Experimental Physics I
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Lecture - 46
Experiment on Platinum Resistance thermometer

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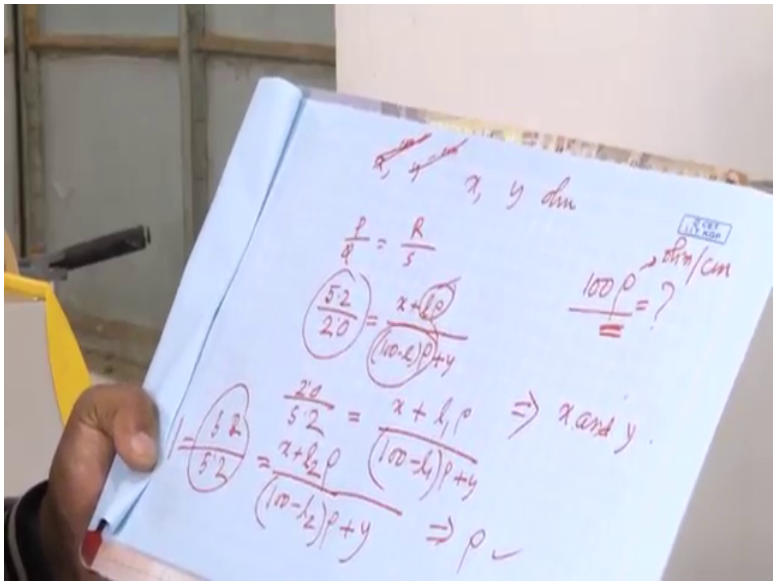

Yes. So, I think we will take this x in terms of length, then it will be slightly easier x centimeter, y centimeter ok. So, this contact register is then we are considering there here there are some wire additional wire inside of this one, no, I do not think I should take this one. This I will take just x and y ohm contact resistance.

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So, now actually if you so l I know, now rho I have to know rho this is the I have to find out rho ok, so this task I have to do, I have to find out rho ok. So, now if say I know rho either it is supplied or I will measure it, so this part I know, this part also I know, and this also I know, x, y is unknown to me.

So, I need two equation I need two equation to solve it, at find out the value of x and y right, so that is why another experiments just x just changing the P and Q ok. So, 5.2 I will take as a Q, and 2 I will take as a P. So, then another balance point I will find out another balance point I will find out, so this x plus l 1 rho divided by 100 minus l 1. So, I have to find out balance point for this condition right, this rho plus y right.

So, again these are non-accept x, y. So, I will have two questions from here I will find out x and y x and y ok. So, x, y is I know; now I have to find out this rho, what is the resistance of this wire per unit length ok. So, length I know this is the 100 centimeter 100 centimeter ok, so total resistance will be 100 into rho basically 100 into rho. If this resistance ohm per centimeter ohm per centimeter ohm per centimeter right, then total resistance of this wire will be 100 into rho.

So, I have to find out rho, so for that we have to we have to perform the second experiment. So, in this case in this case, what I can do, I can keep this P and Q is are equal, so 5.2 5.2 in both cases 5.2 5.2 P and Q. And then I will find out the, I will find

out the middle point of this is it should be middle point, but since x and y is there, so it will not be in middle point. I have to find out the length l for this balance point ok.

So, after balancing, say I got this length is l or l 2 in this case say l 2 ok, then rho and I have x this side, this will be R, and this other side will be other side will be 100 minus l 2 100 minus l 2 into rho plus y ok. So, this so this is one this is one, so this equal to this. So, x, y, l 2 is known to me right. So, then from here I will find out the rho, I will find out the rho right.

So, this way I will find out the resistance per unit length of this meter wire ok. So, now x and y also rho is known to me for this bridge. So, before using this bridge form of my measurement, so this is the task I have to finish. So, how to do that, I told you right.

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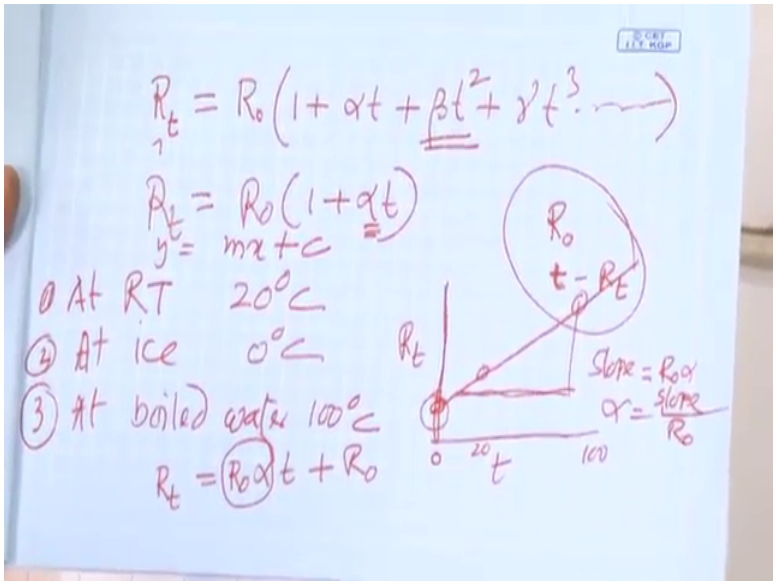

Now, I want to measure the resistance of the platinum wire right platinum thermometers ok. So, for any metal the resistance R t say at temperature t R t, so that one can write R 0 resistance at temperature 0 is 1 plus alpha t plus beta t square plus gamma t cube etcetera right. So, this is the relation between resistance and the temperature.

So, for lower range of temperature one can take approximately this R t equal to R 0 1 plus alpha t neglecting this other part. But, for higher temperature say in this case platinum resistance, generally we use for measuring the higher temperature ok. So, if you

want to measure say more than 1000 degree centigrade, then I think you should at least we should we have to consider this beta.

So, here our measurement is in the level. So, in the range of say 1 to 300 degree centigrade. So, this is good enough this approximation is fine for lower range of temperature. So, if this is the relation between the resistance and temperature. So, this these are coefficient platinum thermometer coefficient, we will tell temperature coefficient ok.

So, so what I have to know, I have to know the, what is the resistance at 0 degree centigrade what is the resistance at 0 degree centigrade, so I have to know R 0. I have to know temperature t, and at that temperature what is the resistance of this of this platinum wire right. So, then I have to measure basically R t t versus R t ok, so that means the thermometer I have to put, I have to put at different temperature. First I have to put in ice, it is a 0 degree right, then I will change the temperature of this thermometer of the yes this platinum wire, so and different temperatures I have to measure resistance.

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So, my task is what task is to measure the resistance. So, for so to measure the resistance to measure the resistance, I will use this bridge can you push the bridge. So, what we will do, as I told these two these two for platinum wire. So, these two we will connect in this third gap , and these two these two these two we will connect. I think this is P P. So, I think this two P P and this two C C. So, this I will connect at the gap 4 gap 4.

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Now, in gap 4 additionally, I will connect one fractional resistance is resistance is very starting from 0.1. Here you can see it is started from 0.1 ohm to 10 ohm ok, we tell this fractional resistance ok. So, to make sure because remember that if I keep P equal to Q that I will keep. So, then R equal to S ok, so in R what is there this platinum resistance plus this two rod connecting rod that resistance. And here plot there is only with this compensating rod that resistance is there. So, this will be balance compensating rod, and these connecting rod of platinum wire that will be compensated right, but here additional platinum resistance is there ok.

If this with temperature if this resistance is very high, so you may not get the null point in this in the in this within this within this wire ok, it may go out ok, so so that is why, we use here one fractional resistance ok. So, just some small resistance will put their, so that resistance should be equivalent to the resistance of the platinum resistance of the platinum at that temperatures ok, so that I will get the null point close to the middle of this or within 40 to 60 in this range I will get ok.

So, this fractional resistance will make sure that this null point we will find out the null point within this within this wire ok, so that is why this compensating wire plus this fractional wire will be connected here right.

Now, now this bridge is ready to measure the resistance right resistance of platinum wire. So, now at now here you can see this thermometer, we have put in the water. Now this

water is in a, is at room temperatures, I have thermometer mercury thermometer. So, here I can see this temperature of this water is 20 degrees centigrade right. So, since it is in this water already.

So, first what we will do, I will measure the resistance of the platinum using this bridge for at this temperature at room temperature ok. So, first I will do the experiment at room temperature there is another reason, because I have to do this experiment at ice right. So, if I do the experiment at ice first, then I can go for room temperature, now problem is to go for room temperature. So, it will take time. So, to just avoid this wastage of this time, just let me do this retake the reading at room temperature, then I will put ice, I will take.

So, at room temperature first, then second I will take I will measure the resistance at ice temperature at ice temperatures, and third I will measure at boiled water temperature boiled water boiled water right. So, this temperature I have to note done this 20 degree centigrade, this is of course 0 degree centigrade, and this is 100 degree centigrade ok.

At this three temperature I will do the I will measure the resistance of the platinum wire right, so why I need this at least this three measurement, because what I will do I will plot graph, I will plot graph temperature versus this R t ok. So, at 0 temperature at 0 temperature, I will get some reading ok. And then at 20 at 20 say I will get some reading and at 100, so this is 20, and this say this 100 ok, I will get some reading ok. So, it will be a straight line it will be a straight line right, because this equation is telling this y equal to y equal to m x plus c ok.

So, in this case I can write R t, I can write R t equal to R 0 alpha t plus R 0. So, C is R 0, so where ever it will cut this axis, so that is basically R 0. So, actually we are measuring at 0 degree centigrade, so that is point directly I can take. So, and then so then this is the m x this is the m right this is the m slope, so I will find out slope of from this from this plot, and this slope is basically this slope is basically this slope is basically R 0 alpha R 0 alpha R 0 is basically this C here ok, I know this R 0, I know in this slope.

So, I will find out the alpha value, I will find out the alpha value slope divide by slope divide by R 0 right slope divide by R 0. So, this is the task we have to do right. So, I think yeah just I think just at one temperature, I will at room temperature, I will just show the data right. So, similar way you can repeat the experiment putting ice, and so we have a arrangement to boil the water right heater. So, then you have to boil this water,

and then repeat the measurement ok. So, I think mister Mithy our lab technical supervisor, he will just show you just he will connect and show you the just one measurement ok. So, so he is connecting yeah.

Platinum.

So, this in third gap, third gap he is connecting this platinum wire ok. As I told that platinum wire we have to connect in third gap third gap ok, then compensating one we have to connect compensating one compensating one we have to connect to the fourth gap including this fractional resistance including the fractional resistance ok, you have to tight and properly. You are tightening means, this basically its shortening of the resistance you know this which whichever is open, so that that is the resistance included there.

So, now you see, so I think now you this galvanometer this deflection, galvanometer deflection you can see in opposite direction. So, if it is putting in this if you put yes, I think if you put at this end, then it is going this decide P by Q equal to R by S, so it is going this other side right. So, if you put just in middle close to the middle, so you have to find out the null point. So, no current through the galvanometer.

So, here you have to take reading it is 53 ok, so it suppose to be this I think no it is at room temperature, so I think this is fine this is a 53 is our reading. So, you have to note down this l equal to 53 equal to 53 ok. And you have to note down also this is the 2 ohm ok. So, fractional resistance is 2 ohm and this one is 53 centimeter. So, you know x, you know y, you know rho of this 1 ok, so your you will you will be able to find out the you will be able to find out the R at room temperature R at room temperature.

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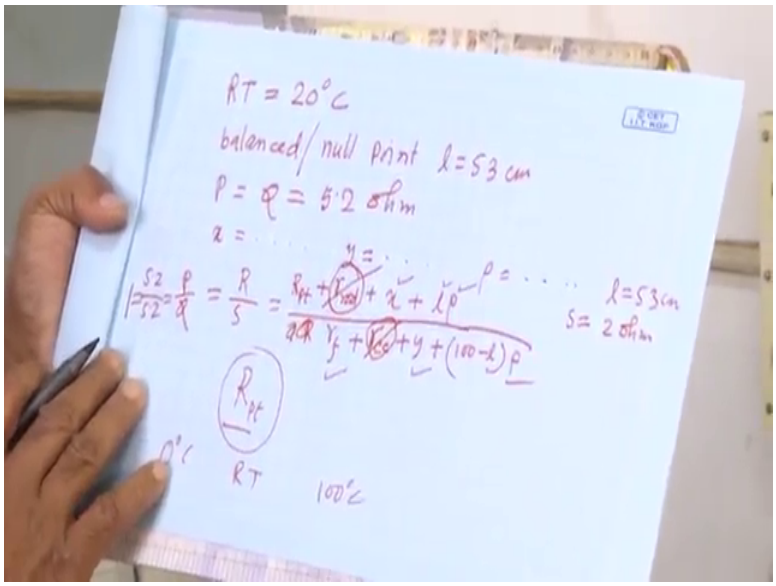

So, what I got, I got this at this temperature room temperature, I have to note down there is a 20 degree centigrade. Then balance point I got balance or null point balance on null point I got null point l equal to 53 centimeter 53 centimeter. Now, P I have put P equal to Q equal to 5.2 ohms ok. x value you have to find out first that you know, so x is this value, y is this value so that we have to find out, so I did not just dint show you, but I have explain how to find out, and rho also you know right. So, you have to write.

Now, what you got P by Q equal to R by S R by S of course. So, in this case your R is this registers of the platinum thermometer actually R R pt resistance of platinum thermometer plus resistance of resistance of this rod of this rod, where this platinum wires are were connected these two rods, then you have you have this x in correction this contact resistance. And then you have l rho l is 53 l is 53, so I also I have to note it down this l equal to 53, whatever we found here.

So, these will be the R this side, and other side what is there? Other side is basically you have this fractional resistance fractional resistance it is it is fractional resistance is I got I think two as I remember is 2 ohm 2 ohm ok. So, 2 ohm resistance, I can write this as a I can write r f fractional resistance r f plus resistance of the compensating rod, so r c I can write r c r c compensating rod r c c I can write, and then I can write plus y plus 100 minus l into rho so right, so this is one 5.2 by 5.2, so this is one right this is one, so that means this equal to this. So, it is assume that this r c c and r rod this will be equal ok,

they will compensate that is a purpose to put this additional to rod. So, you can forget this.

Now, you see you know this you know x, you know l, you know rho, you know this fractional resistance two, you know y, you know this l and rho ok. So, you can find out this R p t resistance of platinum at this temperature. Similarly, for 0 degree centigrade, you repeat find out the null point ok. So, l just l will vary you may need to change this one 2 ohm may not need.

So, one us to find out, instead of 2 ohm you may need to put 1 ohm or 3 ohm that you have to see. To get as I told to get the null point goes to the middle point just you use this fractional resistance ok. So, this way you will get 3 resistance of platinum wire one is at room temperature, one is at 0 degrees ice temperature, and another it is 100 degree centigrade boil temperature ok.

So, this is the experiment very nice experiment simple experiment, but lot of things one can learn from this experiment, how to use meter bridge principal of meter bridge, and these meter bridge, and then what is the necessary of additional to gap which then we are telling Carey foster bridge right. And of course, this how to arrange the temperature, how to arrange the change the change the temperature of the platinum wire, then here this concept of compensating road in o there is the again unique concept ok.

So, you can avoid you can purely measure the platinum resistance ok. So, additional connecting wire, which also will be affected by the by the change of temperature resistance will change.

So, it is difficult to difficult to deduct these this effect of this resistance, so that is why the unique way in this experiment is used, so that is the compensating rod using the compensating rod, you can nullify the effect of temperature, dependent resistance of the connecting wire or connecting rod ok. So, I think yes, so other part data analysis, and then finding out the error of on this measurement also we have to do that, and I think you know how to do that. So, today I will stop.

Thank you for your attention.