Experimental Physics - III
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Lecture – 51
Photoelastic Property of Materials (continued)

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I will demonstrate this photoelastic constant of a crystal that experiment. This is the setup of that experiment in our optics laboratory of Department of Physics, IIT Kharagpur. You can see just I have set that experiment and the fringe as I discuss that I am showing you in a mobile camera.

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These are the fringe dark fringe and this is the crossover.

I will explain everything I will explain everything. Before that here, what we have to do? We have to measure the fringe width as well as we have to measure the as well as we have to measure the fringe shift first fringe width we can measure fringe width we can measure. I think dark fringe are very sharp. We will take reading say let us start from here ok.

This let us take this one this say fringe number 1. what is the reading? How to take reading I tell you. Note down this reading. this is first one, then I am going to the second dark take the reading then third dark third fringe take reading forth fringe take reading this way you take reading of say 8 fringes eight. then note down here, I have table here I have table.

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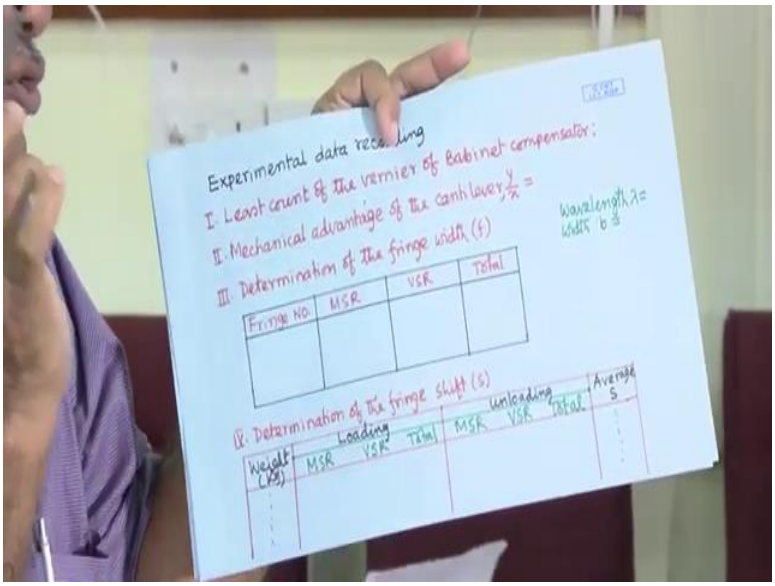

Fringe number 1, 2, 3, 4, 5, 8; then reading we have main scale and Vernier scale I will I will show you since I have set up and then I do not want to disturb before explaining you. main scale reading Vernier scale reading then total readings. Here you are getting the reading of each position of the fringe. now, calculation you can do actually calculation generally.

What we do since this shift this fringe width is very small. You have 8 fringe. You take difference between 1 and 5 then 2 and 6 then 3 and 7 then 4 and 8 in between 1, 2, 3, 4, 5. in between how many fringes are there? 1, 2, 3, 4, 5 this is number 1 this 2 this 3 this 4 this 5. How many? 1 2 3 4 ok.

You have to what is the difference you are getting and divide by. Then take average of these 4 fringes and then divide by 4 that will be the fringe width that way 1 can calculate. Second, we have to measure the fringe shift for different weight as I as I told you. We will put different weight and corresponding fringe shift we have to measure; during loading the weight, we will take one set of reading.

And during unloading the weight we will we will take another set of reading then you can take average of during loading and unloading for corresponding that weight then you will get fringe shift S that you have to you have to. that from this reading here itself you will get this fringe shift ok.

That I will show you how we will do that. Fringe are there what I will do I will set it just middle of this; I think I will set it this middle of this field then you can see the crossover. I have set at the middle of this middle of this one birefringe Now, if I put weight if I put weight here we have here I will I will explain you. Now, I am putting weight just I want to show you here.

I am putting weight I am putting weight there is a slot here. I think I half kilo weight I put ok, but not much change then I am putting them. 1 kilo weight I have put. there is a shift. For this 1 kilo weight what is the shift that to find out. Now, I have to note down that initial reading of this one. Now, I will change I will change these two bring it back in middle to bring it back to middle.

Now, what is the reading I have to take what is the reading I have to take ok? For this weight 1 kilo weight 1 kg weight what is the fringe shift that fringe shift I calculated from this one. Now, now, initial reading you have to keep note down with unload 1 unload switch condition. Now, for different weight, you are changing and brining at back at bringing back at the center and then for that what is the reading you have to note down ok.

Now, again I will put weight 1 kilo more weight I will put now, it is 2 kilo weight 2 kilo weights for that again I am I will bring back to the middle bring back to the middle. we will change the weight and there will be shifting of the of the fringe and how much shifting of the fringe for weight. That to bring it back to the original position hm.

That there will change of the reading. We have to note down those. We will we will weight put weight for that. For 0 weight means, when unloaded. What is the I think yes. what is the reading we have to take and then we are putting weight and then there will be change there will be shift to bring it back.

We are we are changing it and how much. there will be change of the reading. That reading we have to note down ok, during loading during unloading and from there a shift we have to find out.

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as I, here you can see this if we just using my hand if I put just some weight is shifting the shifting of the fringe yes I am putting stress and then they just (Refer Time: 09:53) ok.

This is the weight this is the weight we have many weight. I am not putting them all. Just change weight of 1 kilo. Up to, I think you can give 8 kilo weight 1 kilo, 2 kilo, 3 kilo, 4 kilo. that way you can go to up to 8 kilo and then you again unload it again you unload it during unload, I will unload 1 kilo I will unload 1 kilo during unloading also there will be shift of this and then you should bring back to this and then take reading.

This way during loading during unloading how much the shift is there. With a compens that made compensator that shift we can measure whatever I have I am showing here, that is the, it is a slightly difficult you know slightly difficult to get in camera. it looks very sharp and better. They are precisely you can see.

Now, I will I will show the different parts of the experiment.

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Now, this is the source it is the sodium source yellow light sodium d 1 d 2. now, this is the lens this is the lens convex lens. This light from the source is falling on the convex lens and we have adjust the distance in such way that it should be more or less at the focal point ok.

Rays parallel rays we will get from the other side. Now, this the polarizer this is the polarizer here indicator you can see here indicator 1 can see I have place it more or less at the 45, 55 at this angle. now, this is the axis of optics axis this is the optics axis. Now, the polarize light will come and this optic axis. These the electric component will be in this direction in this direction.

Here it is a small slit is there. Just to select the light width to select the light width and lens. This is now, plane polarized is coming then polarize light is coming as if this is the. Now, slit source this is the slit source plane polarize light are coming and falling on the crystal falling on the crystal this type of crystal as I showed you this type of crystal we have we have.

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We have fixed like this and then this part is it is a like this it is like this it is like this that thus cantilever that force applied here applied here the sharp edge and that force will be put here clamped we clamped here. It will be put on the area of this one v h initially there should not be any weight or some preliminary weight can be maybe there its.

Generally we tell that they do it dead weight this weight generally you can also take it away. Some weight of there this we tell this is the dead weight dead weight so; that means, for this small weight. there nothing will happen no stress that stress is not enough to make it an iso loop an isotropic. It is a looks it is a similar as the unstressed one.

This is the unstressed condition at this condition. Now, light will come light will come e ray and o ray both will have the there will not be phase difference between e ray and o ray. Now, that are coming this is this is the Babinet compensator this is the Babinet compensators this whole part is Babinet compensator.

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This type of arrangement is there this type of arrangement is there you see this part ok.

one part is this you can see this crystal ok; it is a half is the half one half from this and another half from there although it is a rectangular one, but one half is active and another half is passive here the other half is active and another half is passive this part is fixed here we will put this way, I think there is a marking we have to yeah there is a marking we have to put this way.

this part will be fixed and this part when I am rotating this one yes you see this half is going this side this half is going this side other way I am rotating other way it is moving this a as I showed this one half of the crystal one half of the crystal we will fixed and another half of the crystals move. how much it is moving that we can take reading from here.

Here there is a here you can see. This here probably I cannot show you. .

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Now, you see here there is a scale here linear scale there is a scale here linear scale. There is a marker here zero. I initially we will put at 0 I will put at 0 of the main scale it is the in middle I can see it is in middle yes ok.

That time this is the circular scale this is the circular scale here you can see this is the circular scale. circular scale this hundred divisions are there. this is 0 this is 0 if I rotate this then 10, 20, 30, 40, 50, 60, 70, 80, 90, 0 then for one complete rotation here this scale this one moves by 1 millimeter so; that means, the least count or Vernier constant you can tell 1 millimeter by 100.

0.01 millimeter and this other one this other one here you can here there is an option. You can a tilt you can adjust this tilt yes you can see this it is an it is a coming this way other way I will go this them to adjust the tilt this up. now, this is the Babinet compensator. Here you can take reading.

How much you are shifting the one half of the one half of the compensator Babinet compensator and then here this is the polarizer this we will tell analyzer here as I told depending on the position you will get dark, this kind of things here another one. here if you see the position this is at 55 and this is at other side ok.

It generally we keep. that we adjust and generally if we keep at 90 degree cross position 90 degree cross position, generally we get better what I should tell this the fringe it is a

quite distinct it is quite distinct. If you use this one if you do not use this one then it is it is not a fringe is not that sharp this cross position is it is a making make sure that. at dark position it is a it will it will make it dark it will make completely dark.

cross position when they are out of phase when they are it may happen it is in cross if it is in I think same direction and if there is some rotation there is some rotation you will not what you will get you will get some component of the of that electric component along this, but if you keep at cross position. This I think that dark part will be more dark and this part will be more white.

the sharpness of the fringe will enhanced that is the purpose of this polarizer which is acting as a analyzer and this end of this polarizer here this eye piece is there this kind of eye piece are attached this kind of eye piece is attached here. polarizer and this kind a same kind of. So,

Here there is an arrangement to insert this eyepiece. here we have put eye piece and through this eye piece we can see the we can see the fringe as I showed you in mobile camera. Now, this whatever I told you just see and just first measure the fringe width take reading 1, 2, 3, 4, 5, 6, 7, 8 fringe sitting at dark sitting at dark take the reading from here.

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Then come to the next part or putting weight for putting weight. Yeah I think this is the eyepiece cross over is also there. I think yes yeah. This way actually we have inserted at this like this they are we have we do not need. here we have put yeah this eye piece. Next cross keys for just a for different load for different mass or weight ok, we have to we have to take reading of fringe shift.

And that already I have told you. This experiment is very simple and beautiful experiment for measuring the photoelastic constant. here we have that 1 direction we have we are putting the stress in a particular direction say this is the some x direction and light is propagating along the z direction along the z direction polarize light it is on the x y plane. it will it will when it will enter here.

it will have two component 1 is 1 is I think this another is this 1 will act as a e ray and other one will act as a o ray because of this stress this a refractive index for o ray and e ray will be will change. Then it will introduce path difference phase difference that path difference because of that path difference or phase difference there will be shifting of the fringe pattern form by this Babinet compensator Babinet compensator Babinet compensator.

That fringe you will absorb and see the shifting of the fringe as a function of weight. Function of weight that is we are using the cantilever technique we are applying the force or stress that effective stress will be more than the weight we are putting there. That fringe we will see and we will measure the fringe width as well as fringe shift.

this is the whole things it is this you can also see that how to use how to use Babinet compensator for measuring the phase difference between two rays this is the very useful tools for measuring path difference or phase difference between two rays and how it can be done.

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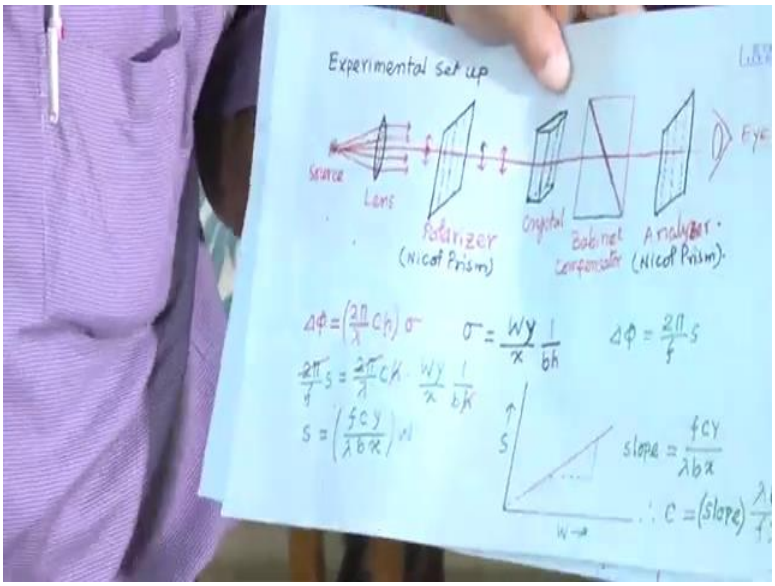

That we have shown I think after that you have to you have to you have to plot graph. As I told you have to taking reading after that you have to plot weight and this is shift from there, you will get the slope and from there slope you will get the photoelastic constant I think this is the a nice experiment, I will stop here.

Thank you for your attention.