country can understand and across the world also. So, those are some of the reasons why drawing is so important to design, to innovation and to engineering. A cutting across disciplines as we just saw. With that we come to the end of the lecture.

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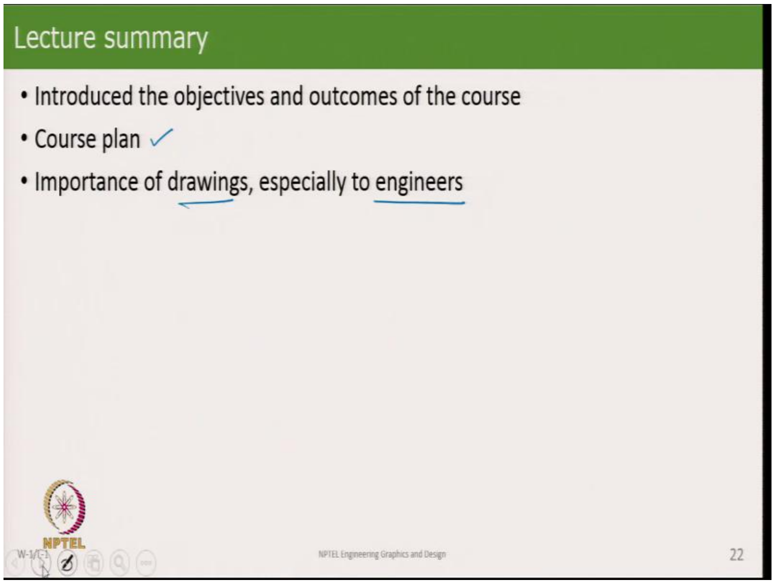

So here, what I have done is I introduced the objectives and outcomes of this course. I have discussed briefly the week wise plan of what we will be doing and ended up by looking at the importance of drawings, especially in the world of engineering. With that we end this lecture. Thank you.