Functional and Conceptual Design
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Department of Engineering Design
Indian Institute of Technology, Madras
Laboratory Exercise-4

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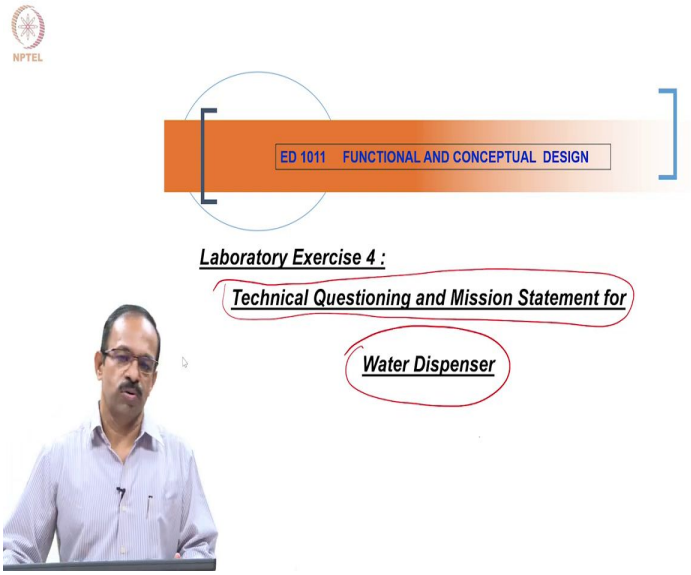

Hello everyone, welcome to the fourth laboratory session. So, today we will be looking at a product for this session which is the water dispenser. Most of you know what a water dispenser. Today, what we are going to do is to do an exercise on technical questioning and mission statement for this product.

In the last two classes, you were just looking at the product and preparing parts list and an assembly chart, so now we will move to the next level where we look at for a given product how do you prepare a mission statement through technical questioning and you learned this technical questioning and mission statement in the theory class, so we will try to implement that for this product.

But what we do is we will go with the same procedure of product dissection and preparing the parts list and then instead of preparing an assembly chart or assembly structure we will go to the level where we try to identify the mission statement for this product, so that is going to be the exercise that you are going to do today.

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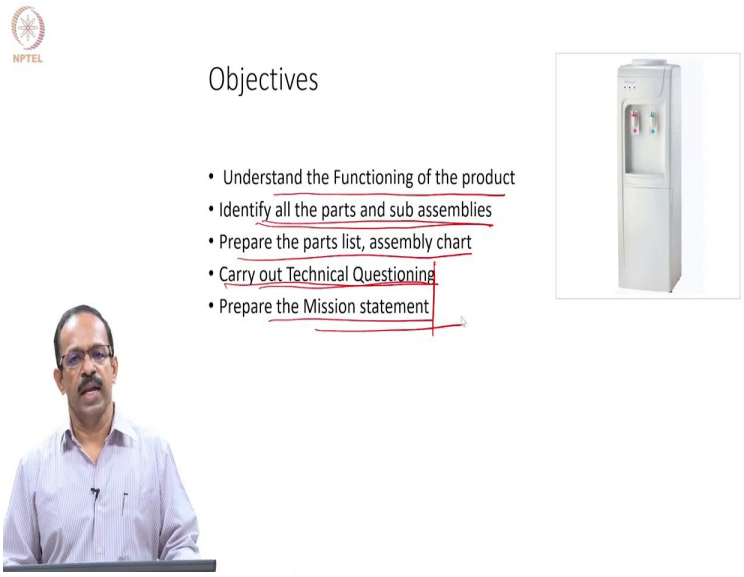

The objectives are understand the functioning of the product and then identify all the parts and sub-assemblies of the product as in the previous case also, so this will be very common in almost all the experiments and then you have to prepare the parts list and assembly chart and once you have done this, then you need to look at the technical questioning.

So, you are assuming that you are going to redesign the product or you are going to make a product of this category, you want to know what should be the mission statement for that product and to do that we will do a technical questioning and at the end of the technical questioning based on the answers that you get you need to prepare the mission statement for re-design of the water dispenser. This is what is expected from you as an outcome of this lab experiment. Let us look at the product.

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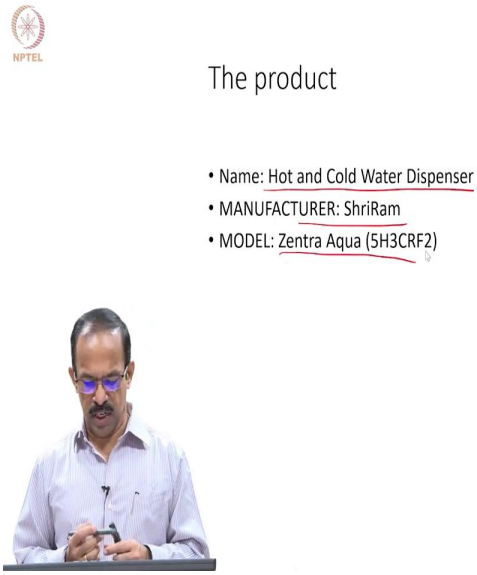

The product that you are going to use or going to dissect is the hot and cold-water dispenser. This dispenser has got the feature for dispensing both the hot and cold water. It is made by ShriRam Industries and the model is Zentra Aqua 5H3CRF2, so that is the manufacturer's specification or the model name.

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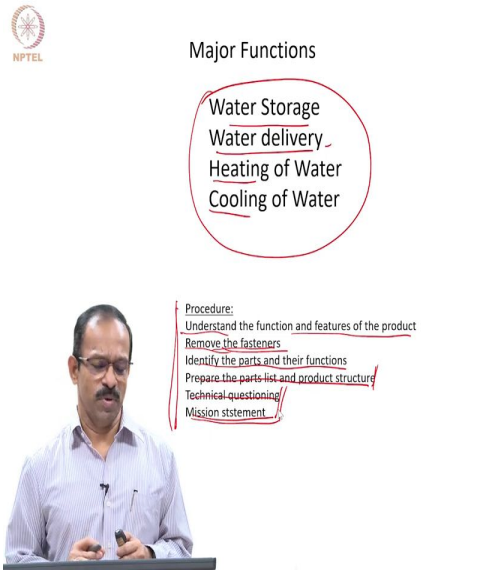

The main function of this product is to store the water and deliver the water both hot and cold water, so these are the main functions of this product, so the product should have some facility to

store water and the product should have some facility to heat water or to cool water and then dispense the water. You need to have these four functions in the product.

We need to see how these four functions are actually put into the product or how the different parts actually contribute in doing these main functions. Okay, so the procedure is almost the same as what we did in the earlier experiment also, understand the functions and features of the product, remove the fasteners, so you remove the fasteners.

First thing, you look at the product and then look at the overall structure of the product and overall functions of the product and then remove the fasteners, identify the parts and their function. Whenever you remove the fasteners and other parts keep a record of this, please number the parts and then keep a record of each part that you are removing and the procedure, the way which you are removing it and then prepare the parts list and product structure.

So, after all these parts taken out, you prepare the parts list and the product structure and of course you need to re-assemble it, but before re-assembling it, you start doing the technical questioning in the class itself with your classmates, your batch mates, your group members, you can discuss and then prepare the technical questioning and the mission statement, so this is what actually is expected and all of you know how to do a technical questioning and prepare the mission statement, but just to ensure that you remember it, I will explain it also, I will explain it once again.

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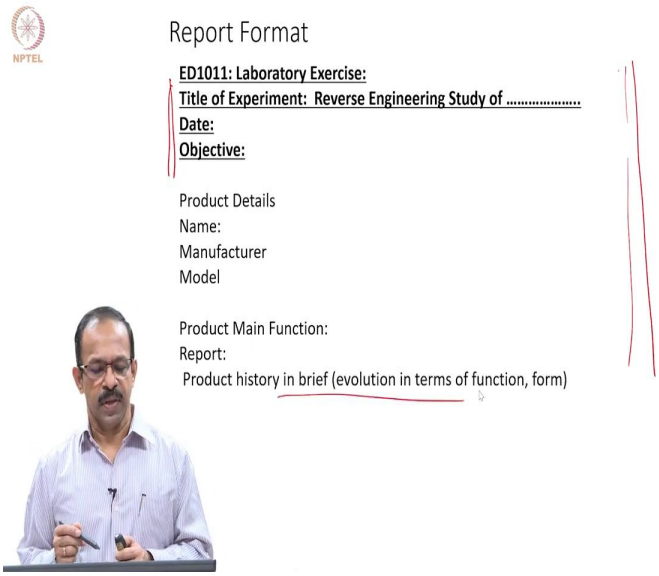

So, the report to be submitted, so whatever you do at the end of this you need to submit a report so the report submitted will be as formatted with this, so the first part will be almost the same in the previous report, product main function, product history.

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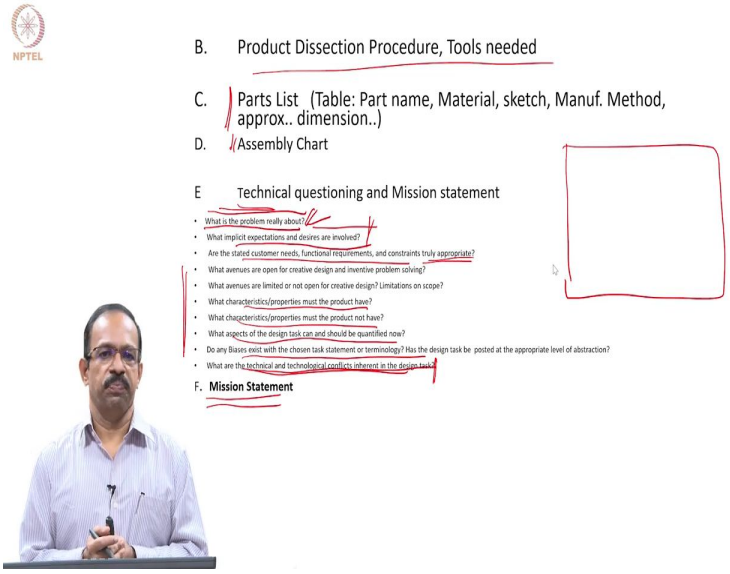

And then we go to the dissection procedure and tools needed, then prepare the parts list and the assembly chart and then go for the technical questioning of the product. Now, since the product is in front of you and you have seen what is there inside the product you can ask the question,

what is the problem with the current product, is there a real problem with the current product, so you can ask yourself, you can ask your friends and then see what is the real problem about.

If the problem is with the filling of water or the problem is in the delivery of water or if there is a leakage or efficiency of cooling or heating, so what actually is the problem that you can identify so that you will be able to pre-design the product, that is the first question you would be asking. Then, you go for what are the expectations and desires for a customer from this product, there will be some implicit expectations.

You are not expecting this to give aerated water or you do not expect this to be used for hot water for some other purpose it is only for drinking you will be using and cooling also you do not expect this to be too cold or too hot for the human consumption, so these are some of the basic expectations and you expect that it will be working basically on the using electricity, so these are the implicit expectations.

And then, you start to take the questions like the customer needs requirements and constraints are truly appropriate, this is based on the problem that you have and the expectations of the customer, whether it will be truly appropriate, you have very limited knowledge at this stage, but still as a group you will be able to answer these questions and then ask the questions what avenues are for creative design, can you do something creative to make the product a better one.

And then, what characteristics, properties must the product have and then what aspects of the design task can be quantified, similarly any biases exist with the chosen task and what are the technical and technological conflicts in the design. This is an important one, which I will tell you where the challenges lie in re-designing the product.

There may be some technological challenges that you will face, so if you can identify those challenges that will be worth, for that you will be able to look at the challenges and then re-design the product and based on this prepare the mission statement. You know the mission statement, there is a particular format for the mission statement, so please prepare the mission statement and submit the report, so this is what is expected from you as an outcome of this lab experiment.

I hope you understood this, so you can go to the TA and the TA will help you to open the product and understand the parts and the functions and then you do an exercise of technical questioning and mission statement. Thank you.

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Student 1: So, what is this product, any idea?

Student 2: Water dispenser.

Student1: And can anyone tell me the function of this product?

Student2: To dispense hot or cold water.

Student1: Right, it has a refrigerator built into it. At your homes you might be having refrigerators. Any idea how those things work? So, this also works on the same principle. There is hot water and cold water, so cold water works on the refrigeration principle and hot water is like your normal, there is a rod that is heated and the water is heated.

So, now start dissecting it, remove the loose parts first and remove the screws here, remove the taps here and no need to remove this full thing because it is pretty difficult. You can remove the tap by turning it. No, like this.

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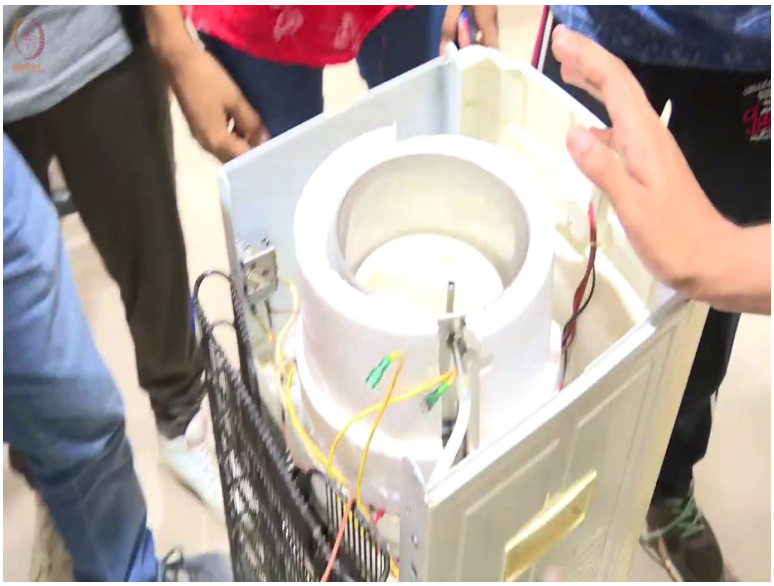

That is like a simple door. So, is thermocol present here, any idea what it's work is?

Student2: Insulating.

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Student1: Exactly, so basically the cold water is stored here, in this particular chamber and this thing insulates it, so just remove the thermocol. Okay, anyone heard of a term known as thermostats? You know what they are?

Student1: Yes, something like that and anyone knows the working principle of thermostats? End of the day, you have to somehow break the electricity circuit to stop the heating of water or chilling of water. So, one is for hot water and one is for the cold water.

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It is soldered there, so it will not come out, just like pull it aside. I will tell you.

Student2: (()) (10:15).

Student1: No, no, no, I told you this is connected to that particular container whose temperature you have to maintain, so it is more of a switch on and off, so if the temperature rises above a certain level it will switch off, if it falls below a certain level it will switch off like for cold water, so like that. As in the strip turns up and down.

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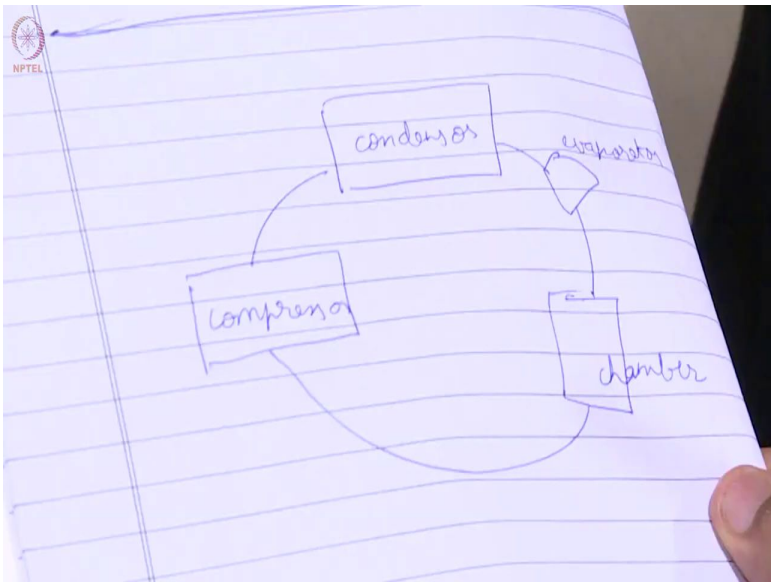

So, there is a gas like ammonia or there is this gas HCF, so these sorts of gases are used to cool. So now what exactly happens is there is a tubing system, a copper tube which has the gas trap. What happens is the gas goes into the compressor.

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Now, this is the condenser, so this part, this full part is the condenser. Do anyone of you know what a radiator is?

Student2: Radiator radiates heat.

Student1: Yes, sort of. So, what happens is suppose you have a hot piece of metal, it will radiate heat, right? So, it will cool down and to increase the amount of heat it is radiating we increase the surface area. So, also this also acts something like that, what happens is these tubes are copper tubes, these are hollow from inside.

Student2: It is hollow from inside?

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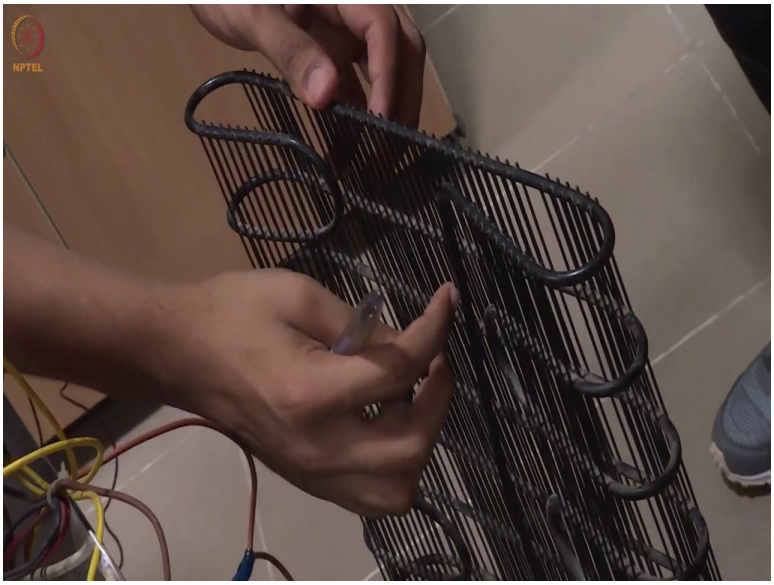

Student1: Yes, hollow, so the gas coming out of the compressor passes in these tubes okay? And it radiates heat and these things, these lines of metal, thin wires, these are, basically their function is to increase the surface area, because imagine just this tube, these tubes, thick tubes and these thick tubes plus thin tubes. Obviously, the surface area of thick plus thin will be much higher, so the amount of heat they are radiating will be much higher.

So, what happens is as I was telling you the gas that comes from this tube and goes to the compressor is high pressure and high temperature gas. When it passes through the compressor a lot of temperature or heat is radiated from the gas, so here you can assume that the gas is high pressure, but the temperature falls, say low temperature.

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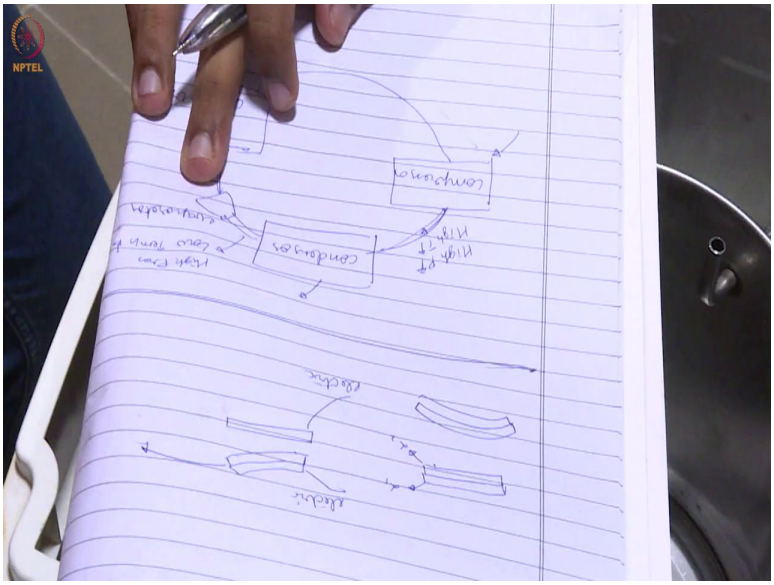

Okay? Now next comes the evaporation. What it does is it sort of initiates because the gas is at a high pressure here it is in a liquid form because when you compress something it turns to liquid, so this evaporator what it does is it initiates a process in which the liquid gas starts changing into a gaseous form. Okay, now what happens when water evaporates, steam. So, it needs some energy to evaporate, like converting from liquid form to gaseous form it needs some energy.

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So, this is like latent heat, this is something like latent heat. So, what happens is, this gas starts evaporating from a liquid state, now it needs some heat to evaporate, okay? So, these tubes are wound about some chambers, so in our particular case this is that chamber and in case of refrigerator, refrigerators are also that chamber and the heat that the gas needs to evaporate it takes from the chamber. So, now imagine if water is kept here and this gas is extracting heat, what will happen?

Student2: Cool down.

Student1: Exactly, so that is the basic principle, it becomes cold and this same cycle, the same tubes they first wound this particular container then go into the refrigerator, wound there and once here this thing is like low pressure and low temperature, like after it passes the chamber it is low pressure and low temperature, then it again goes to the compressor, turns to high pressure high, the cycle continues, so this is the basic refrigeration cycle and this is for cooling. Okay, now I want you guys to look at the components inside and draw a diagram like how the copper tubes are traveling, you will be able to figure it out.

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So, for example, this is one component of how the copper tube is connected to that component, then from that component where the copper tubes are going. So, just draw a diagram if you can. So, the first compressor, this part is the compressor, this black part.

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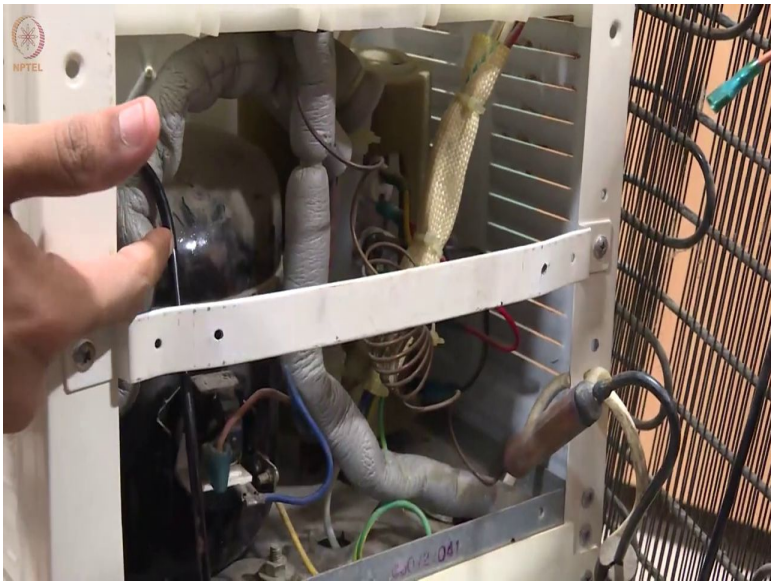

Now, you see this tube, this is coming from the compressor, just take a look inside it, this thing goes this is the same thing only. This thing goes, this is the condenser, so as you see here, compressor, then condenser. Then comes up this part, these two parts the spring and this particular component they are the evaporator, so after condensing the evaporator.

Student2: This is the condenser?

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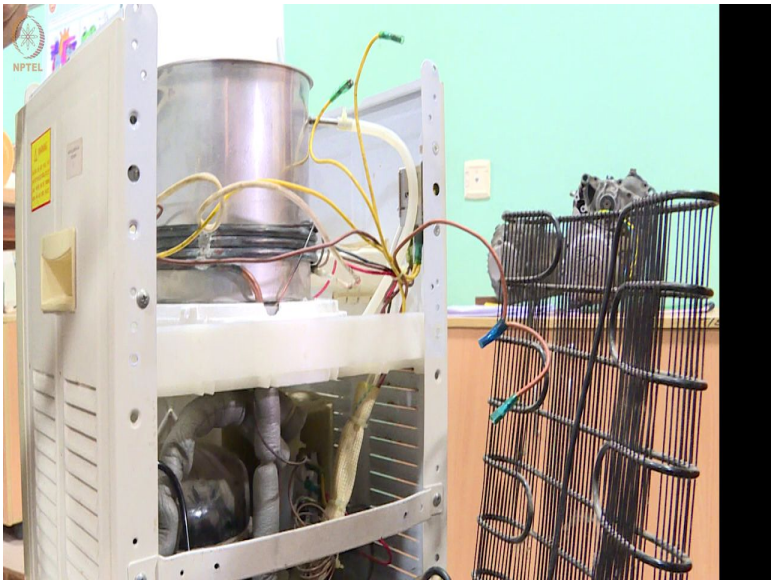

Student1: Yes, this full black part is the condenser, so this is the evaporator. Now, see this thin tube it goes here, it winds here. Then, yes, this is our cooling chamber, then it goes here down, this is the tube, it goes inside so our refrigerator is our second cooling chamber, from the refrigerator it comes back to the compressor, so this is the cycle. So, this is how the cooling is done.

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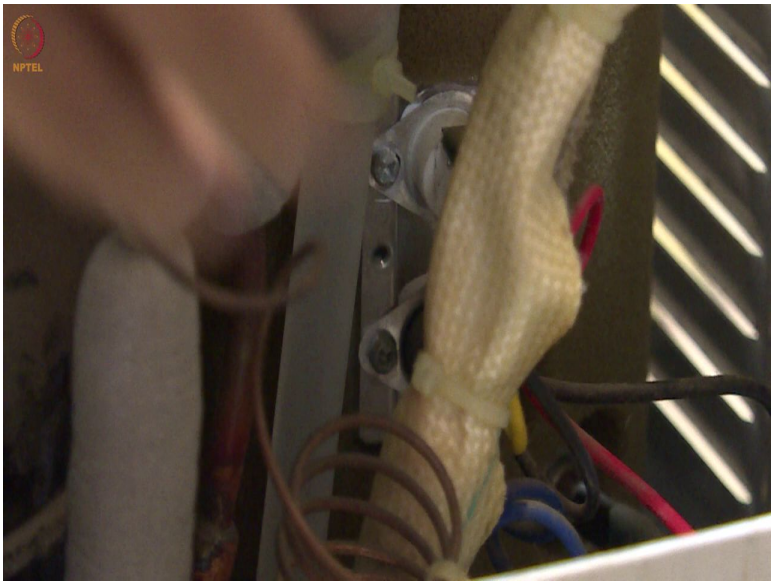

Now, coming to hot water. Now, this particular chamber, have a look at this. So, that is our chamber where hot water is stored, so hot water what happens is it just works on a simple principle, like how your geysers work, there will be a rod which heat, that is the heating element, when electricity passes, it heats up, it heats the surrounding water and then shuts down, so same thing this chamber stores water and it has a heating element in it, so that is the place where hot water is stored.

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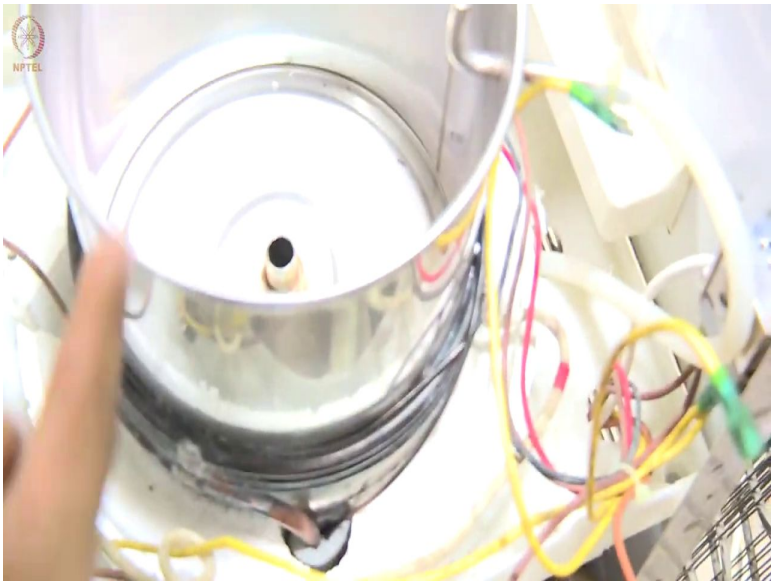

Now, if you look, have a look. Take a look at this particular hole. This thing it passes down, this hole passes in this particular tube just see if you can see it, okay? And it comes out from the cold-water side. Because I told you that cold water is stored there. So, it goes down and comes out from the cold water, that is our cold water.

Secondly, you will see this particular tube also, there are two tubes, one tube, second tube, this tube goes to the hot water chamber. So, your hot water is stored there and from the hot water there will be one more tube that comes out from the hot water chamber. What it does is when you pour water from above there is some water that will go inside this particular hole and there is some water that will be stored here, so if you see the tubing, the tubing is not covering the entire container, it is just covering this particular part.

So, it sort of separates hot water and cold water, there will be some loss of efficiency because at surface hot water, like normal water and cold water is there, but like it is the simple way to separate the two chambers and increase the efficiency.

Student1: These strips?

Student2: This.

Student1: To the cooling chamber, this thing travels down, it goes to the second thing, and from the second thing it comes back again to the compressor.

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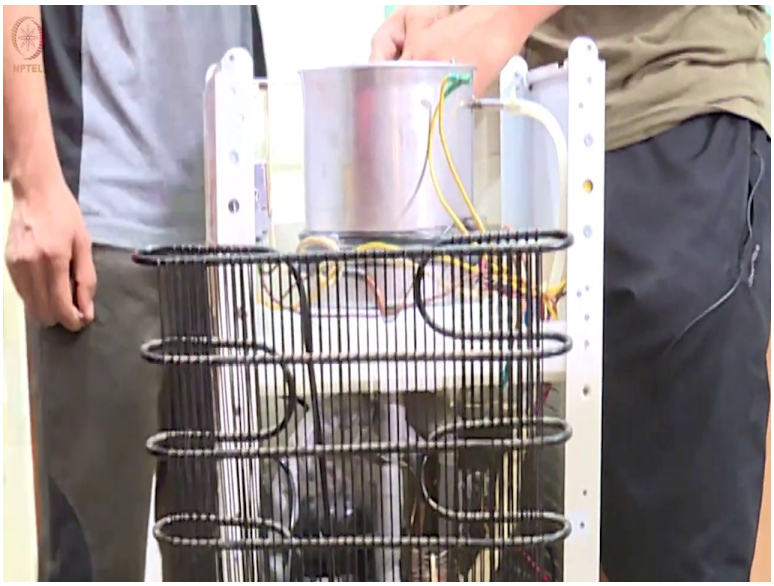

So, these wires are basically attached to this LED in the front, say your water reaches the particular temperature and this thing turns off, that is it does not heat anymore, then this red light will turn on to show you that heated water is ready, same is the case with the cooling chamber, so this thing is more of a digital thing, just on and off, for that changing thing, there is a dial and you have these things, say example, a refrigerator you can set how much the temperature is, so those are different types of thermostats.

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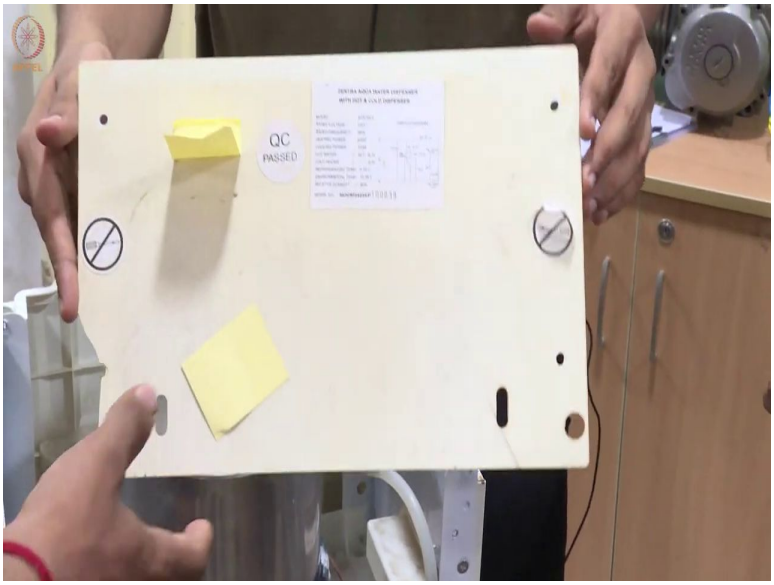

One thing you can do is increasing thickness will be difficult but you can change this particular distance, back panel. Yes, so this is the metal strip, it is used to mount the condenser, just mount this thing first, then from outside just screw it in. This is the condenser; part is the thermostat. If it is difficult, you can remove this particular part.

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And this is the top panel, so we will fix this thing next.

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These are the taps used to dispense water. We will fix them next.

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These are thermocol pieces used to insulate the cold-water chamber.

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This is the water collector; this is used to collect the dripping water.

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This is a shelf, it is used in the refrigerator to accommodate more items, so it goes in here.

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This is the water filter, it does not allow waste to go into the water collector, this part, so it goes like this.

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This is a water guide; it is used to guide the water from the can to the chamber.