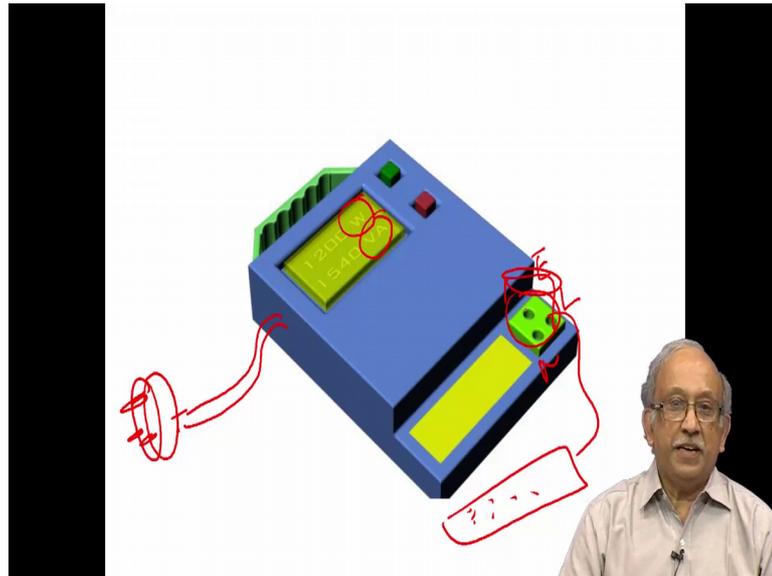


Enclosure Design of Electronics Equipment
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Lecture – 03
Enclosure Design in electronic equipment

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This one is a power meter before the time came when you know we have these small things, the advantage are main thing how it was conceived that it will also have it is own backup power supply inside meaning it can store the things I can store each a item which is there then similarly I can take an output and in fact, more outputs are required, I can even what you call put an extension cord add more load to that one of the typical example I can talk to you is about once upon a time we had this beautiful incandescent lamps you cannot wish away the incandescent lamp even today if you take a small alarm clock usually it has a small lamp inside and today it continues to be incandescent lamp because there is no LED without electronics which works at the 0.9 volts, with which take main what you call the time module works the watch module are all designed such that they work up to 0.9 volts, but usually around one volt we will notice it and we will change it.

So, you need to have an incandescent lamp which works with that low voltage. So, it continues to be there and even if you see several of your car headlights and all that they

are still various what you call you know filament driven things like that including if you have I do not know some hex on or some new lamps are there I am not able to get the name like that, they are still continue to get you know use power and produce a bit of heat, but then when next level when the fluorescent lamps came we were all happy saying the total power has reduced, and then only suddenly the CFLs came that is compact fluorescent lamp a CFLs is nothing, but a regular fluorescent lamp excited fold it and then you have everything on one side like this and then suddenly the LED bulbs have come.

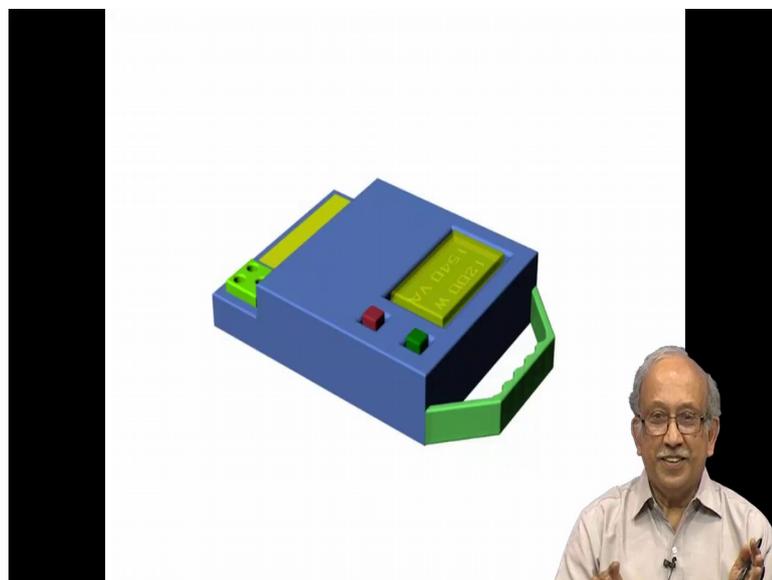
So, called LED bulbs or lamps like that with the critical component, and it is how much power does it consume and then after the power how much light it gives. So, suddenly now we are all familiar with lumens now. So, unless someone something gives a 100 lumens per (Refer Time: 02:37) watt it is no longer lamp as we know it. So, this particular product was made such that things like a lamp load and all you can take power from this here. So, we have in our case no in India we have this is the earth and this is the line and then this is the neutral. So, you can always put a thing here put an extension called and then put any loads here and plot all these things here saying how much of power is there and then you see one very important thing.

Now we have something is w or as the Europeans call it a double way double v which is logical then there is something called a va ; obviously, v into v is not the same as what is there is something called reactive and something called a actual power and so, on and the issue is not about the pearltrans issue is this is made in a rugged case it also has a little bit of a battery backup inside and charged online and what is not shown is on the other side, we have a usual cable here and then it comes with the you should plug you plug it inside carry it around. And then after that you can carry on the measurement said you would like to do the battery they what you call the power source inside does not you cannot power anything out from that, but it will store all the values that you have measured.

So, if I were to take this studio and find out if I were to replace all these lamps what will be the what you call power consumption, I can use this meter for it is a good concept right now there very expensive, but you can rig up one very easily in your thing if you are a engineer working in a let us say engineering college or a lab or anything most of the components are available we just need to do a good reliable box.

So, I will use the word if I use the word box no it does not what you call it is not a correct thing to do, you need a good enclosure one first thing is it will it should protect all the insides from the outside environment and people from outside when the inside environment accidentally nobody should get short circuited, nobody should get you know I am sorry we should get electrocuted or short circuit some things from inside. So, we have several features which are built into it now, including whether you can hang it from somewhere and use it or you mounted permanently somewhere or imagine you are in the retail you are in electrical shop they will tell you sir this CFL takes only ten watts I take the CFL plug it in here.

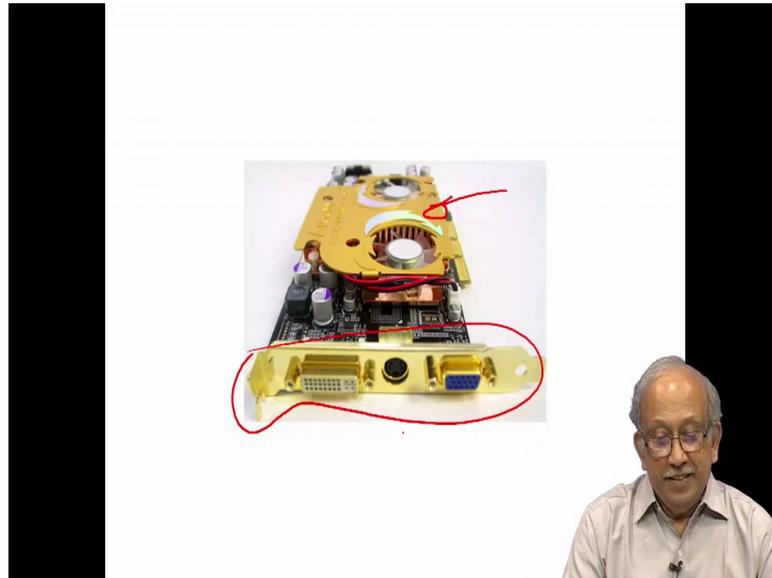
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And check whether it is 10watts or not you see at the back of it now we have this we have two nice switches and then we have a beautiful of this thing and then incidentally this dark portion is insulator and then this green portion here now is a handle by which it will make sure it does not slip in the way it was made, it was made that it can withstand 650 volts.

So, accidentally there is nothing that is in our 230 volt system in India, we have the 400 volts from any two phases the voltage we have is 400 volts not for 40. For 40 is some other issue nothing related to this, but all equipments are generally designed up to 600 to 625, the whole thing has been made though it is a metallic enclosure you have to make sure.

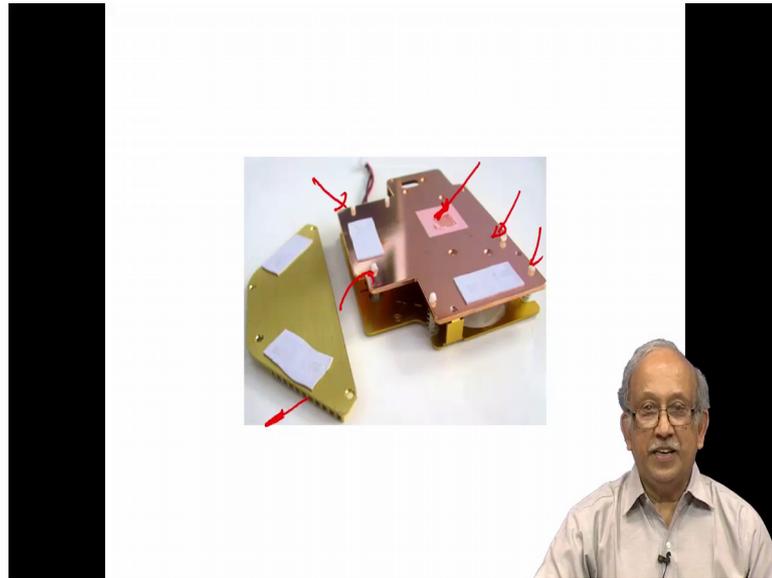
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That we do not get electrocuted by it or we do not accidentally spoil it very interesting thing no very easy thing now why do you get back to a very simple graphics card inside a computer what does it have to do with this course this is where you will notice that packaging is important packaging is critical while we look on graphics card at it is processing capability and how much of onboard memory it has or anything the important thing is if you see here the this is a fantastic you seen that know what a tremendous amount of cooling that trying to use and then we have a fan here and all around the fan we have some fins.

And then you have copper and then more important is that we have this beautiful you know connecting thing you should be compatible it is 100 percent compatible with the existing pc any pc which is about 10 years old and if you want to upgrade it you should be able to go here and buy this card and push it inside on one of the important thing you will see is you seen.

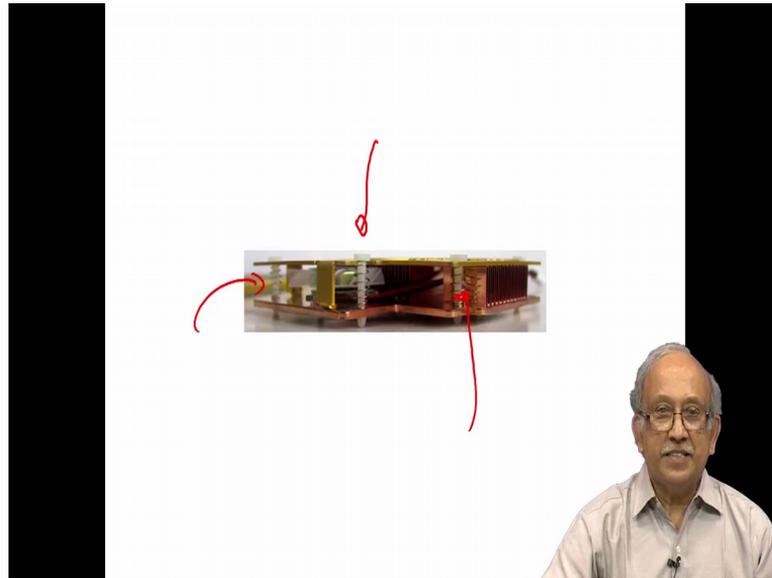
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This this is all the heat sinking part of it you remember in the earlier slide I show you some pachi pachi things on top of a card this is the heat conducting paste that is used and we just paste it onto that have you notice something about it this does not have the carrot stick black color anymore it is not black, but then why all heat devices should be black no not necessary depending on the function, and depending on how well you and some of them. In fact, are given a beautiful this is I do not make maybe actually made of copper this is probably copper and the copper has what you call fins that are either attached to it or part of it, and then you have certain you know cover and all on this side this is the actual heat sink can you see here you it has fins this will go over the other thing and then it will start spreading the heat around.

And I say most important you see here, they are small plastic nobs here have seen this there is nothing that is called a small stand of something for the PCB to sit on top of it if you see one of the earlier lecture earlier slides I showed you there are some points in which the PCBs mounted is just pushed on top of it and it this ensures this that the top portion gets attached to it with the minimum air gap the, but air is a insulator incidentally when we talk about insulation like when we wear a shirt or when we wear a cap or when we put insulation around anything even eating or anything in the house and all that the air which is the insulator not the in between the solid that is there in fact, they try to minimize the solid because any solid has higher conduction.

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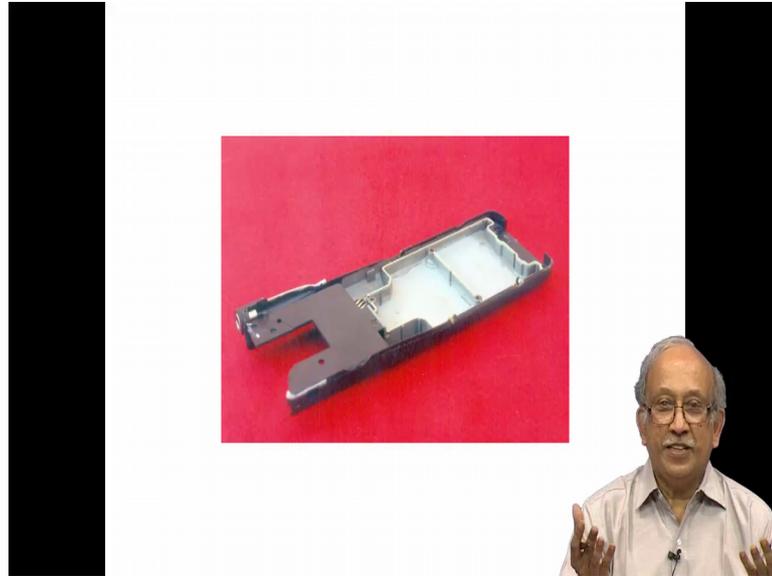
Then air at the normal times now you see you see inside suddenly you notice very very interesting things we have a snaky thing here.

And we have an equally snaky spring thing here and then we have that plastic nobs which I have showing you all around not every time you need a permanent firm semi permanent connection a lot of time the little bit of flexibility is needed that is where our engineering skills you know. I made a statement earlier saying any engineer can make you know an article optimize the thing and it is all what to make is what we do not know how to make we know it is not very true I will now retract the statement saying engineers are also working hard for us as a consumer and for us as product designers and for us as marketing people, to make sure that a new materials new method of you know attaching things and all are there all the time you have a spring here which ensures a little bit of cushioning is there, if something is may rigid the moment there are any heat or any other aspect two things can happen one of them is something will crack, you cannot constrain anything.

So, if you a nature if you see there nothing if bones become stiff they become fragile and break as long as what you call in in organic systems, things are generally flexible much much much more flexible than the one which man tries to make men tries to imitate certain things sorry for getting into a philosophical thing, we try to take cues to make

sure know in which direction the forces should be applied and then we have called isotropic anisotropic materials and so on.

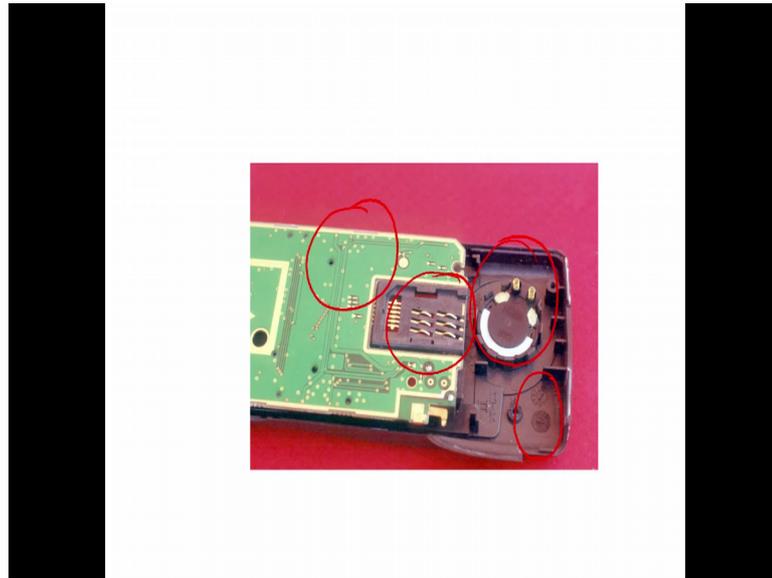
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Now I will get back to slides which I showed you in the yesterdays lecture, this is part of the case of the earliest cell phones I do not know maybe it is a Siemens or anything, you will see that even all there is not made of a single one type of a molding material we have metals, we have some flat portions and then some barrier like thing they have made which ensures that is there and finally, you cannot avoid this springy context you cannot make rigid context and expect them to what you call to your function all the time.

So, whenever you have either a SD card or you have your GSM what you call the sim card and all that no you will find these small things here being used all the time more and more interesting thing you have seen this.

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So, we have something this is the one that reads a sim card looks simple, but inside it is not as simple as it looks. You see that everything has to be springy or rather flexible ensure that you get a proper contact and then we have a place here for a ringer right now they have been optimizing it and then there a that speaker which you get in this no it is just a single line with the single line itself the single line itself they are able to communicate effective load originally they were big. Why I continue to show this slide in all my lectures is you see the amount of effort that is taken to make it sure that EMI and ESD effects are minimized all around, you have a guard and then everything you have a neutral or what you call I am sorry a ground plane and then all the power connections everything run through the distinct parallel to it.

So, only one aspect of it where I said earlier no you cannot pigeonhole it somebody who is making the printed wiring board should understand all these aspects and finally, the person who is making the enclosure make sure that things are working without any problem, and then I will see if I can enlarge this portion. In this corner if you see carefully you will notice something related to the prediction are all marked here saying in which batch the mold was made or was thing.

So, you have a what you call a pointer here and then two pointers it will show you what type of production process they have used when it was produced and all that knows the

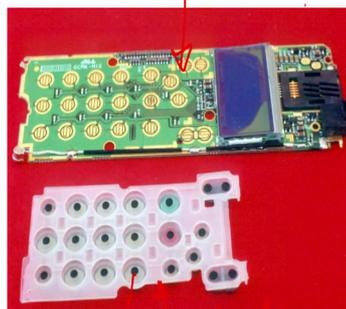
can trace back in case there is a problem they can always trace back and find out how well these things are produced.

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See slightly as it is getting populated you will notice that more and more and more complicated shapes are all done.

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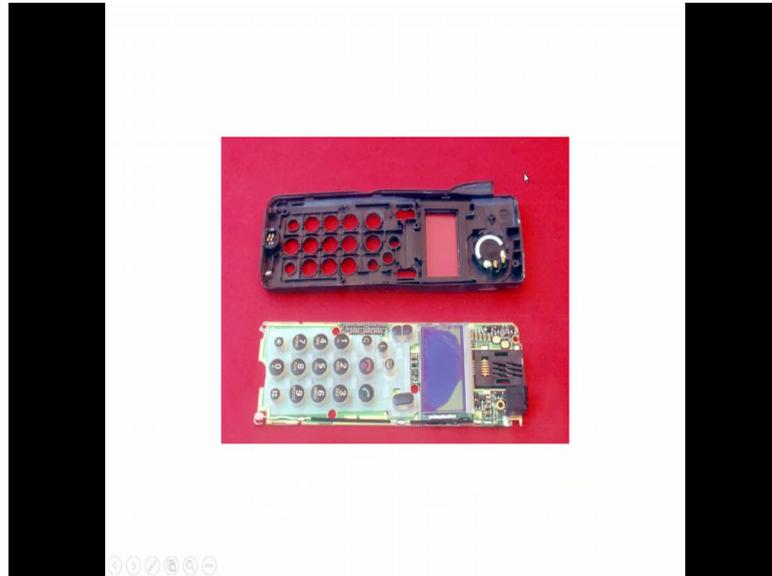


Contact pad! Elastomer!

We finally, come down to this detail which I showed you yesterday one more time saying things like and the input output this point of it is the one that actually makes the cont I mean is the contact pad and these this is an elastomer, means it is a flexible material and

then this is the actual pad, this contact pad ensures that a contact is made and all that I will show you the current things next round, but right now it is a good starting point and then if you remember those flexible connections here they come here.

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What you see outside is only those things oh and then you have a box it is not as if it is obsolete. Now if you go back and see your TV remote which you have in the house typically a TV remote typically a TV remote continues to have the same thing.

So, you have a something with you hold it has a power source a battery inside, I am sorry two cells form a battery you have cells and then on the top you have this keypad which you press. You get frustrated if the if there is a loose contact, but you know what to do you bang it bang it like this, and then you also take the thing and rotate it and it works only if it does not work you change the battery.

So, thing what we need to remember it that is whenever you have any contact what is called a pressure contact from two sources, and typically if the form different materials they invariably end up with a little bit of corrosion in that point. The this is where a mechanical designer has to find out compatibility of all the finishes. Any product you take which has the cells inside first thing you will notice is you need to take it out and you know rub it on a hard surface or somewhere put it back at least temperately it will be back end function two things happen one is in case of what you call a corrosive film

forms you can remove it. Secondly, that little bit of time it takes no it will allow the thing to pick up the voltage and that is enough for you to operate your remote.

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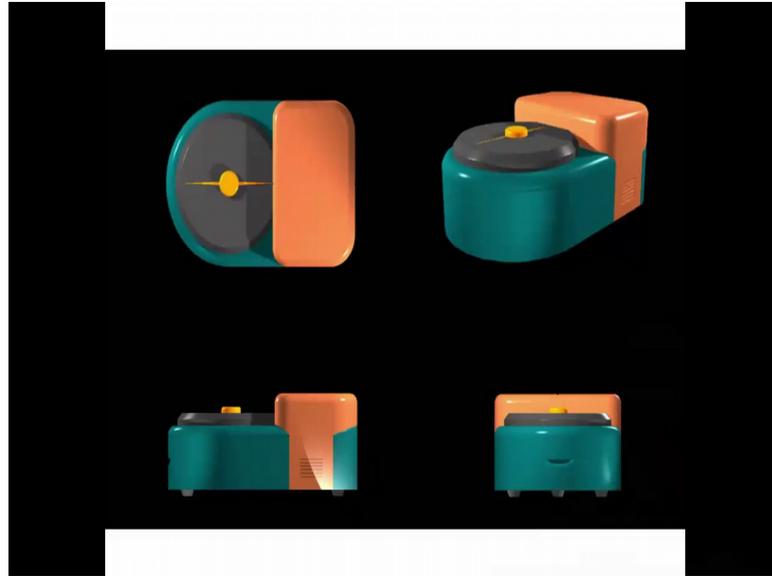
So, inside the remote control even today they continue to use these what you call this sort of things here you have a cover and then finally, when the phone is close to you see the phone will look like this sir please sir put this yeah you see here it is beautiful it does a GSM with the old Simmons phone have a up and down case is a beautiful speaker here there is a microphone, I seen that it once upon a time no microphone was very very critical.

Now these days we do not even know where it is and there is a display as I have told you earlier there is a damaged one and hence the display is not there and then all the keys are there, but you see very important thing to notice here is you see these two what you call pictograms they still represent a hand set as you would find on a desk phone saying make take something you know pick up the handset and put down the handset, those what you call population stereotypes continue to be with us you do not have a off and on or you know drop call or anything which has come later on like that even now, these are still valid similarly the old code where you maintain all these what you call numbers.

So, starting from one two three know you have abcd of all the way w x y z all the keys and then you have the star and hash keys, they continue to be used as probably

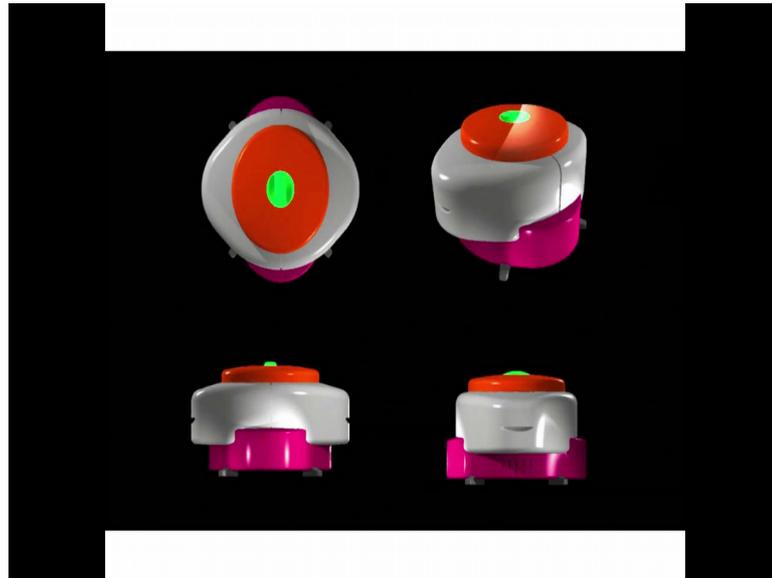
conceptualized in old bell times originals when the original bell hand set and all came. So, I will go to the next slide now.

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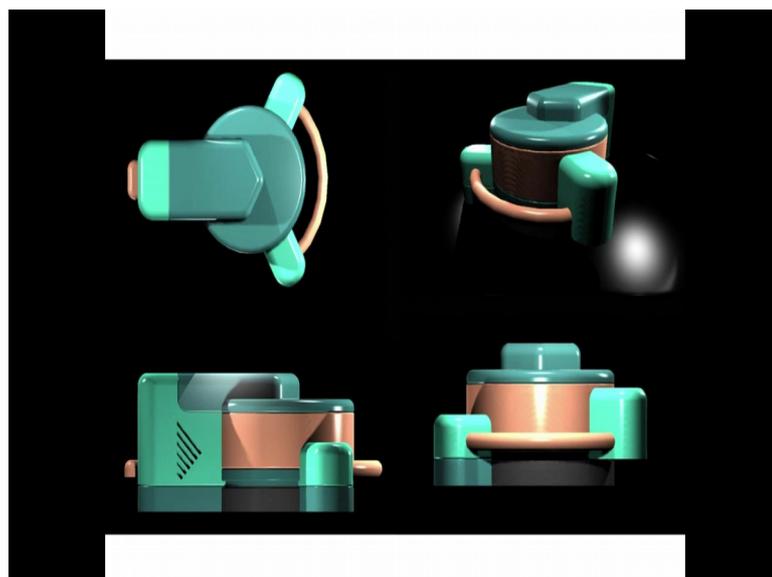
I showed you this yesterday saying this is have typically a biomedical what you call equipment can look like, this is used for human gonadotropin trials you have a carousel here, this carousel you know you open this cover and put the carousel inside and we insure that external contaminants do not enter this, similarly you have to ensure that internal thing do not escape out and to do everything and then you see all these beautiful round edges except one or two places most of the time now, there are no crevices which cannot be cleaned you can always clean this you see here no you take a wet cloth or in the case of after changing the wet cloth now, they also have some separate what you call sanitizer which is not the same as the hand senator whatever little more harsh shall ensure that bacteria and all will not survive while this is one of the simple examples other alternatives also were considered.

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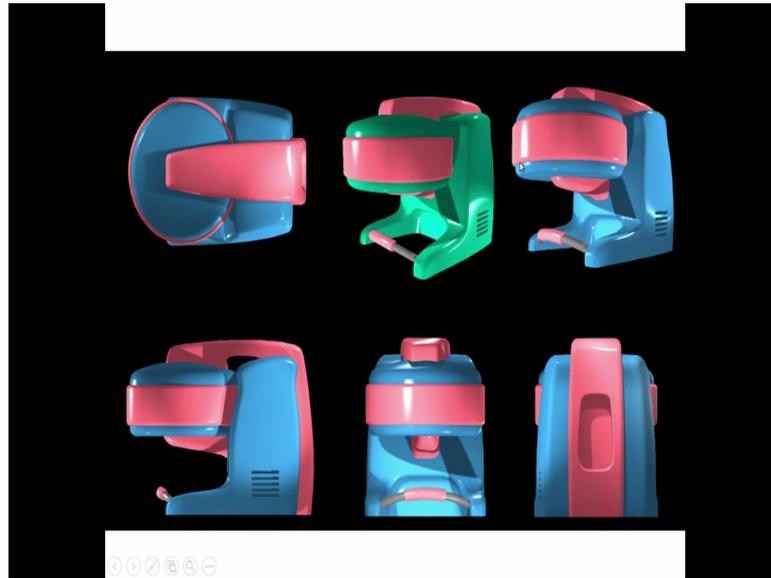
Why I am saying this unlike engineering where often we tend to have a correct answer, in the case of design there are multiple solutions no two solutions have the same order say outcome, it is always a compromise between several options that are possible is also same thing the core part of it is you have a carousel here, the carousel is a very core part of it here.

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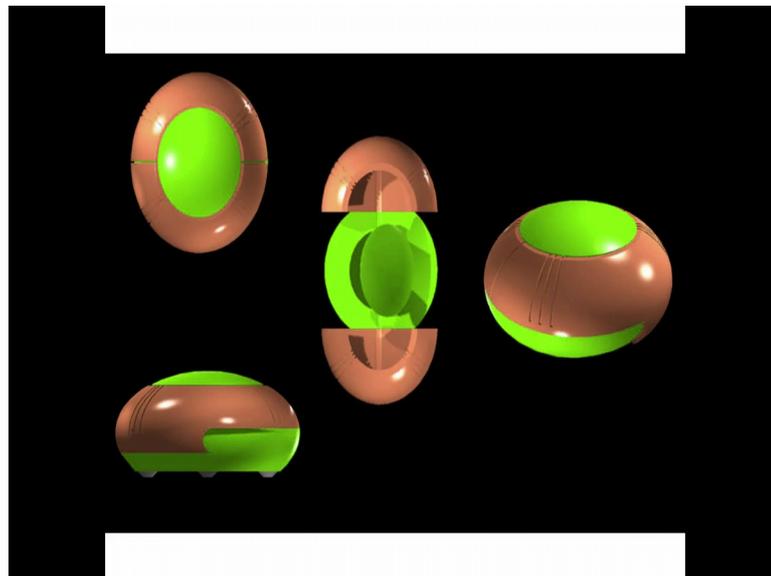
And then you have various you know things about taking and then you have a handle how to carry it and then can you hold it carefully and carry it without contaminating.

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So, these are all the several things which somebody needs to break into everything and all that this was the final thing which I showed you already yesterday, and then something important seems to be the color suddenly everything looks colorful we never thought we needed a color in biology equipment no.

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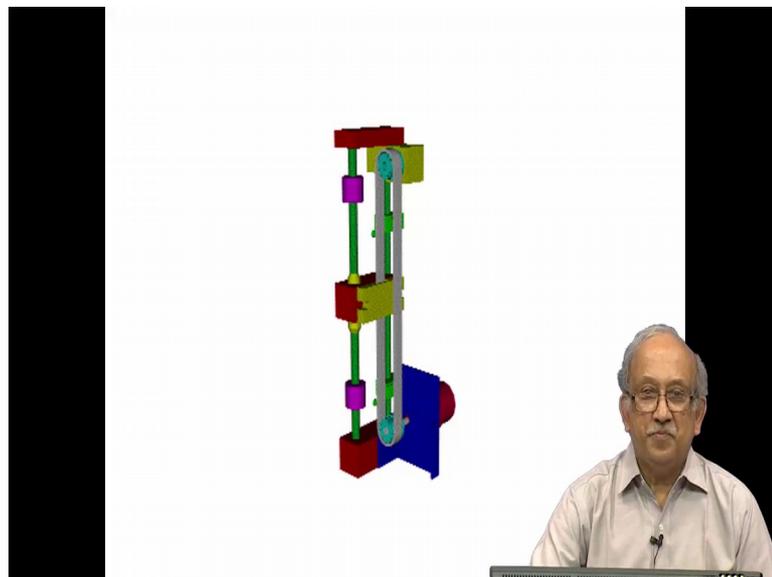


But we have them it is getting interesting very very very interesting why cannot we have it more like this you see here it is a beauty. I mean geometry person may call it a oblate spheroid it is a big name for something which looks nice and cute. In fact, it looks a little

like a robo, it looks like that robo you know which goes around cleans it yes that was part of these things saying we have to make sure that once you close it and completely enclose in even dust and or does not settle outside. This concept could not be implemented implementation is a next level, but first level if you say no in the mind we should make the concept like this, and then all the time keeping in assure that they all the requirements.

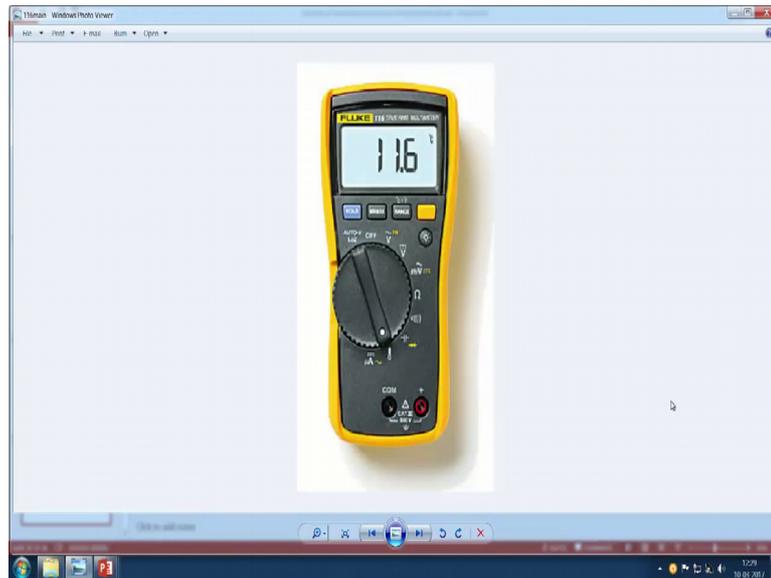
So, that we have how do you open this there is no simple way of opening a hatch or opening it and loading it, and then how do you use it while as a concept it is fantastic we are not yet ready for it.

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So, is something else this is something to do with the some radioactive equipment and so on. Now at this point you see here I thought of giving an exercise for you serious people hopefully you have got a little bit of exposure to how to go about it, a now I will show you my first slide. So, this first slide shows you what could be a very simple.

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It is a handheld meter some meter I do not even know what the meter is I will said the lucky meter because it is by fluke, but then all this what you call the form and shape and the input output have not come by fluke have been designed by fluke, and very thoughtfully they have design we have seen these things I have noticed first of all that is display looks a little bigger than what it can hold in the hand, and then you have something red and you have common and they have a beautiful nob here we have beautiful nob here which has something which you can use for turning.

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Then we also have something where you can thumb it followed no I just use my thumb here and then I turn it like this is this point, I turn like this a nice little turn plus I can use this and turn this also at the top. So, you see here this is the first thing now having gone here.

I think you know what it is, is a full digital oscilloscope hand held and then we all know oscilloscope is it is quite on the table on the desktop, but then it has something else you have a beautiful hard case which does not get to destroyed easily even by accident it falls it is unlikely.

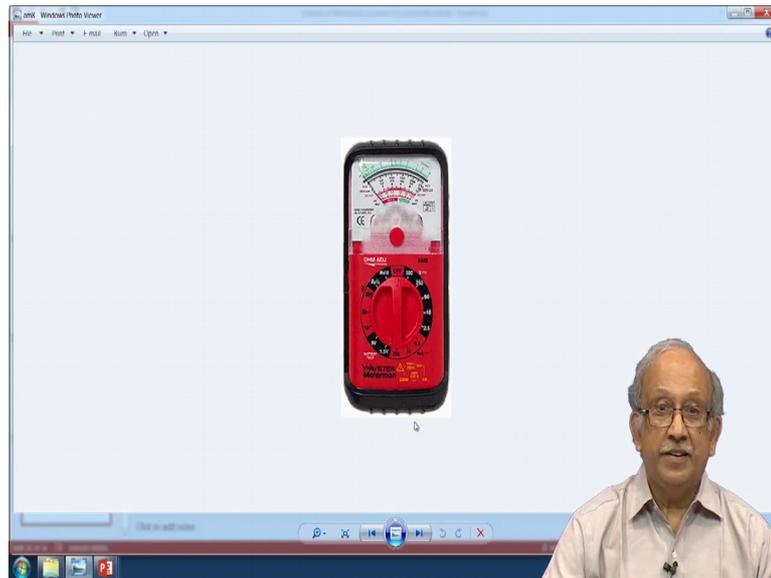
That it will get damaged and then there is a stand at the back plus we also have a nice what you call carry handle here, maybe you can carry it or same thing can be used as a sling. So, you have so many of these things oh beauty more and more handled instruments, but many they are getting more and more colourful.

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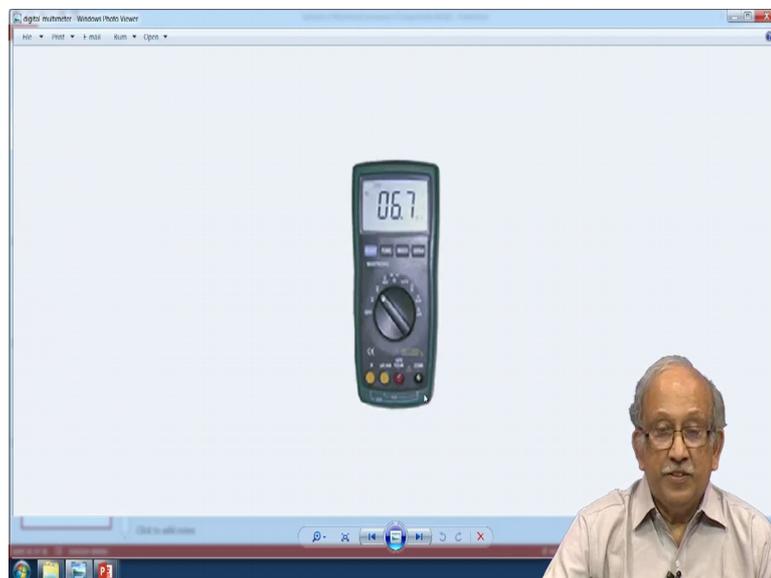
We are all familiar with the old good old multimeter. So, some of you are about mileage will probably remember the old multimeter which have done analog dial, not easy to read the dial, but at least it gave a feeling.

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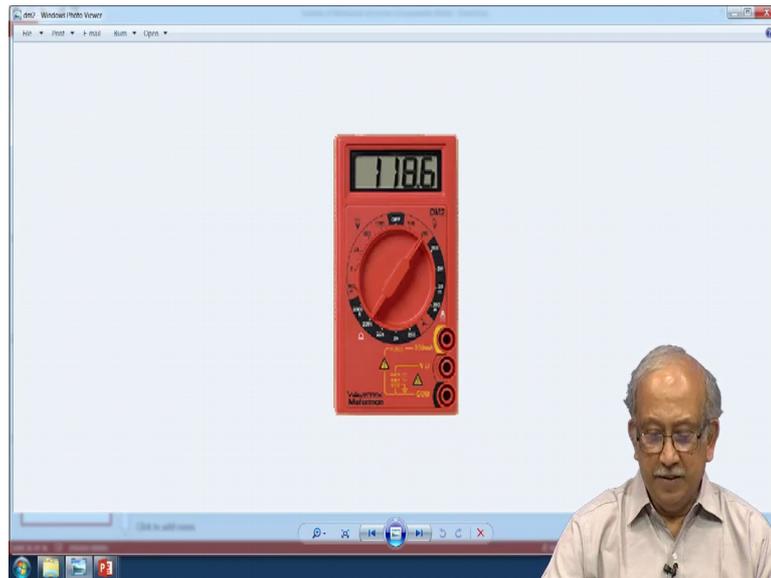
That there is a relative movement about it and saying if you find something between let us say 1.2 and 1.3 you can easily find out whether it is 1.25 or 1.225 that is a quarter you always divide it and manage things.

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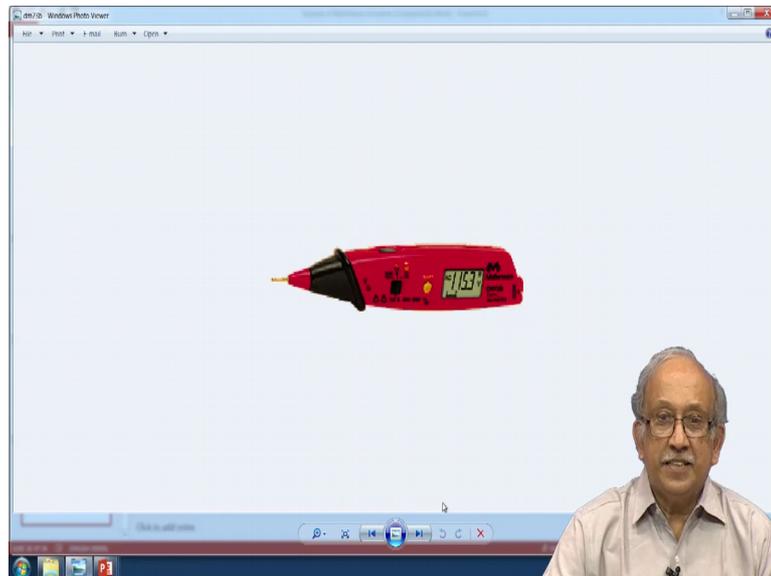
Now, the this is the advent of digital readouts whether it is a numerical readout directly it gives you the numer, the number the only small minor issue about it is often not easy to discern large and small numbers.

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So, is there a way of and then this is the ubiquitous we will I would like to call it what I call off the shelf a simple multimeter, because the next exercise is related to this very easy for you to locate one is not the end of the world no you see here say multimeter or something which it directly measures things.

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Why do you need to carry both the probes around is that no way of just putting a one sided this thing, this could be a signal injector as well as a signal reader as well as a continuity tester.

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Unlimited while those things had a nob which could operate from here this is a nob in the centre, this is a very simple what I called multimeter. Why I showed you is it is a relatively ruggedized multimeter that will what they think inside is probably the same little brittle plastic.

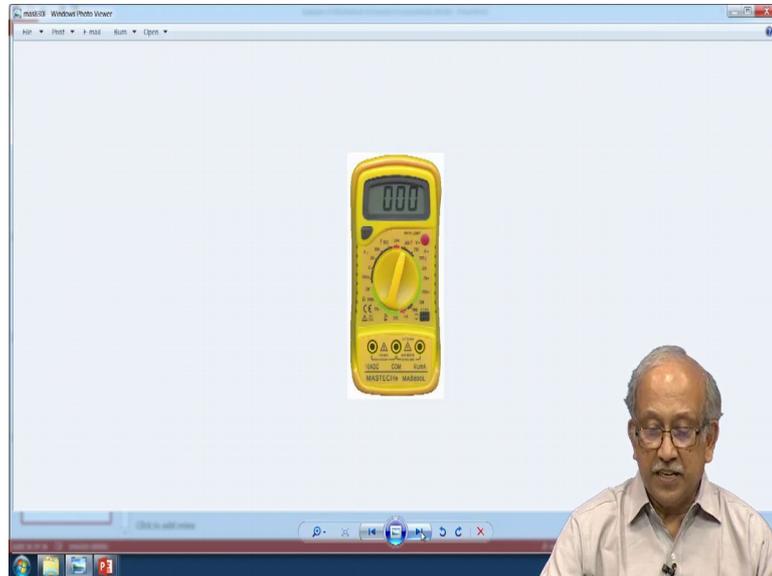
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But then outside it has a rubbery cover which will ensure that even if you were to drop it nothing will happen to it to of a similar kind both are about the same function, but you see that a little bit of ascetics has been added by giving it a u shaped cover here and then

the same thing these 4 lines you know I have been kept here a little the same and then functionally not very different.

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that next exercise what I want you to start is first of all go and have a look at all these items go to the market or just look around in the workshop or your lab or your own home and then imagine how you are going to make a multimeter.

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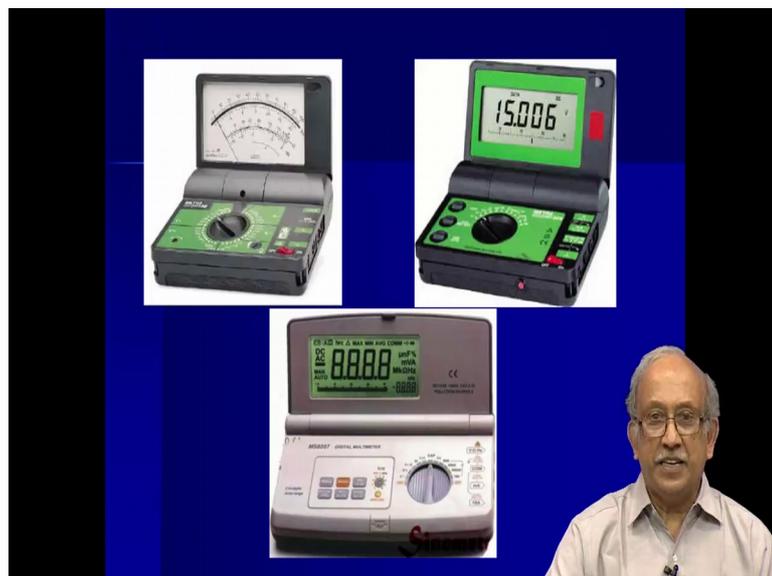
Look around all these things and then decide whether you would want to make something like this something like this or like this or something which has this you see here.

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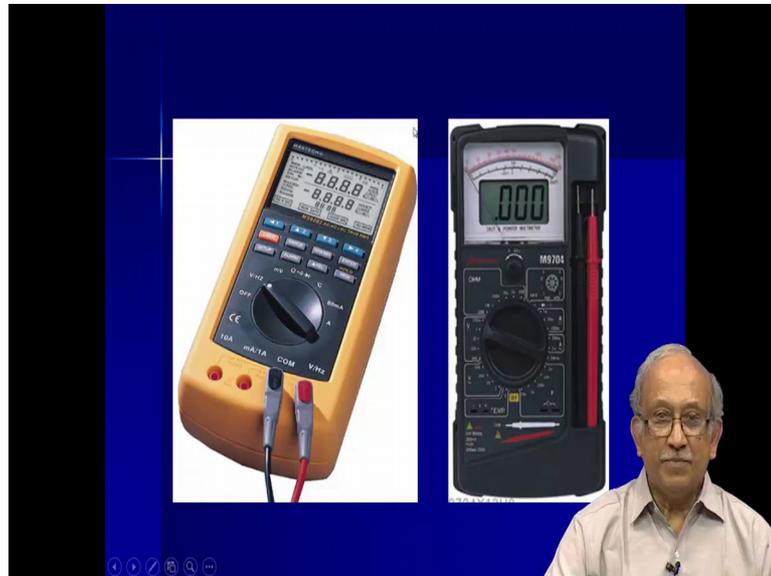
There is a somebody has added a small thing on the top there is a numerical display, but in the bottom what is equivalent to that old analog display they have given a white bind in which the small thing which will show you how well where you stand in that this is in objection to the earlier thing what I have told you.

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Now you decided on which one of these you would like to make I wanted to start whether you wanted a foldable into house or you want to have something.

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In which the probes can be neatly kept in one corner and you see here there is a filed analog and digital thing you have analog meter here plus you have a digital supply here

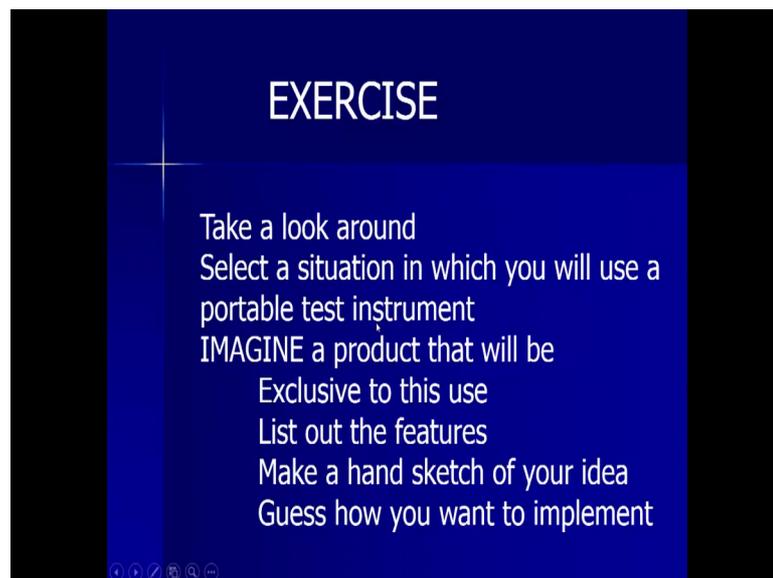
So, you know where you stand in that oh and then they are getting more and more complicated and I am running out of time.

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Most important thing here is while at the first level all the external appearance and how do you hold and all are important, something inside you also find out how well you can keep all the items inside can you stack all of them and then where does the display sit is there a place for the what you call probes, why not wrap the probes around and why not do it and in case it is part of that node you need to replace the probes think a little about it.

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And then this is the exercise have a look at it take a look around all your lab and all that, select a situation in which you will use a portable test instrument because the next lecture I am going to show what my students did they wanted to make something now put the this this thing only listen put this.

Make a portable test instrument imagine a product that will be exclusive to this use meaning your instrument should be specifically tailored for that particular occasion where you want to use, list out the features you want include make a hand sketch of your idea guess how you want to implement your idea. I hope this has been useful this in relation to yes it is thing will be a first to starting point again I am repeating in relation to the previous lecture in this lecture the good starting point for you on how to start designing an equipment, but there is the first exercise I have started with saying no you look at something which is already existing, it could be the simplest we can think is a handheld multimeter and then multimeters can be there.

So, anyway thanks for your patience and what you call try this try this exercise it is not difficult and in fact, if you have a multimeter or if you have a what you call a sound pressure level meter which are one of those things I have shown you earlier or you just need a simple continuity tester meaning, I have a tube I pack it with cells I have two or three cells and then by what you call piezo hooter with it which is about the same diameter. So, I can all of them in a tube and then it can have one or two probes at the other end now when you connect it will give a signal that we useful for me to trace things in a lab one of the things is wiring and then all of us have these headphones one characteristic of headphone is it will have a loose contact, you can check those things it depending on your concept please try. So, thank you for today.

Thank you.