Enclosure Design of Electronics Equipment
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Lecture - 61
Conclusion

This particular course and lecture is meant for practicing students and the occasional what you say serious emitter hacker, who enjoys making their own small products and so on. I am sure, several of you, I would come across the necessity to package a small; what you call electronic circuit that you have the whole thing is address to a what is that has my hope, I think I should put your signal; this things here as my this thing shows here I am from the Indian Institute of Science, Bangalore, India. So, this whole what we call lecture series has 60 sessions lasting a little over may be 30 or 32 hours. There are 4 videos which our shorten our premises and then I would like to ecologist the means help taken by from my colleagues, I have worked on this for a long time. This course has being run in the Indian Institute of Science center for electronic design and technology for over 35 years.

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Started with something and eventually we have moved on now. So, you see here, I will start with the very first slide without too much of hedo as here, if you can show me, we have basically issue of what is the product what is industrial design and then what is

design and then affect finally, you know what constitutes what over the years, things are improved tremendously.

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So, you see here design, since we integrate mainly usability of the product, how will the product can be used by the intended user. So, in this case, first thing that attracts your attention, now when you look at any product is probably aesthetic appeal, how it looks at curves, we cannot ignore it whether you talk about mobile, whether you talk about home, whether talk about your own; what you call any other objects that you own aesthetic appeal and then one should touch it, suddenly you find out the ergonomics, how will it can be handled.

Some people hold a mobile in their hand and all that and when got a shop at least, in this parts of the world, they will give you a mobile which is a mock up, it behaves, it feels, it weighs about the same time as I think. So, you choose between 1 or 2 models, then you come to the functionality outfit functionality is how will you get all the various things and so on and finally, ultimately is in the things since to be about how will the product can be marketed marketing, again it is not about selling, marketing is all about how you get the feedback from the user a lot of times user is not ready for the product.

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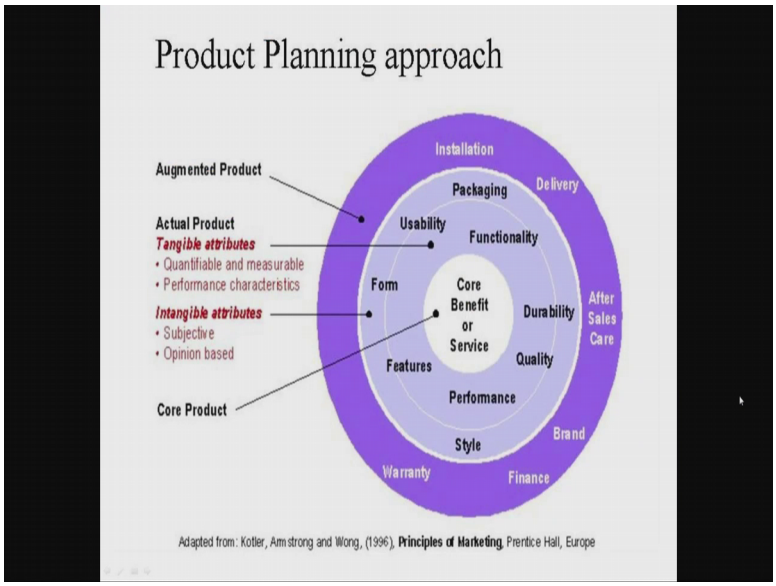

But then how do you work in near future and then how do you have a vision re future from here, part of this has been taken from standard; what you call text books.

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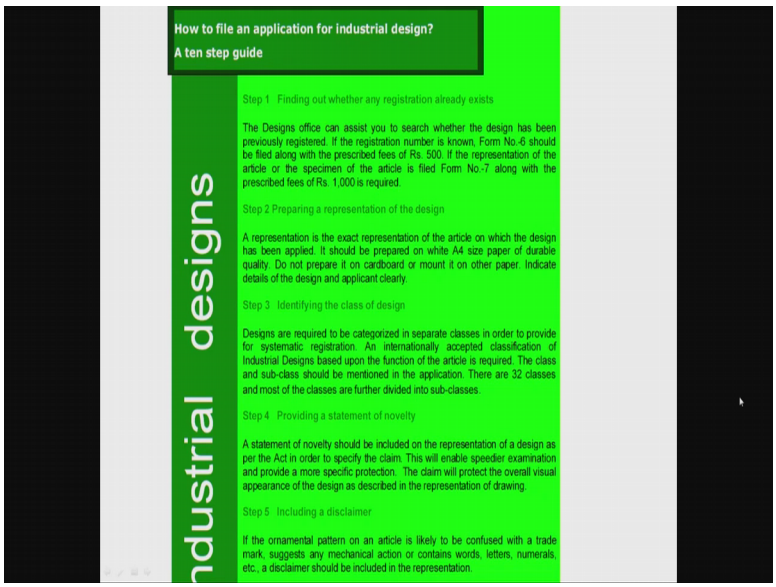

So, you see here, the core benefit we have and finally, we have on top of it is an actual product which has tangible and intangible thing, sorry.

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So, it has the tangible and intangible benefits and so on, as an augmented product with you know, involves all the finance and all that. So, you have finally, products which are sold. So, very nice to see such things and then I probably no need to take a little, I do not know, there can call it a break or whatever it is, industrial design as defined by our patent office several places is about anything which you can file and you can claim as a different thing, no, is a term does any physical occurrence of an object is consider a new industrial design. It is not about the industrial design has the service, industrial design has the philosophy industrial design has you know what we call you know for changing this thing in on that.

So, you see, I am sorry for the what you call small letters a representation is exact of the article on which the design has been applied identifying, then how if the ornamental in article likely be confuse you, the trade mark suggest any this thing and so on. So, I suggest you go to a place called the Vepo and also our own patent office's Vepo and patent office has specifically made definitions about it is not mine, not all mine in the actual; what you call presentation. I had spent a little more on this and then you can understand from the patent office industrial design is something, I will saying already something which can be producible and all which is very different from the original first article that is there. So, I suggest you read it in the 60 sessions which are uploaded, I expect that this things will become little clearer.

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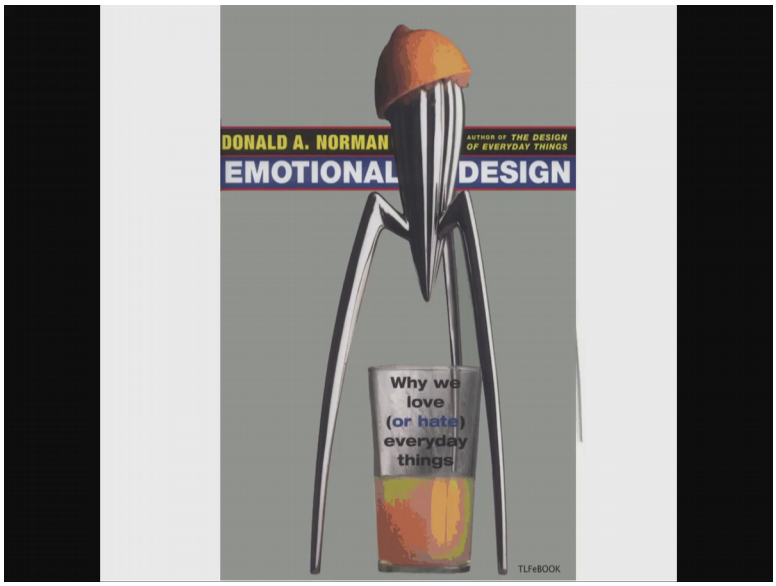

So, the next slide; have a look at it, just have keep looking at it; lot of pigeons and then you see what have started here, oh, suddenly you have seen what started as a very simple object. Now you see it is actually there is huge beehive of activity.

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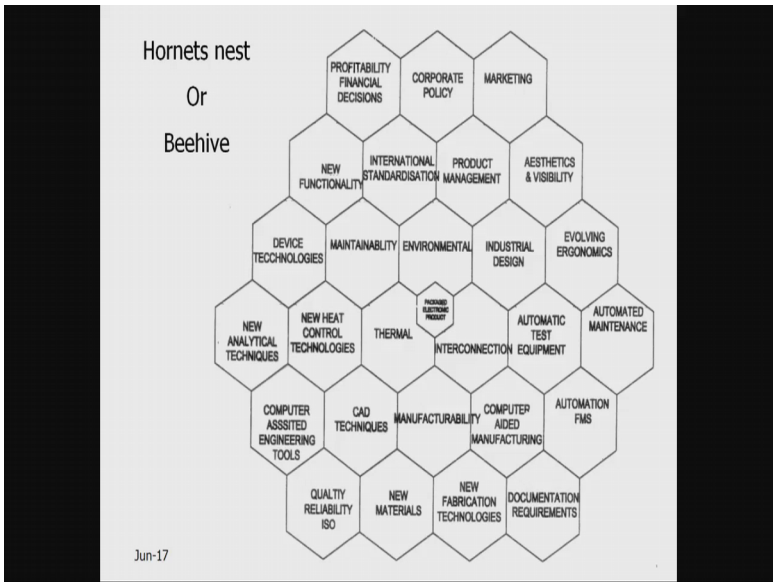

Whenever it comes to these things, you can pigeon hole the various aspects of it, just keep; let this slide show run, I will come back means I mean I will get back to you have a look at all this things.

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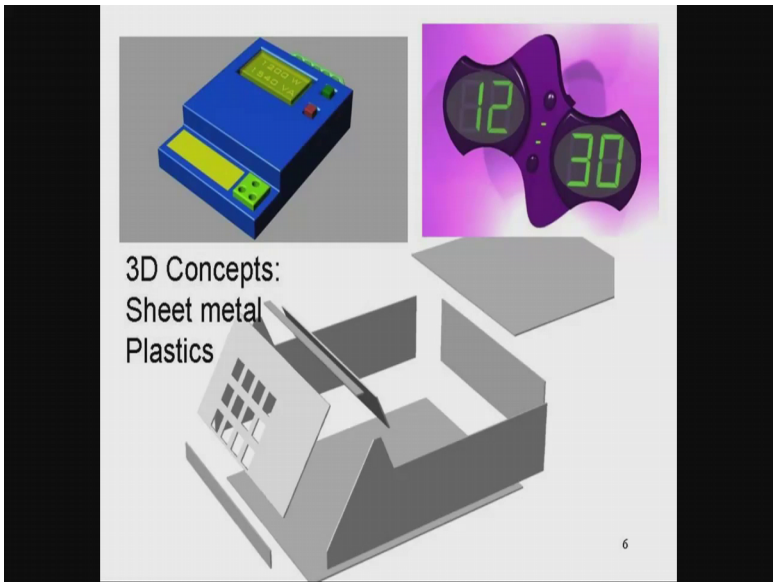

So, we see here what started as pigeon holes, suddenly as more and more activities have come and no place for the pigeons. In fact, if I go back here, again you noticed here, then that is left top corner, next of pigeon place is not visible. It is a stupid allegory, I mean excuse me for the word stupid; what I mean is it looks allegory in some conditions, it works saying the activities are equally defined, I mean clearly defined and they can be run one after the other which was probably once upon a ten things where but.

We have to take a modern product like mobile phone are including anything what you are seeing things are very very complicated, they seem to be getting done together.

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And then all of them have an emotional component in it and how there placed in mind seems to be equally important has this. So, it is a beehive of activity, it is not as if know it just an activity. So, the next slide it shows me this; what you call so many large amount of things which goes into the manufacture of a product; what looks like a very simple product is no longer something you cannot call it an electronic product and then secondly, things are getting; what we call more and more complicated. Even if you take a very routine thing, let us see at the right side, you have wall clock made as a concept by one of our students, we have this wall clock which has, anything you see it looks very different from the other things. This is done by my design student and; obviously, I mean somewhere I do not even know where it is, but; however, in your; what we call at home or workshop or anything it is a re zefarito fabricate that sheet metal which shown down.

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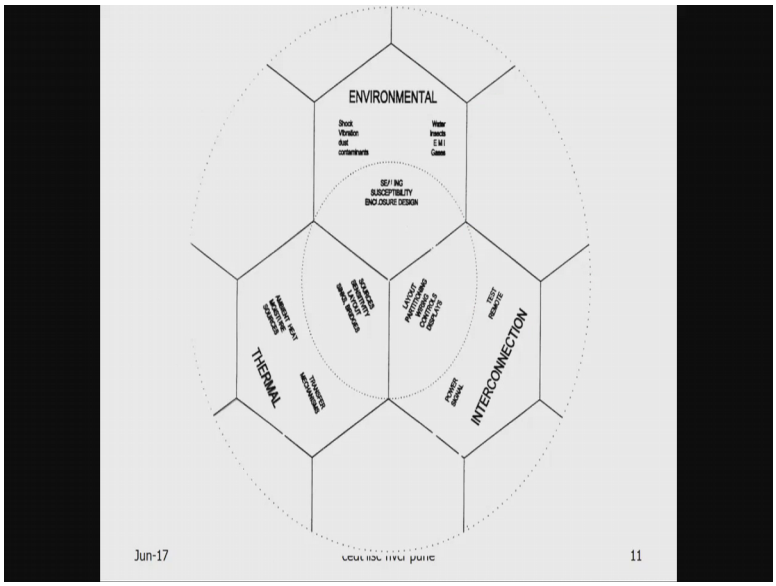

And at the left, we have something which could be done in a plastic or anything, you see here, slowly as we come we are slowly get into the concept of 3 important things, package needs to deal with one is there is a environment outside that thermal issues to be solved and there is interconnection between the inside of the enclosure and the external world. So, the dotted line which is there around is topically is suppose to represent our activity do make a dust proof. We can seal it and then what will happen to be heat so; obviously, you know heat will have a problem, you can take it out. If you make holes, your blowing all the dust in as if this are not enough, how do you take out the connections and how do you ensure while the physical realities all these you know dust and moisture and all that what about the electrical things like EMI and radiation otherwise and now these days people call about non ionizing and ionizing radiation and all how it grades affected is an older thing.

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I have taken what you call extensive, I have depended on extensively on what is available in the free domain you see all those aluminum, various things as a fan there and there are what you call gold colored some pipes, then so on things are become complicated; what looks like a very simple PC or what you call a laptop is not as easy as it is it just to do everything.

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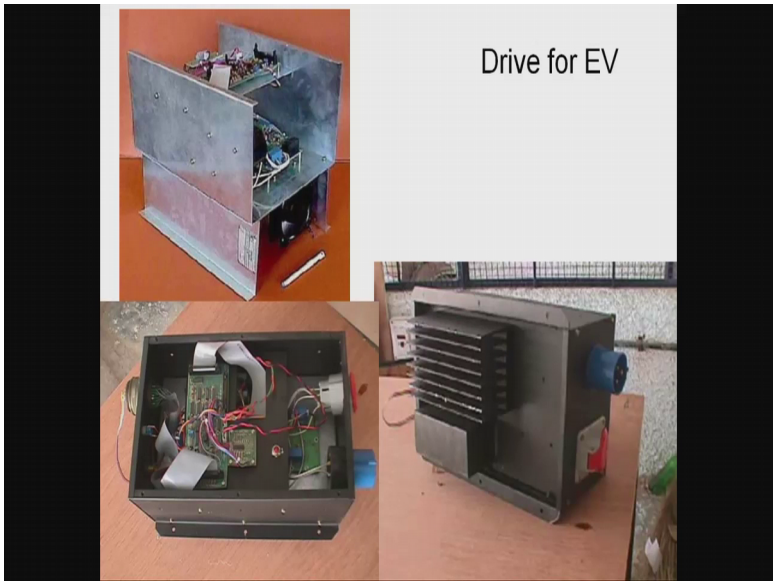

And you see this; what are group has done. These a drive for a electric vehicle left side that was what was we know; we could finally, finalize a design and all that and then

eventually, it ended up in this beautiful enclosure. One of the first thing you will see in this enclosure is there are special connectors here, you have seen these connectors get the power in and send the power out the once with the pins are the plug configuration is the one that fits the motor that blue colored device and this red one is the one where we get the power from power into it.

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And then at the left side, we have a multi pole connector multi way connector which ensures that all the signals and all are taken care of my colleagues in the field, they have been working on agricultural; what you call sensor operations. You see thus 2; what you call dedicated people of the thing, it is a wooden pole something you know which we could add it on the top and then they have put various antennas, they have made enclosures and you see right side top, no, this enclosure is the one that they have made, we can seal it here, then what about the actual sensor, how does it get sealed and still it has to be contact with the moisture the thing around and all that no this lecture series is a little about it.

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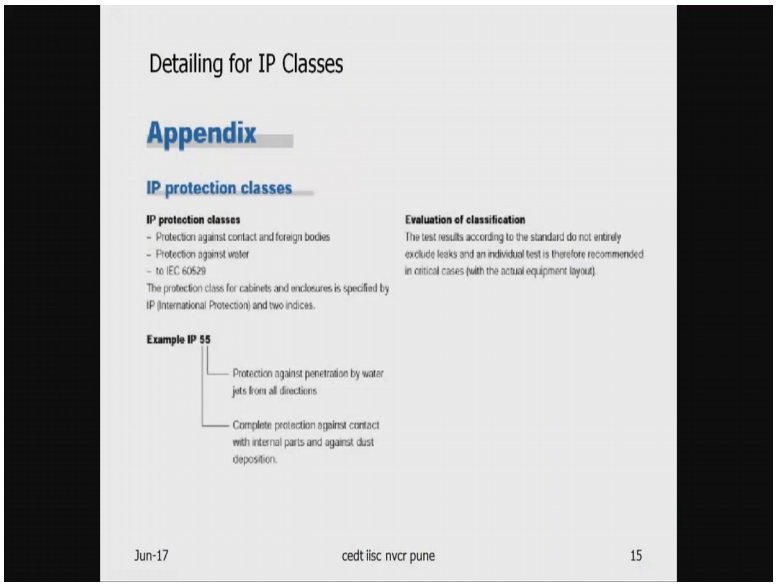

But and then we have the stuff about IP protection or index of protection as per IEC, you know 60529; what do this things been evaluation of you know classifications and so on.

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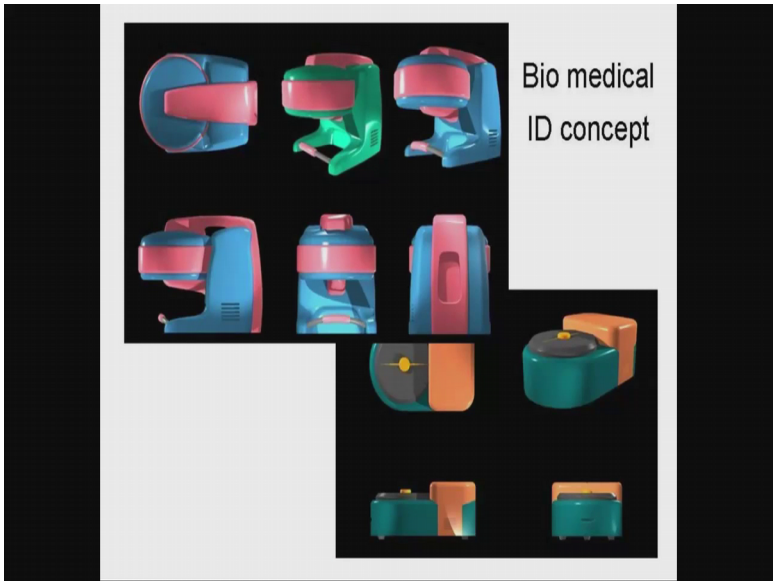

How do you do it at; try to explain a little in this lectures, while that is real and that is something related to what we say technical the something which is user is related in this another design, student made as all this some bio medical equipment, you know which should be easily this start and all that and identifiable and so on.

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There is a small list of all the lectures that have been included this the total 30 hours and then thing have been split into 60 sessions, enclosure design for electronics equipment drums is the little one of the longer ones; there is a first lecture part of this things what we have seen are from there, then you have a aspects and features that are non electrical and essential to electronic product realization electronics people; the field has become. So, specialized them us to do tremendous analysis and optimization, it is not left that much to simple gas work or gut feeling. So, a smart of this non electrical things are all those features which is talking about saying, how do you make sure, it is very much presentable like that. So, next one in line, small electronic equipment; how do you do the simple design; you should go through the lecture in patience, then design as apply to small electronics products and projects.

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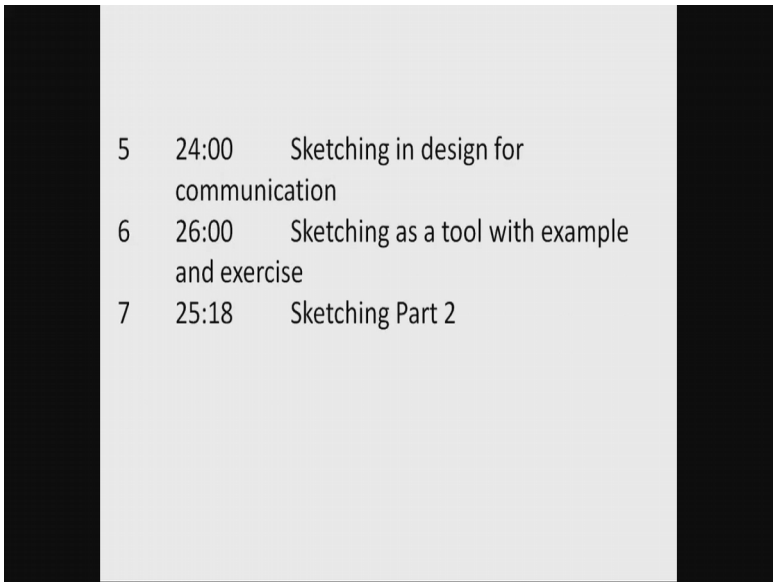

So, I tried to show something next picture actually comes to something which we; what we call, we enjoy, but not if it is your main work, I am sure several engineering students do not like drawing and they would have been or try to do other thing, but then drawing is essential for communication. So, we have a highly developed engineering language and how to do representation if here electronics people, you know, schematics, you know presentation in a schematic; what represents what and how it is and in the case of mechanical, we also have such sayings; how are the; what you call 3 view engineering drawings are prepared and so on like that; however, at the case of products, something else comes into place somehow, we need to learn sketching to quickly communicate our ideas to everybody and as we communicate and has, we sketch, we improve our own understanding of the product.

And at this point, fortunately on our princess, we had some what you call trained graphics designers, but then I have relatively and try to retrieve things from the internet from various; what you call blogs and so on. So, one of those things I have included it and then I would like to acknowledge.

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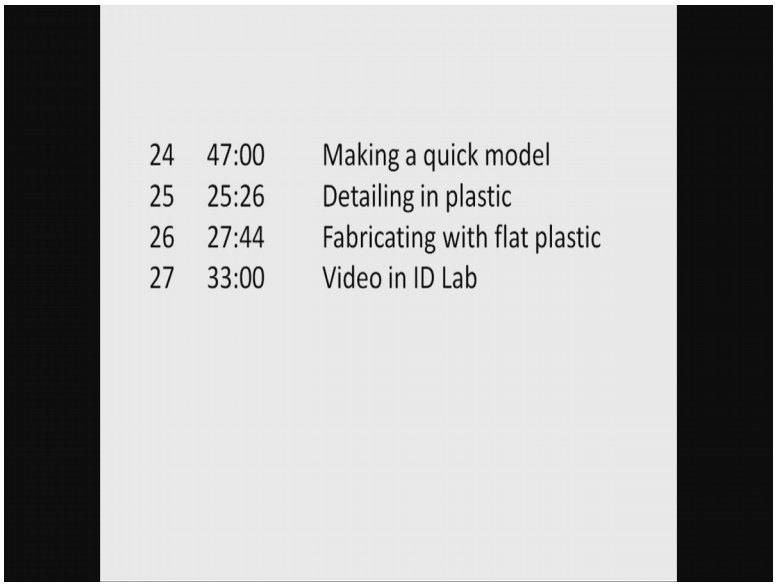

So, acknowledge in the lecture properly, you should understand how difficult it is to make it in all the trouble they have gone and putting it, you must try it out in yourself. Next comes to have end on the sketching and all that invariably we need to make a quick model and they are all familiar with this model making when it comes to architectural models and in fact, where I missed at it when use an architectural model you. In fact, you get a bird's eye view of the whole world all around that bird's eye view seems to be impressed, I have changed. Now its record online only, I thought deserve, it is other shirt instead of hats, you know, this my normal shirts which I wear that was intentional, I wanted to show that I am from IISE and then this is what is my normal wear in all my lectures, I appear like this. So, you notice that all this architecture models and all that they are made in a particular way, they are very very impressive and in fact, these days, it has gone to the next level saying a lot of the MIR renderings.

And there end rings have been. So, convincing and in ignescent point of view has been arranged well difficult for you to believe that it is not a real place that is a; they first make the, it is again one more thing, unless you have demand, you can start the constructions, unless they are something, you know some idea which we need to know, nobody will pick parts of the project. So, your most likely de-comment to contact to these things there and then if you are one of those curious peoples and you keep looking for products all around and if you gone to the CES, the convection which is held in sorry convention which is held announcing new products. Suddenly you will discover does a

new world out there and it is ready; something which happens with hot mobile shows and it is a matter of time from the time, you see the concept and the actual availability for you getting shorter and shorter, some of them are available in next year, may be was in 12 months and somebody has worked on it earlier, some of them text them little longer, we call it futuristic.

So, you need to find out how to make a quick model and then stuff in plastic and then I try to make it relatively simple and easy. So, that what the key to it is you must attempt it and make it yourself and we do not; there is no way of my sending you a kit and this is not the full thing.

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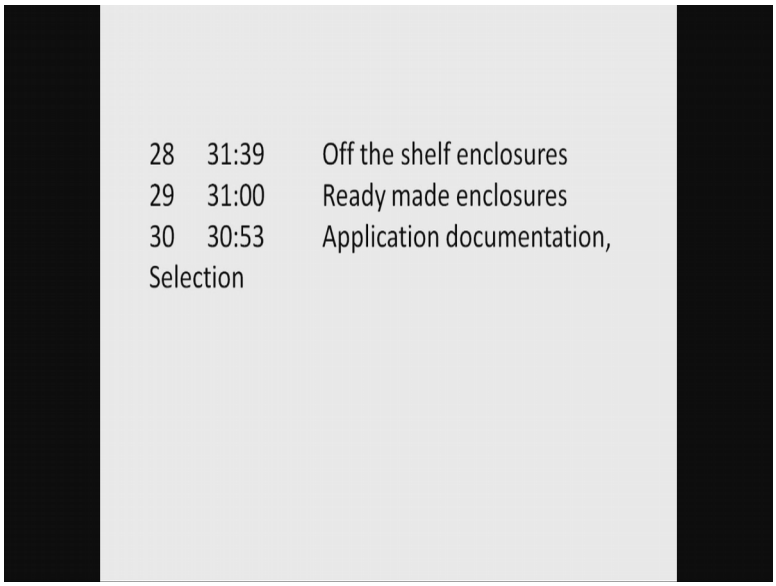

You need to practice it on your own and then try to make things having done. This we come back to some where very important thing in the case of all our in reality. Reality is very rarely people start for usual small projects and may be a few 100 enclosures, it is unlikely everybody tries to start from the beginning and make a new full enclosure for it. So, anything you can think of is probably off the shelf, it is available. We need to go around look for the catalogs and then after the e commerce and what you call this online thing has started things may look a little expensive, but anything you can think of it is already available with more features when you thought were necessary.

And then related to that is the documentation; how do you read the documents they have presented there, how do you select one of them at this point, it is a what you call, I will

not call it a trial and error, I will say it has you know learning experience a probably start with this slightly bigger you know volume than required after that you try to after make the first unit.

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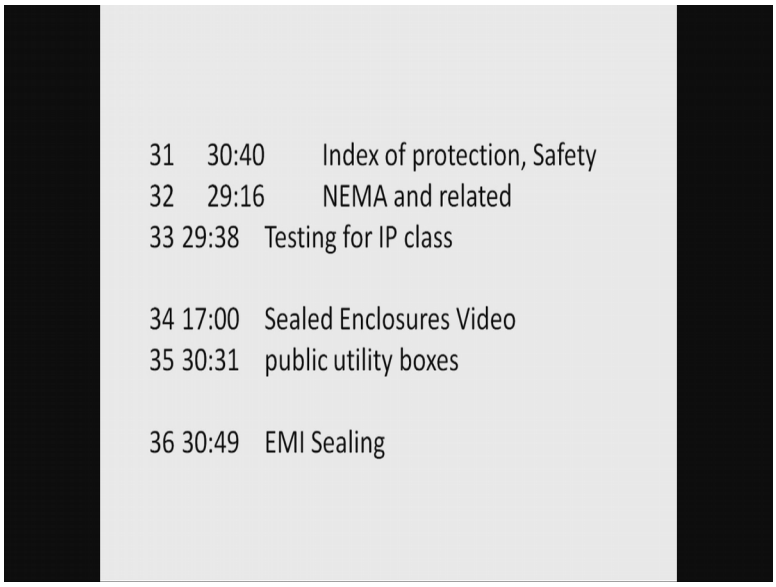

Then you once again go back to the; what you call the catalogs and select things. We come to very very interesting things, here you have seen this, there is something about safety. So, we over here in this parts, I think we believe that some benefactor protecting as out there. So, we are relate lax in it, since we have shown you examples of things which are not you know very very safe, local things and eventually everything was back to this index of protection class that has been started from the IIC and de-norms and parallely that the you know American what you call electrical manufactures association had themselves much before these electronics sink came, they went about standardizing.

So, we have an Nema classes and then there is a little a testing. So, this testing well, I have seen it in reality, you probably have to look up the you know videos online to see how harsh things can be, then on over premises we have a 5 of these sealed enclosures which have using for some equipment, wanted to show you, this the one what I was talking to you in which you know wait into be wait into believe it is alright, somebody will take care of this public like utility, various things are kept outside not at a vandalism that not maintained well. So, I have taken pictures of those things which I feel know; they asre valid for anybody and slowly we come to a bordering rather border line area

called EMI sealing, they affects are felt electrically, but they handling is very mechanical and fabrication people.

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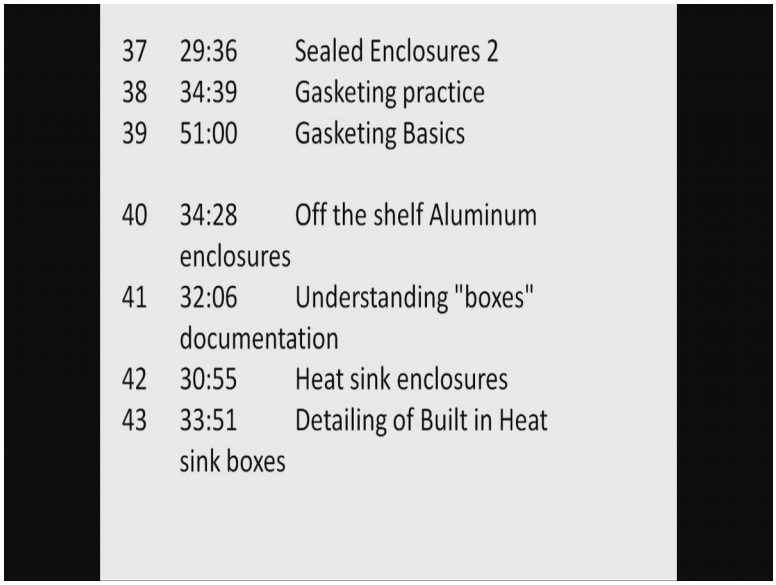

So, this EMI ceiling is critical, then after that something about little more details about the sealed enclosures, then how do you made gasketing practice; gasketing basics these 2 basics and practice is actually taking from various process, it is readable. If you are in that area, if you have not in that not particularly interested in it, he need not pay too much attention starting from 40th lecture, you see that off the shelf, there are various enclosures made out of metal and then the 41; what you call a lecture noise about calling at a box understanding boxes and documentation.

So, in at least here you cannot think out of the box, you can think about the box and then tremendous documentation is available and then you need to see, how will you can understand something for you very much related to; it is that is the word aluminum has been used there very much related to this is enclosures which with heat sink built into in and then how do you detail in and then how do you detail the insides of the; since how do you read, the documentation once more if you go out and say all the things which see all over players. Now these days you have the GSM and CDMA boxes and all that nice they just work

I have no clue about the electronics because they said to complicated where at least the heat sinks.

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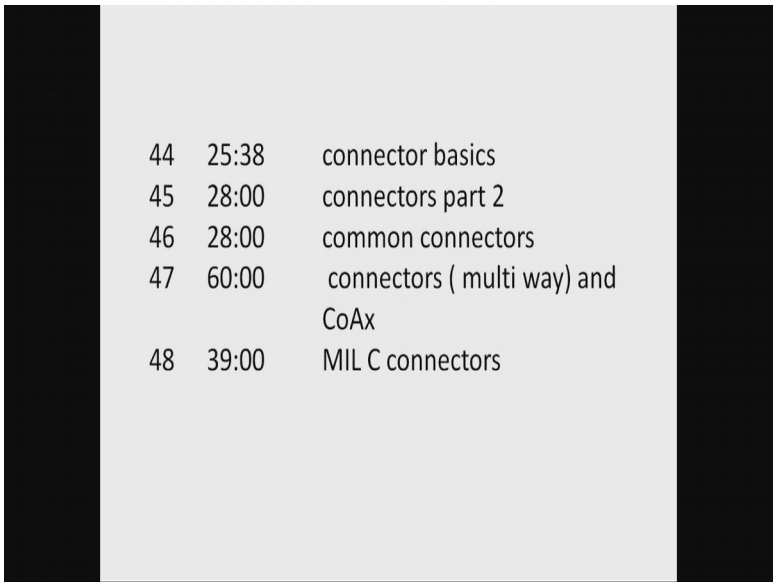

And those things are understandable something which has started in the one of the earlier slides about have covered was both of the things, if you see, first of all know how to handle the heat business, then about the other functional aspects, we come to inter connection aspects of it. In this case is particularly about how to choose a proper connector such that they are enclosure works properly, it will never fail, this has been directly taken from trade catalogs and whatever then unsupplied and at the time of retrieval that is around may 2017, these were current, but I suggest you go back and see what else is available some of them look R K connection, but things are very valid like current carrying capacity number of this orientation and son like that basic USB, it is a standard and then we have A and B and then have a minion day micro USB and then we have a host and then we have the; you shall plug in and all that standards are fixed and slowly thinks are getting evolved as they become smaller and smaller this things have not changed.

Similarly, if you talk about the n type of connector or in the case of power things, these things are not changed, they are still there under likely to continue. So, that lecture was about the connectors the next lecture, if you see here.

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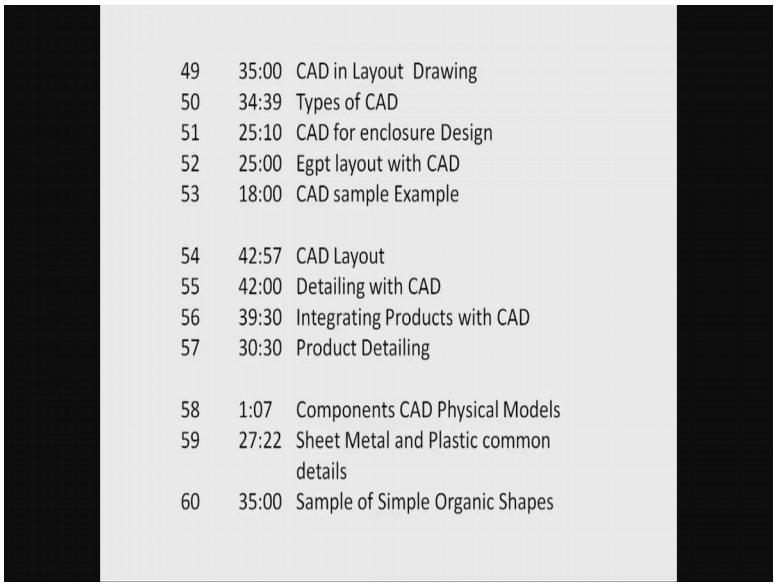

This is something which has been a convenience and both blessing and you know met things to easy. So, we have this compute rated design in layout. So, in this case again I would like to stress that we have compute rated design from the analytical optimization point of view, compute rated design from the way of making manufacturing easy how do you make drawings and for us to understand the various things is are about how to layout all the components and parts and all these things. So, over your personal carrier, if you can build up a library, it is have going and bringing the parts you just bring the library and arrange things well, it has been done extremely well in EDA design; electronic design automation it is not that easily done at this level.

Again architecture; we have piping drawing and such standardized everything you know structural elements are standardized now gets our equipment is still have. It is a prerogative of the designer. So, this find, no, I do not know how 2 types of CAD that too many out there, whatever I am familiar with have used it over here in Bangalore, 2 of the things about the desalt and Semen's have understanding with collages. So, ether solid works are solid edge histote by default and I am sure lot of Prohi people and Katia and Prohi people and so many of you are there and then good or Autodesk products are out there, all of them are equally welcome, I am not endorsing one or the other and if you have the what you call patience and go download limited, you know, user limited save use it short time and in my considered opinion by one by anything is as good as you by.

So, coming back to our list of the slides here you see that how to make CAD equipment its look too much of it know, but I have kept on trying to go to examples as possible, CAD sample example layout integrating products with CAD product detailing and comes to CAD physical models saying just like just like you are able to use your radio tools for having a schematic run beautiful simulation that is you can have a mixed mold enlarged distal simulation at any frequency you are like and eventually after you make a physical printed wiring board everything is accounted for and then you never have a surprise because process people will take care of the other integrity of the physical fabrication.

And you as a electronic designer have made taken care of everything starting schematic diagram making rats nest making a layout running simulation and making tools available tools in that case are various, what you call photolithography devices and drilling and routing something which manufactures attend, then there are programs which take your programs and then optimize things are large panels. So, I think 600 mm and 600 mm seems to be a standard panel, I am not familiar with it, everything gets done as magic, automatically it is not as big magic as a scan are the one inside our heads, but it still a working magic.

In the case of mechanical what has happened is this files; this CAD files can now be sent down stream for the full manufacture, it is plastic, you just need to make the part and then plastic you know gets done automatically. In case it is metal shit; metal including you know hyper gasketing is available and laserketing is available. It gets done automatically; not automatically with lot of human intervention, solids milling is no issue at all, see and see started with actually machining and now something which some of us you know re-messed when we see it on a TV and the little hurt when we get late or saying assembly is automatic. So, all this new programs which had mentioned, they also take care of sequence of assembly and so on and there are process planning people who take this drawings and ensure know you make a robot which makes your car ATS far far safer.

Then what you would assembled yourself this is about summarizes all the lectures and all which are like to will be covered, they are 60 sessions and then if you go through the things, I am not yet fully familiar with it help is on hand somebody is there and then the MOOC and NPTEL people have certain requirements and all that which I am sure; there are you know where the time of registration and all those things are there, I am not what

you call; I will be, I am not very clear about it because my this thing is only about the technical part of it; how are trying to clarify our any gaps you understanding all that help is on hand.

So, thank you and I will say welcome to the course and one small apology I would like to do, I mean I would like to take for your first in my hulls which is accented. In fact, in some of things, somebody has written; why does he not speak in English to me, it look like English. So, kindly what you call, I wants a put up with me understand or limitation this only where not to take and all of us talk like this written understand we can do there is no simple transcription available. Secondly, I have relayed heavily on online public resources. So, in a way, while I am not, what you call selling or marketing any once products, it is retrieved from the interknitted the time of it.

I am happy that such information has been put there and if I feel all of you know should also do and in case there some requirements there know make use of it and things change do not look at what is presented here and then think know, this is the end. May be 2 years or 3 years onwards you know many many more items, especially connectors and all those standard enclosures and then various types of you know programs all of them keep coming up all the time. So, to some up I have small issue with accented speech. Secondly, I have relied on online resources which I expect you to do thirdly which as probably final and I will stop here all the time, new questions are coming, new problems are you know cropping up that no answers, there are no can dancers.

And what if you do like that; automatically something else will happen there you need to you know try and come out with alternatives. Once an alternative as come then try to work out things until they come into the proper form and then in I think it is time I stop here. So, thank you, I will be looking forward for you for taking this class and then giving whatever benefit out of it and may be for a second round, we can probably take a feed back and try to see, but the only problem is in making it general, we can lose you know the specifics and making it very specific, the abstraction is lost. I tried to make a proper what you call balance between them and if you start young, if you do not understand do not worry about it. if you are let us say somebody will started in first or second year of engineering is right time to start. if you are a school what you call project person people see your project will be amidst it where did you get all this you need not credit me, but it is available for you.

Thank you, I will stop here, bye.